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# Engineering Ethics: Navigating Your Way Through Expert Reports and Expert Testimony

by

Randy D. Horsak, PE



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## **Introduction**

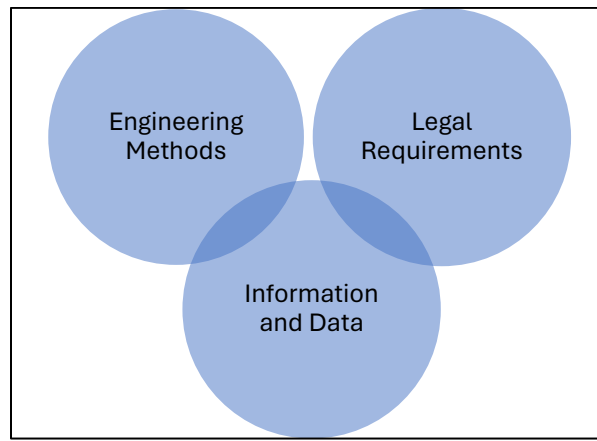
We live in a legal world.

Professional Engineers live in a legal world.

Although it is seldom taught in the engineering curriculum in universities and colleges, the field of engineering is not a standalone field, but rather is an intertwining of engineering methods, legal requirements, and the quantity and quality of information and data.

Professional Engineers may find themselves involved in legal matters for a number of reasons. Some of these include:

- As a Plaintiff or Defendant in a lawsuit in which the Professional Engineer must defend his/her work
- As an Expert Witness in a lawsuit in which the Professional Engineer serves as a technical expert



Engineers may become involved in lawsuits as a result of their actions or inaction. A classic example is the failure of an engineered system in which the Engineer participated in the design and construction. Perhaps a human was injured. Perhaps there was damage to the property. Such damage may or may not be covered by professional insurance. Nevertheless, the Engineer may find himself/herself in a legal battle – including the Courtroom – defending his/her engineering calculations and decisions.

This course addresses the second reason.

Engineers and scientists are frequently used as Expert Witnesses for legal matters. Most of these legal matters involve lawsuits for personal injury or damage to property, or a business loss.



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These legal matters generally end up in a formal lawsuit in either a state or Federal Court in which the Plaintiffs and Defendants battle over two primary things: the law and the facts.

While Professional Engineers may be called up as an Expert Witness in a criminal case, usually they serve as Expert Witnesses for cases involving tort law. Tort law differs from criminal law in that such lawsuits are civil, not criminal, with proceedings that seek compensation of one party by the other party for personal injury or damage to property. The questions that need to be answered are who is responsible for the injury or damage, and what should the compensation be in terms on monetary payment.

Toxic tort and property damage claims are common topics of such lawsuits. They typically point to a release of a toxic chemical or material in which a person was exposed via some pathway, such as inhalation, dermal contact, or ingestion. Or, perhaps, chemicals were released from an industrial site onto public or private property, and the soil, surface water, groundwater, or ecosystems have become polluted. The question then becomes: what caused the damage, who is responsible, and what is the associated financial loss or environmental damage?

Lawyers argue law and the circumstances of the complaint, but typically do not argue the engineering or scientific facts associated with the lawsuit since they are viewed by the Court system as not having the expertise to do so, even if they had undergraduate degrees in engineering or science.

Enter the Expert Witness.

Expert Witnesses are selected since they are viewed as having the necessary educational background, technical background, training, and project experience to explain to the Court and the Jury what happened – and why – so that they have a proper understanding and explanation, independent of any advocacy expressed by the lawyers.

### **The Lawsuit, Deposition, and Trial Process**

The typical chain of events for litigation begins with a claim of personal injury or damage to property, or breach of contract. If attempts to fairly settle the matter out of Court fail, lawsuits are filed, and all the parties involved then fall into one of two categories: Plaintiffs or Defendants. Attorneys are able to obtain records and documents through a process known as Discovery. If the attempts to settle the matter out of Court continue to fail, then both parties decide to go to trial. Expert Witnesses may then be retained by both parties to support their legal positions with technical positions. The Expert Witness performs his/her assessment and usually writes an Expert Report. The opposing side then subpoenas the Expert Report and all associated file materials, including calculations, data, references, maps, sketches, tables, preliminary findings, and communications.



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The Expert Witness is then presented in a formal deposition in which he/she must testify truthfully about his/her work, with the same standards being imposed as will be imposed in Court at a later date. Depositions may last a few hours or a few days, depending on the lawsuit. The deposition usually focuses on the Expert Witness's education, experience, and expertise on similar projects, and the work performed, assessment methodology, and findings and opinions associated with the lawsuit at hand.

This entire process is usually framed within what is termed the "Daubert Standard" under Rule 702 of the Federal Rules of Evidence in which the Judge is assigned the role of a gatekeeper to ensure that the evidence proffered by an Expert Witness is relevant, reliable, factual, and based on a sound methodology. This includes whether or not the methodology used is generally accepted by the engineering profession, whether it has been or can be tested, and other criteria. The intent is to not allow testimony at trial that is not based on sound engineering principles, or testimony that has been applied by an engineer that is not competent. As one can imagine, this "standard" is widely used and widely disputed and argued in attempts to qualify and disqualify Expert Witnesses. The controversy can become "Does the Professional Engineer have expertise in automobile crashes" versus "Does the Professional Engineer have expertise in a blue Ford F-150 crashing into a black BMW-341 travelling 82 mph on Highway 91 on the morning of December 20 during cold weather conditions." This provides for legal arguendo.

One element of this process is questioning whether the methodology has a "known error rate." While on the surface this appears to be a bona fide criterion, in practice some attorneys use it in an attempt to disqualify either the Expert Witness or portions of their Expert Report. A simple example: a portion of an Expert Report states "...during high wind conditions the crane collapsed and hit the side of a fuel tank, causing the tank to rupture and the contents leak out onto the ground." Engineers understand error rates in terms of calculations involving the failure of a crane, the failure of metallic structures being impacted by a crane, etc. But must an error rate be calculated to support that statement? And does such an error rate actually exist? When does "gray beard engineering" suffice or not suffice? This provides for more legal arguendo.

### **The Responsibility of an Attorney**

The fundamental difference between a Professional Engineer and an Attorney in a civil case is that the Attorney is an advocate for their client (whether it be an individual, company, insurance company, or other) whereas a Professional Engineer is expected to be a trained professional who explains the engineering, science, and mathematics to a Court and Jury rather than being an advocate. The level of advocacy by a Professional Engineer is a balancing act: he/she is expected to be truthful and scientifically objective, yet at the same time representing one party and not the other party.

The term "lawyer" generally refers to a person who has completed law school, passed the BAR exam, and is allowed to practice law. The term "attorney" generally refers to a lawyer who has



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been appointed to act on behalf of someone in a legal matter, including Court. The responsibility of an attorney is to represent his/her client. The client could be fully guilty, or fully innocent, or somewhere in between. Crimes could have been committed. Regulations could have been violated. Negligence could have occurred. But, regardless, it is the job of an attorney to defend his/her client's position within the framework of the legal and judicial system. Attorneys then tend to gain highly favorable outcomes in a lawsuit for their Plaintiff clients, and low favorable outcomes for their Defendant clients.

In both instances, they are advocates and push their client's position however they can.

As someone once said, "If only the law favors your position, then emphasize the law. If only the facts favor your position, then emphasize the facts."

All of the legal strategies and tactics may appear to range from good practice to bizarre practice by someone like a Professional Engineer who has been trained to solve an engineering problem by listing the assumptions, performing the calculations or design, checking the math, and then drawing a square box around the final answer.

To a Professional Engineer, the process just described is near "black and white." But, to a lawyer, "black and white" does not exist, only varying shades of gray. They thus argue assumptions and facts, even when they are obvious to a Professional Engineer. They may assert that black is white, and that white is black. In a sense, that is their job.

Interestingly, such a claim of black versus white points to a sort of immunity from facts as held by attorneys in a litigation. While they should not openly lie about a matter, they frequently ask Expert Witnesses leading questions in hope of tripping them up. In sharp contrast, Professional Engineers are encouraged to stick to factual information and data.

### **The Responsibility of the Professional Engineer**

The role of the Professional Engineer in litigation is to explain the context of the legal matter in terms of engineering, science, and mathematics. The Judge of any Court conducts trials with issues having a very broad range of subject matter and cannot be expected to have expertise in any given field of engineering. Hence, the Professional Engineer's role is to explain what happened and why, and not further confuse the factual evidence. Similarly, a Jury may have members with limited education, and complex topics must be explained to them since they ultimately decide the outcome of the trial.

In the role as an Expert Witness, the Professional Engineer has the primary responsibility of explaining the litigation in terms of technical cause and effect. This may involve laboratory analysis, physical testing, calculations, assessments and evaluations, and reliance upon work completed by third parties. This is challenging at times: the engineering topics can get very



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complex, and while presenting the Court and Jury with a plethora of differential equations may make you feel intelligent, it runs counter to the management of understanding. The Professional Engineer must exercise good judgement over presenting differential equations to a Jury when simple illustrations suffice.

Importantly, a Professional Engineer, in stating his/her findings and opinions, can rely on the findings and opinions of other professionals and non-professionals. For example, if you are testifying about the cost to replace a failed underground pipeline at a site, you can rely upon a laboratory or corrosion expert that opined as to the cause of the corrosion that led to the failure. It is not necessary for you to independently duplicate that workup.

### **Engineering Ethics**

This is not an ethics course, but the principles of ethics are woven throughout the field of forensics and expert testimony. Professional Engineers are highly regarded by society, in general, primarily because they are viewed as not only having technical expertise but also being apolitical. The Board of Registration for Professional Engineers in all states cites various responsibilities for Professional Engineers, with the following being some of the more important ones.

The National Society for Professional Engineers lists the following fundamental “canons” of engineering ethics:

- Hold paramount the safety, health, and welfare of the public.
- Perform services only in areas of their competence.
- Issue public statements only in an objective and truthful manner.
- Act for each employer or client as faithful agents or trustees.
- Avoid deceptive acts.
- Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

There are many “rules of practice” that accompany these “canons.” Let’s review some of the “gray” aspects of each as they apply to tort litigation.

In planning, designing, fabrication, constructing, and operating an engineered system, Professional Engineers should ensure to the extent practical that the safety, health, and welfare of the public are at the forefront on the project. Tight schedules and inadequate budgets are not excuses for short-cutting safety. Similarly, in tort litigation, a Professional Engineer who testifies that inappropriate safety, health, and welfare considerations were acceptable is not compliant with the canon. Even when his/her client is wrong and clearly at fault, it is not acceptable for the



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Professional Engineer to testify otherwise. It is unethical for the Professional Engineer to assert otherwise, or to “put lipstick on a pig and say she’s foxy.” It is ethical to explain the facts about the matter to the Court and Jury, pointing out the pros and cons what actually occurred.

Professional Engineers should only testify about matters for which they feel comfortable in doing so. No Professional Engineer is fully versed in each and every engineering topic, even in his/her own specific field. So, there are likely varying opinions that may be expressed in Court. Testimony should normally be restricted to education, specific training, and experience on other projects. So, could a Mechanical Engineer testify about an Electrical Engineering matter? Yes, in two ways. He/she could testify about the matter by relying on the work of a trained Electrical Engineer who performed some related tasks. Or he/she could testify about relatively simple electrical matters simply because he/she has fundamental training as an Engineer. For example, he/she could proffer testimony about an electrical shock hazard as a result of bare conductors being present at the site. Similarly, an Electrical Engineer could testify that he/she witnessed a mechanical pump failing and spewing out gasoline.

Issuing public statements should be made in an objective and truthful manner. Testifying in Court is essentially testifying in public, and thus the same canon applies. Further, an Expert Witness is sworn in during deposition, mediation, or trial to “tell the truth, the whole truth, and nothing but the truth.” Testifying that the mechanical pump failed is one thing, but failing to testify that the failure injured a worker is quite another. Attorneys like to push the envelope on truth telling. They will openly instruct the Expert Witness to tell the truth, while at the same time admonishing him/her not to say things that may get their client in deeper trouble with the Jury. This is a tightrope that the Professional Engineer must navigate very cautiously. If the Jury suspects that the Professional Engineer is simply a “hired gun,” then the entire testimony may be viewed suspiciously. Conversely, there is no reason to purposely spill as many beans as possible during a testimony since that comes across as the Professional Engineer having some vendetta. The best advice is to simply answer the question truthfully. If the interrogating attorney presses for additional information or explanation, then answer those questions truthfully.

Once a Professional Engineer is engaged by a client or attorney as an Expert Witness, he/she takes on multiple responsibilities. Firstly, he/she owes his client the responsibility of performing his/her work in a professional and thorough manner. While over-evaluating a matter may be costly to the client, a quick and dirty evaluation may place your client in an untenable legal quagmire. It is important to find out the facts of the litigation, and what each party is alleging, and then compare that to your skill set for helping your client. Secondly, the Professional Engineer has a duty to explain engineering, scientific, and mathematical aspects of the lawsuit to the Court and Jury. Whereas the attorneys may initiate theatrics and drama in the Courtroom, the Professional Engineer should avoid the drama and focus on explaining complex issues to the Court and Jury, in much the same way as a teacher instructs students. You can explain Ohm’s Law to a Jury without theatrics.



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In a Court of law, all participants are expected to behave appropriately. Professional Engineers should clearly testify about their skills and expertise, point out similarities of previous projects to the legal matter at hand. They should avoid deceiving the Court and Jury by having a conflict of interest, hiding pertinent information and data, exaggerating information and data, or misrepresenting their findings and opinions. As a key point, Professional Engineers should be compensated for the time they spend on their work, and not be compensated on a contingency or incentive bonus basis.

Any experienced Expert Witness will tell you that depositions and trials can range from mundane, boring events to made-for-Hollywood theatrics. Some attorneys in Court are matter of fact, others seek to mousetrap the witness with each question. Juries typically respect the engineering profession because Professional Engineers as a practice conduct themselves in Court honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession.

### **Engineering Standard of Care**

Engineers design and build things: airplanes, buildings, computers, light bulbs, and paper clips. These are termed “engineered systems” since the fundamental fabrication or construction of such “things” requires expertise in engineering to ensure that the “thing” not only functions properly but also is safe for normal intended use.

But “things” can and do fail. They fail due to poor design, poor construction, wear and tear, or poor operation. Or inappropriate application. When failure does occur, the issue becomes: was the Engineer who designed the “thing” responsible for its failure? Or was there some other cause?

The term “Engineering Standard of Care” is a very broad term that refers to the degree of prudence and caution required of an individual, in this case an Engineer. It is necessarily tied to circumstances and facts. The term includes a wide array of related terms, including the following:

- Practice of Engineering

The practice of Engineering as a profession is intimately linked to formal education, other supplemental training, project experience, and the requirements set forth by the Board of Registration for Professional Engineers.

- Practicing Engineering Without a License

Non-engineering professionals (e.g., biologists, chemists, geologists) frequently perform engineering tasks and issue engineering-type reports based on a very limited





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understanding of engineering principles. In doing so, they practice engineering without a license.

– Practicing Engineering Outside Area of Expertise

Professional Engineers should only practice within their area of expertise, but yet are free to render certain opinions outside that area based on overall engineering principles. For instance, a Mechanical Engineer may offer certain limited opinions about electrical systems, even though he/she is not an expert in electrical engineering.

– Good Engineering Practice

Good Engineering Practice (GEP) consists of proven and accepted engineering methods, procedures, and practices that provide appropriate, cost-effective, and well-documented solutions to meet client and end user requirements and compliance with applicable regulations. Fabrication, construction, and operation of an engineered system stem from GEP. GEP requires the exercise of reasonable judgment in light of the facts known, in a manner consistent with applicable Law, regulations, reliability, safety, environmental protection, and economic efficiency, and taking into consideration applicable contracts or agreements.

– Engineering Design Standards, Methods, and Practice

Standards, methods, and practice exist for all tasks and components that are part of an engineering project. Engineering judgement and “gray beard engineering” also come into play for many projects.

– Engineering Approval and Certification

Some engineering work, especially for public facilities, requires formal approval and certification by a Professional Engineer. In doing so, the Professional Engineer “blesses” the work after appropriate review.

– Engineer of Record

Many engineering projects and assignments require that the responsible Professional Engineer be identified and memorialized on key documents and drawings. This is essentially a due diligence function.

– Specifications and Drawings



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Engineering projects and assignments have identified specifications and drawings for the work which together serve as the “engineering design basis.” While alternative methods generally exist for any project, the selection of preferred options is important.

– Intended Use Versus Bandwidth Analysis

This principle relates to how narrow or broad an engineering design can be insofar as performance, reliability, safety, and other metrics. For example, some designs and/or materials can accommodate broad applications, whereas other designs and/or materials are limited in application.

– Reliability

This principle is generally defined as the degree to which information, data, measurements, calculations, specifications, designs, reports, assessments, etc. can be depended on to be accurate and meaningful.

– Predictability

This principle is generally defined as the degree to which a correct prediction or forecast of a system's status can be made either qualitatively or quantitatively. “Cause and effect” is related to predictability.

– Contract Terms and Conditions

All engineering projects and tasks should have an executed contract, subcontract, purchase order, task order, or other document that identifies and captures the scope of work, work by others, deliverables, work methods, budget, and schedule. This also includes “change orders.” Working without documentation can be highly problematic.

– Breach of Contract

Breach pertains to a Professional Engineer not conforming to the requirements set forth in an executed contract that contains clear terms and conditions. Breach can be intentional or incidental.

– Process Safety Management (PSM)

A PSM review is typically conducted for any engineered system that has the potential for failure or under-performance that could result in human injury or loss/damage to property. PSM reviews help identify hazards and risks so that they can be corrected before implementation of the engineered system.



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– Best Engineering Practices and Benchmarking

While there may be a wide array of methods for performing a task or designing an engineered system, most Professional Engineers strive to utilize the best practices reasonably available. These practices are based on historical applications and their success compared to alternatives.

– Graybeard Engineering

Graybeard engineering refers to the judgement made by an experienced Professional Engineer based on his/her experience on similar projects or tasks, sometimes without the benefit of a comprehensive analysis.

– Project Definition and Non-Conformance to Project Requirements

In a litigation scenario, these terms pertain to an evaluation of the original goals, objectives, scope of work, design, and construction of an engineered system, compared to any non-conformance identified which allegedly resulted in failure or under-performance.

– System or Component Defects, Failures, Hazards, and Damages

Such occurrences result from incorrect specifications, manufacturing defects, poor construction practices, poor operational practices, or failure to maintain and repair.

– Responsibility for the Health and Safety of the General Public

A chief responsibility of a Professional Engineer on all assignments is decision-making that takes into consideration the health and safety of the general public, irrespective of schedule or budget.

– Conflict of Interest

Professional Engineers should identify and avoid conflict of interest so that all engineering work is performed on a sound technical basis, not a “political” basis.

– Errors and Omissions

In a litigation or insurance scenario, the term “errors and omissions” refers to some level of negligence by the Professional Engineer or subcontractors/subordinates for which he/she was responsible.

– Professional Ethics and Code of Conduct



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Professional Engineers should maintain a high level of appropriate ethics and conduct at all times, and on all projects.

- Rendering of Engineering Findings and Opinions

In a litigation scenario, Professional Engineers should render opinions based on the available evidence, information, and data, and limit opinions to such information.

Opinions should be unbiased even if they differ from the client’s position.

### **Engineering, Procurement, and Construction Standard of Care**

Engineering responsibility in the area of Standard of Care may relate to only the engineering portion of a project, or it may extend to a broader scope:

- Planning and Design
- Engineering Design
- Procurement
- Fabrication
- Construction, Construction QA/QC and Oversight
- Commissioning and Operations
- Associated Contracts and Subcontracts

Frequently, Engineers are assigned field tasks during the construction phase of a project. As an example, an “in-field design review” may be required to construct an engineered system that includes an engineering review of the system’s specifications and drawings. During construction, a Professional Engineer may determine that the original design is not achievable, and “as-built” systems are then completed, sometimes with and without the input or knowledge of the original Engineer.

As another example, construction “errors” frequently occur. These errors may stem from engineering, procurement of materials, procurement of construction personnel and equipment, or failure to perform in-field Quality Assurance / Quality Control oversight. In some cases, vendor data from engineered system components may be misinterpreted, misused, or omitted. As a result, the constructed system may be prone to failure.

Contractual “issues” may also arise. For example, vague and ambiguous language in the contract may slide through reviews and not become problematic until an engineered system fails during operation, and a lawsuit is filed. Then, the arguendo over terms such as “highest standard” begin.



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## **Writing Your Expert Report**

The culmination of your technical work on a Lawsuit is usually your Expert Report. There are various sources of guidance for such reports. For lawsuits in Federal Courts, Rule 26 of the Federal Rules of Civil Procedure applies. This is good guidance for lawsuits in State or County Courts as well. The disclosure of the Expert Witness must be made in advance of trial, including the Expert Witness's qualifications, publications, prior testimonies, compensation, and Expert Report. The Expert Report must include a complete statement of the Expert's findings and opinions, the information and data considered in formulating those findings and opinions, and associated exhibits and references. Expert Reports are the norm for such testifying, but in the absence of preparing a formal report, a disclosure to the Court can be made as to the subject matter of his/her appearance in Court and a summary of the facts and opinions to which the Expert Witness is expected to testify.

There are many good references for structuring Expert Reports, how to present findings and opinions, formatting of reports, what to say and not say, etc. which are beyond this Course. The attorney that you will work with can assist you in this portion of your work. However, the key point is this: anything and everything that you write down is subject to legal and technical scrutiny and challenge. After each sentence is written, the Expert Witness should ask himself/herself whether the opposing attorney will beat him/her over the head with that sentence in Court.

This point can equally apply to Professional Engineers in the exercise of their normal duties, outside of litigation. Routine reports, letters, emails, or memos on a project to even colleagues at the same company may find their way into the Courtroom someday, and thus should be written with that possibility in mind. When a project "goes south" and ends up in Court, records are subpoenaed that may include those very documents, even if they are years old. Unfortunately, Professional Engineers seldom think about such occurrences in day-to-day activities, and not until they find themselves immersed in litigation.

Expert Reports can vary in length and detail according to the matters at hand, and the influence of the attorney involved. Again, there are various guidelines in the public domain that assist the Professional Engineer in his/her writings. The advantage of "bare bones" text is that it only offers "bare bones" opportunity for the opposing attorney to challenge your findings and opinions. But the converse is also true: bare bones text can be used by the same attorney to assert that your work was only cursory in nature and thus insufficient from which to derive your findings and opinions.



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## **Conundrums for Expert Witnesses**

Conundrums in lawsuits are endless, but they tend to fall into several broad categories. Some of these are:

- Lack of clarity as to what the Professional Engineer is expected to do and not do
- Lack of clarity concerning the engineering or scientific facts associated with the lawsuit
- Being forced by your client, or your client's attorney, to take a technical position that is favorable to them, but which is not fully supported by information, facts, and data
- Sufficiency of information and data
- Allowing the attorney to "ghost write" your report
- Rendering findings and opinions from limited information
- Contractual Requirements
- More Probable Than Not Opinions
- Reliance on Work by Others
- Conflict of Interest and Personal Bias
- Testifying Outside Your Expertise
- Allocation of Causation
- Rendering Legal Opinions
- Taking Adversarial Positions to Other Professional Engineers
- Behavior as a Professional Engineer

These conundrums revert back to several aspects of being a Professional Engineer: Professional Engineers are bound to both Good Engineering Practice and a Code of Ethics/Conduct.

### **Clarity of Your Assignment**

Engagement Letters are important documents that memorialize the scope of work, deliverables, schedule, billing rates, and budget for your work. It is very unwise to take on an assignment in litigation without a clear Engagement Letter. The Engagement Letter should also discuss the basis for and limitations of any opinions you may offer, and specific areas in which you will not be testifying. If some tasks are added or deleted, it is wise to revise the Engagement Letter to reflect such changes in scope of work.

The scope of work for the Expert Witness should be clearly defined, to the extent possible, and specific out-of-scope tasks should also be clearly identified in an engagement letter. Nevertheless, the initial scope of work in the Expert Witness's engagement letter should allow for changes, including radical changes, as the litigation process develops over time. In any event, the engagement letter serves as a formal contract between you and your client, whether the client is an attorney or a party in a lawsuit.



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Attorneys frequently retain Expert Witnesses well after the discovery process has occurred, including depositions of key witnesses. As a result, Expert Witnesses frequently find themselves in a position of needing certain information, but the opportunity to obtain such information has long passed. By far the strongest legal positions can be developed if Expert Witnesses are retained early in the process and have input into both the legal strategy and also the need for certain information.

Frequently, Expert Witnesses are engaged by an attorney and have only a rough idea of the legal and technical issues involved in the case. As the process matures, it may become obvious to the Expert Witness that their client's position is flawed, or even unwinnable. While a good legal strategy makes up for a lack of technical information, it is no better than having a strong technical strategy implemented by a mediocre attorney. At some point, this concern should be expressed by the Expert Witness to the attorney, giving the attorney an opportunity to settle the case.

Opinions are generally rendered according to one of several possible legal representations, including the phrase "more likely than not" or "more probable than not." This speaks to a preponderance of evidence that supports the Expert Witness's findings and opinions. Some legal experts equate this to 51% or greater; however, this numerical value can be problematic. Another term used in some Courts is "within a reasonable degree of engineering or scientific certainty." All such terms are subject to debate, and the Professional Engineer should discuss this criterion with the attorney.

Parenthetically, if a Professional Engineer renders an opinion of "more likely than not" by rationalizing that this represents a probability of 51% or more that he/she is correct, that leaves a nominal probability of 49% that he/she is incorrect. This is materially different than "beyond a reasonable doubt." This "near 50/50" criterion allows other Expert Witnesses the opportunity to proffer conflicting opinions. The Expert Witness should clearly understand this, especially for lawsuits in which there is limited and even conflicting technical information and data, since the addition of another bit of information could flip the opinion from "more likely than not" to "less likely than not."

#### Sufficiency of Information and Data

Engineers and scientists love to frolic in information and data. The greater the quantity the better. The greater the quality the better. But what occurs in situations in which information and data are limited, uncertain, or even questionable? In those situations, the quantity and quality necessarily affect the Expert's findings and opinions.

Integrated into the Professional Engineer's thinking thus lies the dimension of limited information and unknown factors. As an example, a very limited site assessment at a contaminated oil and gas operation yields marginal amounts of information and data, resulting in



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significant extrapolation and interpretation of the nature and extent of contamination. A single soil or groundwater sample is a classic example – how do you extrapolate your finding from a single data point? Thus, the ultimate engineering cost estimate to remediate and restore the site is based on a limited engineering feasibility study which is based on limited remedial investigation, and on limited sampling and analysis.

Further to this potential problem is the potential for unidentifiable sources. Without extensive site characterization and remedial investigation, such sources may not be identified. For example, underground saltwater lines and petroleum lines frequently leak over time, and such leaks may or may not be discernable from limited sampling of soil and groundwater. As a result, many remediation projects exceed their original cost estimates due to unknown or changing field conditions and unanticipated sources or pockets of contamination that were unknown at the time of the cost estimate.

When questioned under oath, then, how should the Professional Engineer respond? Frequently, the attorney asks him/her to make a huge technical leap. If contamination exists in both end zones at a football field, then the 50-yard line must be equally contaminated. But is it? It may be greater, the same, or less. Or, not at all.

Pushing the envelope by attempting to extrapolate or interpolate limited information and data can be problematic for the Professional Engineer. The answer, of course, is to attempt to collect additional information and data so that he/she will feel comfortable in rendering defensible findings and opinions. But this is seldom the case: the Professional Engineer may be encouraged to make technical leaps, even though bound by the principle of “the truth, the whole truth, and nothing but the truth.”

The flip side of this is also true. At times the Professional Engineer must make a recommendation to either test or not test something. The test results may prove to be favorable to the lawsuit, and thus worth the expended time and effort. Or, conversely, the test results may prove to be unfavorable to the lawsuit, and even help the opposition, and thus would have best been left alone.

### Ghost-Writing of Expert Reports

Courts, and especially Juries, fully depend on a Professional Engineer being educated, knowledgeable, competent, experienced, objective, and truthful. Juries tend to include lay people with little to no knowledge about esoteric aspects of engineering and science. Thus, when they listen to an Expert Witness opine that certain chemicals were released from an industrial facility and migrated through the soil and groundwater, they accept the Professional Engineer’s findings and opinions as factual, and not biased. At the same time, they realize that the attorneys are highly biased, favoring the position of either the Plaintiff or Defendant regardless of causation or fault.





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It is unequivocally unethical for a client or their attorney to “ghost-write” the Professional Engineer’s expert report. Ghost-writing can take many forms, including writing large sections of the report, revising or editing sections of the report, changing terminology used in the report, or even changing the Professional Engineer’s findings and opinions.

To be clear, some edits or suggested changes in a Professional Engineer’s Expert Report may be warranted under certain circumstances. For example, the Professional Engineer may write “the date of the failure is unknown” when indeed it occurred on February 1, 2020. So, that edit / correction is warranted. Another example could be “the liner was installed in March after a large rainfall event” when, in fact, the liner was installed *before* the rainfall event: the Professional Engineer simply erred in his/her statement. Those types of edits and corrections should be taken in stride by the Professional Engineer.

However, some Professional Engineers tend to be “wordy” in their reports. For example, they may issue a report with eight distinct findings. The attorney may read the report and decide that he/she only wants or needs three of those findings, and thus instructs the Professional Engineer to delete the other five findings. Is this ethical? Does it serve the ultimate client? Does the deletion clarify the facts pertinent to the Lawsuit, or does it simply remove evidence in an advocacy?

In the extreme, some attorneys will draft large sections of expert reports, including the findings and opinions, and submit them back to the Professional Engineer, as a “better discussion” of what happened. While such drafting may be a better discussion in terms of journalism, it clearly flies in the face of the Professional Engineers being objective, unbiased, and ethical. The Professional Engineer simply cannot with a straight face tell the Jury that the bridge collapsed because of vehicle overload when he/she knows that the probable cause is something else.

### Hired Gun Testimony

During the course of depositions and trials, the opposing attorneys may challenge the findings and opinions of a Professional Engineer, claiming that he/she is a “hired gun” that only supports Plaintiffs, or only supports Defendants, or has worked for the same law firm over and over again. While there is nothing inherently unethical or dishonest about providing professional services on such a basis, it can be spun in front of a Jury that does not understand all the terms of engagement among a client, the attorney, and the Expert Witness.

Thus, the Professional Engineer must be prepared to address this issue if it surfaces during a deposition or trial, fully understanding that the opposing attorney will attempt to paint him/her as biased and untrustworthy, and with a possible “hidden agenda.”



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Reliance of Work Performed by Others

Expert Witnesses are not expected to know everything about everything. Yet, they are expected to be able to review work performed by others and make engineering judgements about such third-party work, and if/how that work should be incorporated into their findings and opinions. It is ethical to rely upon the work of other Professional Engineers or other professionals. It is ethical to rely upon information and facts presented by third parties, including lay persons. The absence of a degree in engineering does not disqualify any person that has knowledge about the litigation, assuming that the person presents that information fairly and correctly. Thus, Expert Witnesses frequently rely upon laboratory testing protocols and data, survey data, site reconnaissance information, maps and drawings, and other information from both individuals and the public domain. The Expert Witness is cautioned to reference such information as being from a source, not his/her own work product.

Conflict of Interest and Personal Bias

Conflict of interest and personal bias are important aspects of the canons of Engineering. Ideally, these issues should be addressed during the engagement letter process to avoid bigger issues in Court. Attorneys who sense conflict of interest and bias will zero in those issues during depositions and examination at trial. If the Professional Engineer exhibits bias, the Court may reject him/her as an Expert Witness, or the Jury may question the validity of the testimony. At the same time, the Professional Engineer is human, and it may be difficult not to sympathize with someone who has been injured.

Testifying Outside Your Expertise

Some lawsuits demand that the Expert Witness have a highly defined level of expertise in order to testify. Other lawsuits do not. Consider two extreme examples.

During an explosion at a refinery, a large fire ensued that ignited various hydrocarbon fuels, creating a large thick plume of smoke that impacted a large group of downwind receptors. Part of that plume includes fine particles with metals and other contaminants sorbed onto the particles. Air dispersion modeling was used to determine the plume trajectory, ground-level concentrations, and exposure and dose to the receptors. In such a lawsuit, the Professional Engineer that testifies should have strong technical skills in the key areas: combustion, releases of chemicals from a fire, fate and transport analysis, and receptor analysis. It would be inappropriate for a mechanical engineer with expertise in only pumps to testify, or an electrical engineer whose job skills are essentially limited to computer software.

On the other hand, if someone was running within the refinery to escape the fire, and accidentally slipped on a puddle of lube oil, those same engineers may feel comfortable in testifying about the slip and fall incident. That is because all engineers have basic training in a



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wide range of fields. In this instance, any Professional Engineer should feel comfortable in testifying on the lack of surface friction resulting from a layer of lube oil being on a concrete surface.

### Allocation of Causation

Allocation and allotment of causation is a very difficult challenge for the Expert Witness. Consider the following example. Consider a bucket that holds 10,000 mL of water. Assume that a dozen people help fill the bucket, and eventually the bucket overflows. Who is responsible for the overflow? Person No. 1 who contributed 500 mL? Person No. 2 who contributed 8,000 mL? Personal No. 11 who contributed water to fill the bucket to the brim? Person No. 12 who contributed 1 mL when the water level was at the brim?

This same thinking can be applied to the failure of an engineered system. Was it due to site conditions? Aging? Inadequate design? Improper fabrication? Improper installation? Inadequate maintenance? Environmental circumstances? In Court, the various parties will argue their position to their advantage. As an Expert Witness, you need to be able to view all possibilities, the resultant outcome, and how this all fits into your client's legal strategy.

### Rendering Legal Opinions

Attorneys will always advise Professional Engineers not to render legal findings and opinions. However, what constitutes a legal opinion is difficult to define. Professional Engineers live in a world of contracts, subcontracts, purchase orders, and their associated terms and conditions. In fact, many Professional Engineers draft contract documents and have the legal staff review them, not the other way around. While the interpretation of the language may fall into the purview of law, the practicalities of such interpretation clearly fall within the purview of engineering. Issues such as breach of contract, indemnification, and insurance coverage clearly are non-engineering topics. Issues such as to why or how a contract was breached may involve engineering metrics. For example, supplying a beam with a capability of 99 when the contract called for a capability of 100 is both a legal breach and a technical breach. The attorney argues the law, and the engineer explains the science and mathematics.

### Taking Adversarial Positions to Other Professional Engineers

In a legal battle, the Plaintiff and Defendant retain attorneys to represent their position. The attorneys typically display polarizing views of the litigation to both the Court and the Jury. That is to be expected. But the Plaintiff and Defendant also retain Expert Witnesses to explain the technical aspects of those views. Thus, Professional Engineers may be in juxtaposition to each other based on the facts of the case, including causation, exposure, injury or damages, breach of contract, and monetary damages. One would think that the Professional Engineers would have similar findings and opinions, if they reviewed the same information and data, and conducted the



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same level of assessment. Obviously, this causes head scratching in the Jury since these supposed “experts” cannot agree on subject matter. This becomes worse under the legal criterion of “more likely than not,” which is a metric that is difficult to define, measure, and defend. So, while it is not unusual for experts to have varying opinions, the real issue is to what extent a Professional Engineer should purposely attack his/her opponent in the context of helping his/her client. Just because the experts represent opposing legal opinions does not mean that the experts should automatically challenge the opinions of the opposing expert. This should be considered on a case-by-case basis.

### Behavior During Depositions and Trials

When testifying, the Professional Engineer should recognize that the attorney questioning him/her may be very experienced, very inexperienced, clever, deceptive, polite, or rude. Before a Professional Engineer accepts an assignment that involves testifying as an Expert Witness, he/she should read up on practices and tricks undertaken in such an environment. It is anything but what they experienced in the College of Engineering.

The Professional Engineer should also recognize that a good adversarial attorney will cleverly and in a roundabout manner attempt to get him/her to agree with the attorney’s position in the lawsuit. Or the attorney may attempt to mousetrap the Professional Engineer into opining to something he/she should not be opining about, perhaps something far afield of what the Professional Engineer intended.

Above all, the Professional Engineer should remember and abide by the Engineering Code of Ethics and Good Engineering Practice. The public, in general, has respect for the engineering profession, and in Court the Jury will note the sincerity, competency, and unbiasedness of the Professional Engineer even when he flounders a bit here and there on the stand.

Maintaining professionalism goes a long way. At times, opposing attorneys are difficult to deal with and come across as arrogant, mean-spirited, and sarcastic. The attorney that you are working with should as a matter of practice attempt to rein in this inappropriate behavior in and defend you. If that does not happen during a deposition, it is perfectly acceptable to defend yourself, including taking a break from the action. You are there to answer questions about your work, not to be insulted. In Court, the Judge will normally allow the opposing attorney to question you thoroughly but will shut things down if the attorney becomes abusive. Successful lawyers know the boundary well, but wannabe attorneys learn this the hard way.