



An Engineering View of Liability and Negligence in Engineering

2

**Professional Development Hours (PDH)
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Continuing Education Hours (CE)**

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Table of Contents

LEGAL LIABILITY BASED ON NEGLIGENCE	3
CONTRACT LIABILITY, CRIMINAL LIABILITY, AND TORT LIABILITY	3
PROFESSIONAL NEGLIGENCE	6
STRICT LIABILITY IN TORTS	6
CONCLUDING REMARKS ON NEGLIGENCE AND STRICT LIABILITY IN TORTS	10

A Design Engineer's View of Liability in Engineering Practice: Negligence and Other Potential Liabilities

This paper examines concept of professional liability for engineering activities and products and its relation to the concepts of professional negligence and product liability as defined in law, particularly in the United States. Elements of tort liability discussed in this paper reflect societal expectations for engineering practice and engineering products. The paper first examines the basis for legal liability for general tortious conduct and then specifically examines the concepts of professional 'malpractice' (professional negligence) and strict liability for products in the United States.

LEGAL LIABILITY BASED ON NEGLIGENCE

'Perhaps more than any other branch of the law, the law of torts is a battleground of social theory.'
Prosser and Keeton on Torts, § 3, p. 5.

The purpose of this paper is to examine liability faced by engineers for their professional activities and to encourage engineering professionals to understand societal expectations as expressed in civil liabilities for their activities falling under an expected standard of care.

This paper briefly examines tort liability under the concept of negligence (as applied in jurisdictions in the United States). Tort law varies from jurisdiction to jurisdiction in the United States, but the various states apply common principals and analytical tools in establishing liability. Internationally, many nations apply concepts relating to negligence in a similar way. As a result, many of the elements of liability under negligence discussed in this paper are useful outside the borders of the US, because they hold in those nations that apply liability under common law and under civil codes. As an example, the elements required for liability under negligence are remarkably similar in a broad range of national jurisdictions. In the United States tort law falls under jurisdiction of the various states rather than under federal law, and as a result, the law varies from state to state. The paper also briefly explores concepts of Strict Liability in Torts for products, a notion of liability that does not require a finding of negligence. This concept (as applied) is unique to the United States but is of interest to anyone offering products for sale in the United States.

The paper concludes with examples of questions of liability for engineering products, services, and activities such as product design.

CONTRACT LIABILITY, CRIMINAL LIABILITY, AND TORT LIABILITY

It is important to appreciate that society can legally impose liability for actions based on a variety of criteria. The following discussion will address three resulting categories of liability: contract liability, criminal liability, and tort liability.

In assigning liability under **contracts**, society imposes liability based upon an exchange of promises (an agreement). As a result, contract liability imposes responsibility for the protection of a single limited interest (the promises of others) [1, §1, p. 5]. Contract law imposes liability on a party for promises to another party.

In assigning liability under **criminal law**, society can protect the broader interests of the public (as the public, not as individuals). In criminal law, society claims an interest in certain conduct (criminal conduct) that may bring harm to individuals. The state brings

legal actions for criminal acts, such as theft or murder, even though it may be an individual member of society who is harmed. In that case, the defendant has a liability to the state. (The defendant may also have liability for the harm to the individual under civil law for the same act.)

Tort law is 'directed toward the compensation of individuals, rather than the public, for losses which they have suffered within the scope of their legally recognized interests generally rather than one interest only, where the law considers that compensation is required' [1, §6, p. 1]. One could view torts, at least tort concepts discussed in this paper, as based in the concepts of fault and/or fairness. In this view, negligent tortious conduct includes conduct that falls below accepted community standards of behavior. Tort law addresses whether the legal system should require one party (the defendant) to pay a sum of money to another party (the plaintiff) because the defendant's conduct in fulfillment of some duty to the plaintiff has fallen below those standards of behavior (fault). This redistribution of wealth should be based on fairness.

The study of torts involves a broad range of topics developed over centuries in the literature including case law, academic journals, and legislation. This paper clearly cannot address the broad fields of torts. Readers with additional interest in the development of negligence and other concepts of 'torts' may wish to consult *Prosser and Keeton on Torts* and *The Law of Torts* [1, 2].

The term tort comes from the Latin term *tortus* (to twist. . . twisted, wrested aside). *Black's Law Dictionary* defines tort as follows [3]:

A private or civil wrong or injury other than breach of contract, for which the court will provide a remedy in the form of an action for damages. A violation of a duty imposed by general law or otherwise upon all persons occupying the relation to each other is involved in a given transaction. There must always be a violation of some duty owing to plaintiff, and generally such duty must arise by operation of law and not by mere agreement of the parties.

Negligence is 'conduct which falls below the standard established by law for the protection of others against unreasonable risk of harm' [4]. In order to establish liability for damage, the courts analyze the following four elements:

1. duty
2. breach
3. proximate cause
4. damages.

Tort liability can be found when the defendant breaches a duty of care to the plaintiff, and the breach of that duty is the proximate cause of the plaintiff's damages. A description of the salient terms follows. A plaintiff must prove all four elements in order to receive compensation.

Negligence is a broad principal of liability. The most general **duty under tort** is that a person is under a duty to exercise 'reasonable care' to avoid harm to others. A person is under this obligation (duty) to all other persons at all times. The root word for negligence (neglect) 'imports an absence of care or attention on the doing or omission of a given act' [3, p. 930]. It relates to the responsibility of 'reasonable' people towards others. The law of negligence attempts to assign liability for damages to parties due to

unjustified acts of others. One of the purposes of tort law is to compensate a victim for injuries suffered by the acts (or unreasonable omission of acts) of others.

Legal concepts of negligence generally are related to **moral fault** [5]. While the concept of 'fault' under negligence law and 'moral blame' are related, they are not synonymous. "Fault' is a failure to live up to an ideal of conduct' [1, p. 535]. Although fault may be blameworthy, a person might be free of moral blame for a failure to live up to some ideal of conduct due to such things as sudden illness over which the person had no control. Concepts of strict product liability, however, are not generally related to moral fault.

The **breach of duty** required in negligence represents a failure to fulfill the obligation of reasonable care under standards established by society (generally).

Liability under negligence requires a sufficient causal connection between plaintiff's conduct and defendant's damages. Causation sounds like it may be an easy concept, but the application of the concept proves troublesome. The connection required is 'proximate cause'. Consider 'causes' in two distinct categories: 'cause in fact' and 'legal cause'.

Cause in fact examines the factual connection between the defendant's conduct and the damage to the plaintiff. The defendant's conduct is not a 'cause in fact' of the event if the event would have occurred in the absence of the defendant's conduct), that is, to prove liability that the defendant's act must have been a necessary condition for the harm done to the plaintiff. Plaintiff cannot, however, establish liability in negligence simply by proving that 'but for the conduct of the defendant' the damages would not have occurred.

Proximate cause requires more than cause in fact. It requires 'legal cause' or 'responsible cause'. Proximate cause requires a sufficiently close relationship of the breach of a duty to the damages to a specific victim. This requires that the breach be more than simply a necessary condition for the damages.

Proximate cause refers to legal proximity that in fairness allows the defendant to be held financially responsible to the plaintiff for the alleged tortious conduct. A defendant will not be held responsible for all damages which are 'caused in fact' by her conduct. Proximate cause relates to the concept of duty. A defendant has an obligation to exercise 'reasonable care' to all other persons at all times. Proximate cause addresses if the defendant was under a duty to protect this particular plaintiff against the particular event that injured the victim of that breach of duty.

Note that the plaintiff must actually have suffered **damages** to recover compensation from the plaintiff. That is not to say that the defendant was not negligent, but tort law generally is not intended to punish negligent behavior itself, but to compensate 'innocent' parties from the damages the innocent parties suffered from the negligence of others. As a result, it is entirely possible that a negligent party exhibits negligent (or even grossly negligent) behavior but will not be held liable (under tort law) for his or her negligence.

PROFESSIONAL NEGLIGENCE

Establishing liability for professional negligence requires the same four elements as negligence in general: duty, breach, proximate cause, and damages. Professional negligence represents the breach of the duty to exercise the degree of care and skill which is exercised by 'reasonably' qualified professionals in that field. Professionals expose themselves to liability under the legal concept of negligence when their conduct represents substandard care as defined by the profession. Note that liability does not necessarily result from below average care, but from substandard care, a distinction that is illuminated by the definition of malpractice in *Black's Dictionary of Medical Terms*:

Professional misconduct or unreasonable lack of skill. . . Failure of one rendering professional services to exercise *that degree of skill and learning commonly applied* under all the circumstances in the community by the average prudent reputable member of the profession with the result of injury, loss or damage to the recipient of those services or to those entitled to rely upon them. It is any professional misconduct, unreasonable lack of skill or fidelity in professional or fiduciary duties, evil practice, or illegal or immoral conduct.

'Professional negligence' represents a special case of negligence in which society holds members of a profession responsible for meeting a standard of care and competence.

Members of the profession generally define the standard of care to be provided. For example, courts generally require that a plaintiff must provide testimony from a structural engineer to establish the standard of care used by structural engineers.

As stated above, it is possible for an engineer to exhibit professional negligence without being held liable (under concepts of torts) for his or her actions if there was no damage to others. That does not make the behavior less negligent, just less costly.

It is also possible in US jurisdictions to be held liable under tort theory for the results of professional activities in the complete absence of negligence. In fact, it is possible to be held liable for the result of professional activities even if the professional exhibits the highest standards of professional conduct.

STRICT LIABILITY IN TORTS

This paper earlier stated that many of the justifications and analysis for negligence (including professional negligence) are applied in numerous jurisdictions across the world. The United States, however, stands alone in other developments of tort law, specifically its broad application of strict liability in torts for products. This section discusses potential liability for 'engineered' products.

Courts can assign strict liability in torts for products that are '**defective**'. (The language used by some courts are products in a 'defective condition unreasonably dangerous'.) That liability can be assigned regardless of whether the defendant has been negligent or has been careful (applying accepted standards of care for the product, its design, its manufacture, its assembly and associated warnings). In order to apply strict liability for products, courts have required the following [4, 6, §1]:

- The 'product' was in a 'defective condition [resulting in a product that is] unreasonably dangerous'. Defects can be created by manufacture, assembly, design, warning labels, marketing, etc. (This paper will discuss the design safety of the product in following sections.)
- The defendant was in the 'stream of commerce'

that produces the product and/or delivers the product to the customer (manufacturer, subcon- tractor, wholesaler, distributor, retailer, etc.).

- The product was defective when it left the defendant's hands.
- The product was intended to reach the plaintiff without substantial change.
- The defect caused (in fact) physical harm to the plaintiff. (Strict liability in torts may relieve the plaintiff of responsibility for unforeseeable misuse, abuse, alterations and other defenses. See [6, §2].)

The rationale used by courts for imposing strict liability in tort includes the deterrence and loss spreading [2, p. 975].

Deterrence: courts have stated that strict liability in torts encourage manufacturers (and others in the 'stream of commerce') to make products safer. This increased liability may make products more expensive, but courts argue that the increased price more accurately reflects the true social costs of the products.

Loss spreading courts have stated that strict liability spreads losses that would be a hardship upon individuals, but the manufacturer (and others in the 'stream of commerce') can offset the increased risk by purchasing insurance.

In addition to deterrence and loss spreading, courts have also argued that applying strict liability places responsibility (liability) on the same entities and individuals that control the design, specifications, manufacturing tolerances, material specifications, and condition of the final product as it is delivered to the ultimate customer. Those in the 'stream of commerce' ultimately determine the safety of the product itself. (One may note that in applying this justification, the courts are addressing the inherent safety of the product itself-hence the term, product liability. Courts also recognize the notions of safety in the use (or misuse) of the product. In the analysis of the application of liability in a specific case, the courts will, of course, consider the proximate cause of injury including any alleged defect in the product as well as the use of the product.)

Strict product liability places liability on those who control the safety of the product. Courts distinguish the safety of a product *per se* (which the designer and manufacturer ostensibly control) from the safe use of the product (which the user ostensibly controls). According to Prosser and Keeton, this approach to strict liability in torts for products potentially assigns liability to a defendant 'merely because, as a matter of social adjustment, the conclusion is that the responsibility should be so placed' [1, p. 537].

It is important to recognize that this form of liability flows from characteristics of a product *per se*, not from any unreasonable behavior of an engineer or of a manufacturer.

Please recall the quotation at the beginning of this paper: 'Perhaps more than any other branch of the law, the law of torts is a battleground of social theory.' The reader may not agree with liability placed on a defendant in the complete absence of wrong doing or of irresponsible behavior. (In strict liability, the plaintiff need not prove that the defendant's action fell below society's expectation for reasonable behavior. Instead, the plaintiff must prove that the product *per se* was in a defective condition unreasonably dangerous. It is certainly true that negligent behavior can result in a product in a defective condition unreasonably dangerous. The plaintiff may, of course pursue both theories of liability at the same time. One theory does not preclude the other.) In fact, many have significant misgivings of no-fault liability. This paper, however, is not an appropriate medium of criticism of tort law. The purpose of the paper is to present a brief description of a small

subset of tort law as it applies to engineers and their products. This paper attempts to discuss tort law and will leave it to other sources to criticize or defend tort law.

How can strict liability in torts produce different results than liability under negligence?

This paper will examine two cases. The first example (hypothetical) will examine a product defect under 'manufacturing defects'. The second example (from actual litigation) will examine an alleged 'design defect'.

Example 1. Hypothetical case

Consider Company X that is in the business of designing, manufacturing, and assembling auto- mobiles for the consumer market in the United States. Engineers at Company X applied normally accepted design methods in designing brakes for their new model automobile that Company X called 'The Stopper'. Company X relied on reputable suppliers and contractors that used normally accepted design approaches and manufacturing techniques for their brake systems. In fact, Company X devoted unusual attention to the entire break system from engineering design to the smallest detail on the manufacturing and assembly of the breaking system. While these extraordinary efforts cost the company more money, the company believed that the increased safety was worth the investment.

The Stopper proved to be a commercial success selling more than 500,000 vehicles per year. Company X found itself a defendant in a court- room in a case involving injury of a driver due to brake failure on a newly purchased Stopper (the brake failure occurred the same day as the purchase of the vehicle). Expert witnesses for the plaintiff and for the defendant agree that the engineers and others at Company X were careful in the design, manufacture, and delivery of the brake system. Both experts agree that Company X exhibited proper care in the design and manufacturing of the brakes. The experts also agree that their studies indicate that no matter how careful Company X had been, one out of every 200,000 brakes will fail due to material defects that no company has the technology to eliminate or to economically detect. Clever design by Company X, however, meant that only one on five of those defects would result in a safety issue. Both experts also agree that this defect was the cause in fact of the accident that resulted in injuries to the plaintiff.

Under negligence law, Company X would (ostensibly) not be liable. Company X had a duty to the public, but they were both competent and careful. Under this hypothesis, they were very careful, and they have the evidence to prove the extent of their diligence.

Under strict liability in tort, however, the outcome may be just the opposite. Company X produced a product that was in a defective condition (defective brakes), the product (The Stopper) was intended to reach the consumer without alteration (it was sold as a completed automobile, not as an automobile kit), and the defect was the proximate cause of the plaintiff's injuries. Barring defenses not raised here, Company X may well be held liable under strict liability torts for injuries caused by the break system in The Stopper even though no one claimed negligence. No one claimed malpractice or professional misconduct. No one claimed lack of competence. Strict liability may be viewed as a 'no fault' system. Company X arguably had done nothing wrong, they had simply sold a product with a material defect that they took great efforts to eliminate.

Example 2: Design of a Product, Boatland of Houston v. Bailey et al.

This paper has discussed how an engineer can be held responsible if his or her

professional acts fall below an established standard of care and competence for professionals in the area of practice. The first example (above) dealt primarily with liability for a material defect in the product. That is, the product did not perform as designed. (Defendants have argued that a product cannot be defined that it can never fail. Courts have recognized the statement under negligence, but under strict liability in torts, the product designer and producers will still be held responsible.) Can a defendant be held responsible for damages caused by their design (*per se*) even if their competence and standard of care met the accepted norm? The following example is a case decided in 1980 by the Supreme Court of the State of Texas involving just this question.

Boatland [7] is a case from the Supreme Court of the State of Texas that provides reasonable insight of societal expectations of the responsibility of engineers in their execution of engineering design. The defendant in the trial court, Boatland, sold a 16-foot bass boat to the deceased husband of plaintiff, Bailey. The boat struck a partially submerged tree stump and the change in speed threw the driver out of the boat. The boat continued to run, circled around, and the boat's propeller killed the driver. The plaintiff (the driver's widow) argued *inter alia* that the boat was defectively designed because it did not have a kill-switch that would turn off the motor when a driver was not in the seat. (Plaintiff also argued that the boat was defectively designed because it had 'inadequate seating and control area arrangement, unsafe stick steering and throttle design', 609 S.W.2d 743, at 745.)

For the purposes of this paper, it is important to consider three phases of the case: the trial court where the evidence is presented, the court of civil appeals that reviews how the trial court applied the law, and the supreme court that reviews the law applied both by the trial court and the court of civil appeals:

- *Trial court.* The jury in the trial court failed to find that the boat was defective because of the absence of a kill-switch. ('After considering the feasibility and effectiveness of an alternative design and other factors such as the utility and risk, the jury found that the boat was not defective' [7, p. 745]). The trial court found for the defendant.
- *Court of civil appeals.* The court of civil appeals found that the evidence provided by the defendant (about the availability of a kill switch for the bass boat) was appropriate for the question of negligence (since it gives support to the defendant's duty of care by establishing an industry standard of custom of use), but not appropriate to determine if the product was defective (where the court of civil appeals found that 'state of the art' was the standard). The court of civil appeals found that the trial court erred in allowing the defendant to enter into evidence the fact that no commercial product was available as kill-switches for bass boats when the boat in question was manufactured and sold. The Baileys [the plaintiffs] offered state of the art evidence to establish the feasibility of a more safely designed boat: they established that when Bailey's boat was sold in 1973, the general concept of a boat designed so that its motor would automatically cut off had been applied for years on racing boats. One kill switch, the 'Quick Kill,' was invented at that time and required no mechanical breakthrough. The Baileys were also allowed to show that other kill switches were presently in use and that the defendant itself presently installed them' [7, p. 748].
- *Supreme Court.* The supreme court disagreed with the court of civil appeals and affirmed the trial court. 'In our view, 'custom' is distinguishable from 'state of the art'. The state of the art with respect to a particular product refers to the technological environment at the time of its manufacture. This technological environment includes the scientific knowledge, economic feasibility, and the practicalities of implementation when the product was manufactured' [7].

This 1980 Texas case is indicative of the development of society's review of and expectation for design activities. In the United States, engineering professionals will be held responsible not only for practice performed below professional standards but will also be held legally liable for products that are in a defective condition (unreasonably dangerous) even in the complete absence of negligence.

CONCLUDING REMARKS ON NEGLIGENCE AND STRICT LIABILITY IN TORTS

The area of negligence and product liability represents a broad field of law, and this article clearly can provide only an introduction. These comments do, however, provide insight into societal expectations for the acts of engineers and for the products that engineers design and manufacture. The literature clearly indicates that society has expectations on the performance of engineers and their products. Furthermore, courts will enforce those expectations by imposing liability for an engineer's failure to meet those expectations.

Liability imposed under negligence requires that an engineer has a duty to exercise reasonable care, and he or she can be held liable for a breach of that duty that serves as a proximate cause of damages to the legitimate interests of others. For professional negligence, the duty is determined by the standard of care for the profession.

Courts in the United States can also impose liability for products *per se* in the complete absence of negligence. Defects may take the form (*inter alia*) of material defects, defective warnings, defective manufacturing, and defective design. This reflects a societal expectation of reasonably safe products. The paper addressed some aspect of potential liability for professional negligence in general, and for two areas of strict liability in tort: defective material and design.

Defective material

The Stopper hypothetical case illustrated potential liability for a product containing a material defect. The law of negligence provides potential civil liability for professional activity that falls below the standard of care practiced by the community. The profession itself has significant influence in establishing the standard of care (or acceptable practice). Standards-setting organizations (such as ASME and IEEE) have developed and promoted discussion and agreement on accepted practice for various engineering activities. In the Stopper example, it appears that the firm conformed to established standards. A material defect provided a proximate cause for the accident. The company did not design the brakes to fail. In fact, they went through considerable pains to improve the safety of the product. Regardless, under strict liability, the company may be held liable for the product that did not perform as designed. That is, the brakes were not designed to fail, but they failed due to a material defect (not due to their negligence). Under strict liability in torts, they can be held liable for a defective product unreasonably dangerous that caused loss to a third party.

Defective design

The 'real life' Boatland case clarifies societal expectations for engineers' design work. Cases like Boatland indicate that engineers have a design responsibility beyond following simply acceptable practices. Rather, engineers are charged with 'evaluating scientific knowledge, economic feasibility, and the practicalities of implementation' in improving product safety. The question is, how far does this liability extend in engineering design? In Boatland, the defect was not material defect (causing the product

not to perform as designed). The alleged defect was because of the product performing precisely as designed (but without a kill switch).

The 20 years since *Boatland* have seen significant criticism of the application of strict liability for engineering design [2, p. 977; 8]. The Court's discussion from *Boatland* (above) discriminated between applying custom (current standard of care) and 'state of the art' (technically feasible). The court also considered economic feasibility. This reasoning (and reasoning in cases and criticism of strict liability in product design) reflect societal expectation (as indicated both in court decisions and in legislation) for engineering design. The obligation, however, is not just a duty to avoid substandard practice, but a duty to improve the standard of practice related to safety (given current technology and economics constraints) [9]. (The *Restatement of Torts, Third* [9] omits reference to strict products liability. The publication stated that the courts may use the language of strict liability for products, but they actually apply negligence standards for product design.) In *Boatland*, the Texas Court of Civil Appeals refused to consider economic constraints, but the Supreme Court stated that economic constraints were relevant and could be considered in strict liability for design defects. This standard provides broader latitude for engineering design decisions. (Please keep in mind that each jurisdiction has developed its own statutes and case law in negligence and product liability. This Texas case, however, provides valuable insight into the thinking of the courts in products liability.) In fact, consideration of the reasonableness of the design decisions bring in arguments more closely related to negligence than to strict liability in torts [10]. See for example, discussions in [2 pp. 986-987; 10].

In the last 50 years, engineers practicing in the United States (and those distributing products for sale in the United States) have seen increasing societal expectations for safe products and safe services both under the theory of negligence and under the theory of strict liability for products. One may question whether liability for engineering design is judged by negligence standards or by strict liability standards (see previous paragraph), but both standards reflect an increasing societal intolerance for design defects that cause injuries to those properly using an 'engineered' product. Engineers have responded by continually improving safety characteristics through design and manufacturing capabilities. As an example, Motorola includes the following language in its design process [11, p. SG-5-1]:

Identify the physical and functional requirements of the end product which are necessary to satisfy the requirements of: Customer's intended use of the product; Foreseeable misuse of the product; Environment in which the product is used.

The cited material reflects a design engineer's responsibility to design a product not only for the safe use intended by the designer but also to design a product for 'foreseeable misuse' (potentially a broad charge). The question is not whether or not the design engineer has a responsibility to reduce unreasonably dangerous design characteristics of a product but only how far that responsibility extends.