

New Private Eyes Focus on Disasters

Forensic Engineers Re-Create Conditions in Bid to Place Blame

By BRUCE KEPPEL,
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After a giant floating roof over a sewage-treatment tank operated by the city of San Diego at Point Loma collapsed early last year, the city lodged a \$1.5-million loss claim against the contractor who built it.

The contractor's insurer, Mission Insurance Co., called in a team of engineering sleuths to pinpoint the cause of collapse and evaluate whether the sewage-digester tank had to be replaced, as the city claimed, or whether the roof could simply be replaced. Los Angeles-based Garrett Engineering dispatched a team of technical specialists that included:

- A sanitary engineer, who defined the overall problem.
- An investigator, who ruled out sabotage.
- An electrical engineer, who ruled out failure of a pump.
- A structural engineer, who assessed the scope of needed repairs and their design.
- A general contractor, who estimated their cost.
- And a contract administrator, who advised the insurer on the recovery of federal aid funds.

The team found that the failure occurred because an employee of the plant had left certain valves closed while draining the tank, creating a vacuum that sucked in the roof; that the original control valves had not been installed according to design specifications, and that reconstruction was unnecessary.

As a result, the insurer was able to settle the claim for the actual cost of repairs—a fraction of the original claim.

Garrett Engineering is one of only a handful of engineering companies that specialize in re-creating the conditions that brought about structural failures, fires, crashes and explosions. This work, sporting the newish title of forensic engineering, usually requires the skills of a variety of specialists, combined with the courtroom savvy of trial attorneys. The customers are chiefly insurance companies and public agencies that have been hit by multimillion-dollar damage claims and want to assess their responsibility or vulnerability to a damaging jury award.

Forensic engineering cases range from the banal to the spectacular.

For example, about a year ago, one of Southern California Rapid Transit District's double-deck buses lost a dual-mounted rear wheel, which rolled into another lane of the San Bernardino Freeway, almost demolishing a small passenger car, said RTD safety director Joe Reyes. He called in Truesdail Laboratory of Los Angeles to in-

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investigate. Analysis of the wheel's lug nuts and studs disclosed that failure had occurred because a lug nut had been excessively tightened during a wheel change.

This cleared RTD of liability, which farms out its tire-servicing work, Reyes said. After reviewing the data, the contractor's insurer quickly settled the resulting damage claim rather than fight it, he said, and both the district and the company changed procedures to avoid a replay.

Perhaps the largest and best-known company in the field is Failure Analysis Associates, founded 17 years ago over hamburgers in a Palo Alto watering hole named the Oasis.

"We can take on the engineering study of any physical catastrophe or disaster," boasts Bernard Ross, one of the founders.

Over the years, Failure Analysis Associates has helped determine what caused the disastrous failure in 1982 of two aerial walkways at the Kansas City Hyatt, a pair of fatal crashes involving DC-10 jetliners and the fall, 12 years ago, of entertainer Ann-Margret from a Lake Tahoe casino stage set. The company has even investigated the relative "popping" capabilities of champagne corks made of various materials, Ross said in a recent interview.

Handles Many Cases

The company handled about 1,500 cases in 1983, Ross said, and estimated that it generated \$25 million in fees and research grants last year, up from about \$20 million last year. He said he expects the company's research work for government agencies and public utilities to keep growing.

Careful re-creations and analysis often provide crucial insights and evidence that can facilitate claims settlement, as Failure Analysis demonstrated in its first highly publicized case, which involved the injury of Ann-Margret in 1972 while performing at the Sahara-Tahoe Resort Hotel in Stateline, Nev. The entertainer tumbled from a set shaped like a clown's hand with a finger uplifted as it was being lowered into position backstage. During the descent, she apparently leaned forward slightly and pressed against the finger. The platform suddenly tilted, spilling her, breaking her jaw and cutting and badly injuring her face.

The aftermath was a \$1-million damage claim against the hotel, whose insurer called in the Palo Alto-based firm.

"We took the platform," Ross explained, "found a cocktail waitress of the same size and weight as Ann-Margret and developed some quantitative results measuring the force necessary to shift the platform. We learned that it would take only a few pounds on the clown's thumb to cause it to act as a lever, tipping the platform 90 degrees."

Designer, Builders Liable

The designer and builders of the platform eventually were found responsible, spreading the liability beyond the hotel's owners and leading to a settlement.

What has given rise to such fault-finding firms, speculated Robert Garrett, president of Garrett Engineering, is the proliferation of lawsuits seeking multimillion-dollar damage awards and the tendency of attorneys to go for a "deep pocket"—usually an insurance company, a municipality or a government entity with substantial financial resources—wherever a link, however tenuous, can be established.

At the same time, Garrett pointed out, technology has become so complicated that tracing cause and effect often surpasses the competence of any one expert, encouraging firms such as Garrett Engineering and Failure Analysis Associates to assemble a roster of specialists that can be tapped as needed.

"The whole world is specialized," Garrett reasoned, "and it's almost impossible for any one person to know everything involved in a single claim. We'll call in whatever skills are necessary to solve a problem," he said.

Uses 50 Specialists

Garrett Engineers draws upon 50 specialists, both from the staff and outside. Their skills range from aeronautical and nuclear engineering to architecture, geology, soil mechanics and traffic engineering.

A key to success in forensic engineering, Garrett said, is the ability to interpret often arcane technical findings for jurors.

In a case involving a television studio, for example, an actress claimed that the wind had slammed a door on a stage set, striking her head and causing brain damage. Investigation revealed, however, that the door was hollow and the wind blowing at 14 m.p.h.—a combination that generated 7.9 pounds of force, not enough to crack an egg, let alone a skull. To demonstrate this finding in court, the company set up a similar door,

created a 14-m.p.h. wind and let the door shut on an egg, which remained whole.

The jury concluded, Garrett said, that "the individual may have from other causes suffered brain damage, but not from being hit by a hollow-core door in a 14-mile-per-hour wind."

Forensic engineering parallels the forensic medicine practiced by coroners who determine cause of death and present the findings in court. Marvin M. Specter of White Plains, N.Y., president of the National Society of Professional Engineers and founding president of the related National Academy of Forensic Engineers, defined forensic engineering as "the application of the art and science of engineering in the jurisprudence system."

Few Accepted as Members

Fewer than 200 engineers have so far been accepted as members of the 2-year-old academy, said President Paul E. Pritzker of Quincy, Mass.

"There is no question," Pritzker said, "that problems with structural failings and product liability require engineers with expertise and an affinity for the jurisprudence system, so that when they are asked to qualify as experts they are purveyors of fact." While a client will likely be in an adversary position, he said, the forensic engineer's mandate is to "identify facts forthrightly."

Investigative procedures include mapping the distribution of wreckage, studying injuries, collecting and analyzing physical evidence, checking blueprints, specifications and change orders, measuring points of stress and cracking—all of which may eventually yield a "failure sequence."

Pritzker's own firm, George Slack & Pritzker Forensic Engineering Consultants, was called in to investigate the deadly hotel fires

that erupted within two weeks of each other in 1980 at the MGM Grand in Las Vegas and the Stouffer Inn in Harrison, N.Y. In both cases, he said, the fire's origin was known almost from the outset, and the investigators' mission was to answer why it spread so quickly and whether there were violations of the fire code.

Such disasters normally bring together a variety of teams representing one or another client liable for all or part of the damages, said H. Murray Hohns, a La Crescenta-based partner in the forensic engineering firm of Wagner-Hohns-Inglis Inc. Disputes do arise.

"Experts of integrity can disagree," Hohns acknowledged in an interview, "but the facts generally speak for themselves. So it is rare, when the pushing and the shoving are over, that we don't agree."

Expert consensus came relatively quickly, for example, in what may be the most celebrated recent case of stress sleuthing—the spectacular collapse, during an afternoon tea dance, of two elevated walkways at Kansas City's Hyatt Regency Hotel on July 17, 1981. The toll: 114 people killed, more than 200 injured and hundreds of lawsuits seeking more than \$3 billion in damages.

Ross' Failure Analysis Associates was called in that night by the hotel's architects. The next morning, the company's six-man team began photographing the scene, doing preliminary analyses and rummaging through the ruins.

"There's a lot of engineering pathology," Ross explained, and the multiple clues to the disaster's causes must be uncovered, sorted and evaluated. "Just like Sherlock Holmes, we take 'fingerprints' of metal fractures," he said. A replica of the fracture surface is constructed, he explained, and investigators can lift off stress impressions. Scanning these under a powerful

microscope can reveal whether the fracture resulted from wear or a sudden overload, he said.

In the Hyatt case, he said, analysis demonstrated that "failure derived from the fact that a vertical hanging rod with a nut on it pulled up through the cross beam, and the whole structure came unzipped." When the first rod failed, it threw an extra load on the remaining rods, causing them to fail, he added.

"The walkways just weren't built according to the way the architects and the structural engineers had drawn them," Failure Analysis concluded. "The contractor," Ross said, "had rearranged the structure in a very disastrous way, imposing some critical loads on cross beams of the upper walkway, and the beams themselves were poorly constructed in the field. It did not fail because people were dancing or had overloaded the walkway."

First Official Move

(The Missouri attorney general last February charged the St. Louis-based engineering firm that built the hotel with negligence in the design and inspection of the walkways. It was the first official move to fix personal blame for the disaster, though more than two-thirds of the hundreds of claims have already been settled out of court. The architects, Ross' clients, were not named.)

Garrett predicted that the team approach to forensic engineering will continue growing, finding commercial success in functional failure.

"The world is infinitely more complicated each year, and the 'expert witness' of just a few years back is now nearly obsolete," he said. "It takes a team of experts to completely analyze an accident to ensure that something has not been overlooked. Then all of the pieces have to be fit together—like the pieces of a puzzle."



Garrett Engineering was enlisted to analyze an accident last March 5, when an RTD bus hurtled down a freeway offramp into an intersection, killing a motorcycle rider. At Pomona Drag Strip, left, technicians use device to mark spot where driver hit brake, measuring, above, stopping distance. Conclusion: The accident was a combination of mechanical and human errors.