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# How Much "Stuff" Fits Inside a Container? A Forensic Use of Three-Dimensional Data

**Steven M. Schorr, PE**

A convenience store owner was claiming property loss due to theft. Specifically, he was alleging that he had received a shipment the day before a burglary and the contents of that shipment were received in a specific size box. Photographs taken after the burglary showed the size of the objects that were allegedly stolen during the burglary. Through the use of three-dimensional camera-matching, the photographs were utilized to measure the length, width and depth of the "stolen" objects. Additionally, the photographs defined the parameters of the box that allegedly contained the objects. Utilizing basic three-dimensional software, the engineer replicated the totality of the alleged stolen objects and, utilizing the computer, arranged the objects in the most efficient manner in order to see whether they could actually fit within the box. The analysis established that, even when the objects were arranged in the most efficient manner, the volume of the content exceeded the volume of the box and, as such, the claimed objects could not have fit inside. The three-dimensional computer software allows for a visual, and very effective, demonstrative exhibit to illustrate the facts based on science.

# Routine Delivery Ends in Dock Injury

**Thomas J. Cocchiola, PE, CSP**

**Case Synopsis**: A truck driver was injured while making a routine delivery to a supermarket that had a dock lift for unloading freight. The dock lift had a hydraulically powered hoist that raised and lowered its platform between ground level and the truck bed elevation. Delivery truck drivers were able to unload items directly onto the elevated platform before lowering it to the ground. A movable control pendant enabled users to operate the dock lift while standing on the platform. On the day of the accident, the driver backed his truck up and elevated the dock lift before using a jack to unload groceries. Seconds later he was injured when the dock lift platform unexpectedly tilted to one side and caused the pallet jack to slide toward him.

**Expert Analysis**: The platform tilted at the time of the accident because the hoist overextended and caused a hydraulic cylinder to disengage, which left one side unsupported. The dock lift was a relatively old piece of equipment that had been repaired and modified over the years. A limit switch, which de-energized the hoist when the platform reached its maximum elevation, was replaced and a stop block, intended to restrict upward movement, was modified. An evaluation demonstrated that the modified switch and stop block did not prevent the hoist from overextending, causing the platform to tilt. The evaluation concluded that the dock lift was unsafe to operate due to a lack of routine inspections and maintenance in accordance with applicable safety requirements.

**Results**: Case resolved in a favorable manner.

## Runaway Tractor Trailer

R. Scott King, BSME

**Case Synopsis**: The operator of a commercial tractor-trailer was fatally injured when the brakes on his vehicle failed while descending a long hill. Witnesses reported seeing smoke and smelling a strong burning odor from the truck shortly before the incident. After the incident, police investigators discovered various braking deficiencies consistent with reduced braking efficiency, which would have rendered the vehicle out-of-service. Researching the vehicle's service and maintenance history revealed a recent Department of Transportation (DOT) inspection that reportedly included inspection and servicing of the tractor-trailer's brakes. Based on this, the estate of the deceased operator filed suit against the defendant repair shop alleging defective vehicle inspection, maintenance and repair procedures.

**Expert Analysis**: After preserving the incident vehicle, a joint-expert examination was conducted. In addition to a full brake system inspection, which included removal of all tires, wheels and brake drums, the tractor's Engine Control Module (ECM) was imaged. Consistent with the police inspection, the independent inspection revealed numerous braking deficiencies that adversely affected vehicle braking characteristics. Experts for the defendant repair facility conceded that several of the braking deficiencies likely existed at the time of the recent DOT inspection; however, it was clear that several others occurred after that inspection. Further, all of those deficiencies should have been identified during a proper pre-trip inspection. Moreover, a review of the ECM data, combined with an analysis of the tractor's transmission and drive axle configuration, revealed that the operator initially selected a gear that was several gear ranges too high for the hill he was descending, and that he attempted to downshift into a lower gear midway down the hill but was unable to do so. As a result, the vehicle descended the remaining grade in neutral, rendering the engine brake ineffective.

**Result**: Based on the inspection observations, test results and ECM data, investigators concluded that factors contributing to the incident included the operator's inexperience, improper transmission operation, and inadequate pre-trip inspection, as well as improper maintenance by the defendant repair shop. Case settled.



## Fall From Elevation

Jon J. Pina, MS, CSP

**Case Synopsis**: A union millworker was injured when he fell from a scaffolding platform positioned 21 feet above the concrete floor below. Plaintiff was tightening the bolts when his torque wrench malfunctioned, causing him to lose balance. His personal protective equipment (PPE), a fall protection full-body harness with a Self-Retracting Lifeline (SRL), was tethered to the gantry. Upon falling, he struck several objects as his SRL failed to "catch" and stop his fall. Apparently, the internal latching mechanism of his torque wrench broke, causing him to slip forward and fall. His personal fall arrest system's retractable device also failed to operate properly to halt his fall because it didn't lock up.

**Expert Analysis**: Fall protection in the construction industry is required for all work six (6) feet or higher from a lower level. Standard handrails with mid-rails, or barricades that can withstand a 200-pound force in a downward manner, are the preferred protection in preventing falls. Safety net systems below work surfaces, where practical, are an alternative to handrails or PPE. A full-body harness PPE, with a shock absorbing lanyard and double locking hooks would be an acceptable, but less preferred, method compared to the standard handrails/barricades. The employer must supply the employee with the proper PPE, have a written PPE program, and also provide adequate training.

Defendant's safety expert provided documentation that, according to OSHA regulations, the defendant was not the controlling employer nor responsible for the manner and methods employed by the plaintiff's employer. It was the plaintiff's employer's responsibility to provide PPE, and to assure that the trainees were properly trained. It is the construction manager's responsibility, as the controlling employer under OSHA's Multi-Employer Directive, to coordinate the activities of the various contractors and their subcontractors. The controlling employer is not responsible for the manner and methods employed by specialty contractors.

**Result**: Case settled favorably for the defendant.

# Falling Tree Leads to Family Tragedy

## Russell E. Carlson, RCA

**Case Synopsis**: In September 2003, the remnants of Hurricane Isabel crossed the mid-Atlantic region and passed over New Jersey with high winds and heavy rains. In the pre-dawn hours, a family of four was driving on a state highway when a tree broke near its base, fell across the road and landed on the passing vehicle. Both parents were killed; the minor children in the back seat were injured.

The condition of the tree at the time of failure, as well as existing weather conditions, were scrutinized as causative factors. The tree was located at the edge of the state-owned right-of-way. An old box-wire fence was attached to the tree on the side toward the road. The ground at the base of the tree sloped steeply downward toward a naturally wooded swamp. The base of the tree had an open cavity below the major buttress roots on the down slope side, and internal wood decay extended several feet up the trunk.

**Expert Analysis**: Plaintiffs claimed the species of tree, Ailanthus, or tree-of-heaven, was a contributing factor to the failure because of "rapid growth patterns and weak wood and branch structure." The presence of the cavity at the base of the tree was claimed as being a "serious and obvious defect." Plaintiffs also claimed that Ailanthus trees are undesirable for a number of other reasons, most of which had no bearing on the failure of the tree.

Ailanthus trees have softer and less dense wood than some other tree species, but they have denser wood than many other native trees that are considered desirable. This species grows quite rapidly when young, but growth rates both vertically and radially soon slow. Plaintiffs' assertions that the tree was weak because it grows fast were incorrect. It is considered to be invasive because of its ability to create numerous root suckers, often at the expense of other species, but this was irrelevant to the failure.

A careful review of police photographs, and examination of the incident site, revealed several key facts. The crotches that Plaintiffs said to be weak did not fail. The main trunk leaders above the lowest crotch broke on impact, but were not a factor in the whole tree failure that caused the incident. The open cavity at the base of the tree was only visible, prior to the failure, by observing the base of the tree from the side opposite the roadway. The observer would have to climb over the fence and walk through the heavy vegetation and soft ground in the adjacent swamp to see the cavity; any normal and reasonable inspection of trees along roadways does not include such an extensive inspection. The failure of the tree was the result of hidden internal wood decay, not detectable through standard inspection techniques.

Plaintiffs' case was built on the supposition that Ailanthus trees were undesirable in the landscape, considered invasive, and had characteristics that often led to failures. None of those factors contributed to the tree failure or the fatal incident. Plaintiffs also attempted to place an unsupported burden on the state to make extensive inspections beyond normal and standard procedures.

**Result**: Case settled.

# Elderly Swimming Student Dies in Shallow Water Municipal Pool

## Tom Griffiths, Ed.D.

An elderly swimming student, who was waiting for an Aquacize class to start, drowned while she was practicing her strokes. With a break between swim class and Aquacize class, she decided to take advantage of the extra time to practice her swimming. Within minutes, she became distressed. Unfortunately, she went unnoticed because the lifeguards were distracted by picking up swimming equipment left on the pool deck, as well as performing other secondary pool duties unrelated to visual surveillance of the patrons in the pool.

The lifeguards violated the Golden Rule of Neglect, the RID Factor; failure to RECOGNIZE the victim because of INTRUSIONS and DISTRACTIONS, which distracts lifeguards from their primary duty of patron surveillance.

As a result, a favorable settlement was offered to the family of the deceased.

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# Is It Flushable And Why Does It Matter?

## Johann F. Szautner, PE, PLS

**Case Synopsis**: Mr. and Mrs. Fixit converted their basement into a home office and recreation den with a bathroom. The dropped ceiling, wall paneling, carpet tile flooring and the brand new toilet were in place when a severe storm struck their town for days. In the morning of the third day, they experienced a power outage. Mr. Fixit went into the basement to check the circuit breakers. Before he could turn on the light switch, he stepped into ankle deep water, or so he thought. There was water, but he also noticed distinct items typically associated with what is flushed down the toilet. He opened the bathroom door and witnessed the artesian fountain their toilet had become.

Mr. and Mrs. Fixit experienced a backup of waste water into their home. Upon denial of their insurance claim by their home owners' insurance company, a lawsuit was filed against the town, and their sewer authority, to recover costs for the clean-up and damages.

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**Expert Analysis**: Whenever the floor of a building is at a lower elevation than the next upstream manhole on the sewer collection system, a blockage in the main sewer can lead to an overflow of waste-water into the building. Sewer backup is one of the most common basement flooding occurrences in any given municipality with a central collection system. Although municipalities take proactive steps to locate and inventory collection pipes with potential for flow blockage, these blockages continue to happen. On the one hand, these blockages are related to what sewer users flush into the system, like grease, sanitary napkins,tampons and diapers; on the other hand, we know that our infrastructure, especially in older urban areas, is and has been for years completely under-funded, not only for capital improvements, but also to keep up required routine maintenance.

Many sewer systems are plagued by illegal inflows from rain water collection to sump pump discharges and ground water infiltration through leaking pipe joints and manholes. Street trees and landscaping, if not carefully planned, are another potential for flow blockage as plant roots will seek and find waste-water flow sources for nourishment.

Routine inspections of known problematic pipe sections is the best way of locating potential problem areas and addressing them with maintenance, including flushing and vacuuming. The municipality, or operating authority, is typically responsible to maintain the sewer collection pipes and building laterals within the road right-of-way or easement, while building owners are responsible to maintain sewer laterals on their properties.

The town's sewer authority maintenance crews typically respond to sewer blockage incidents as they occurr. Random inspections are done in known problem areas and maintenance, including chemical treatment and pipe flushing, occasionally follow these random inspections. Their engineer had prepared a comprehensive plan for managing sewer overflows, but the authority had not implemented it.

**Result**: Case settled.

# Camera-Matching a Three-Dimensional Environment

## Terry W. Myers

**Case Synopsis**: A large box truck traveling on a two-lane, rural roadway happens upon a passenger car waiting to make a left turn. The truck operator locks his brakes, and skids toward the stopped vehicle. The truck then veers left across the centerline, impacting an oncoming vehicle, head-on. A police investigation yielded a not-to-scale diagram, with no measurements. However, because of the crash severity, photographs were taken of the tire marks as well as other physical evidence.

**Expert Analysis**: An engineering expert was hired to reconstruct the crash; specifically, to answer the question of whether tire failure resulted in the truck veering to the left. Since no measurements were taken of the position and orientation of the marks, and the physical evidence had long disappeared prior to an expert being retained, the field crew utilized a Leica High-Definition Survey (HDS) laser scanner to develop a three-dimensional environment of the existing roadway and adjacent structures. Utilizing that three-dimensional environment, engineers were able to accurately "camera-match" the tire marks, and other physical evidence, into the existing environment created by the laser scanning data.

**Result**: Engineering analysis of the tire marks and other data concluded that the left deviation of the tire marks was due to driver input and not tire failure, consistent with testimony of the vehicle operator.

# Farm Tractor Versus Motorcycle: Was Speed a Factor?

**Curtis M. Beloy, PE**

A farm tractor was traveling northbound, on a two-lane country road, well below the speed limit and with its four-way flashers on. As it approached the driveway, the operator of the tractor extended his left arm to signal the turn in towards the driveway. A northbound motorcyclist attempting to overtake the tractor in the southbound travel lane collided with the rear of the tractor as it turned across the southbound travel lane.

The defense argued that the physical evidence left at the scene established that the motorcycle was traveling over the speed limit as it approached the collision area. Based upon the location and length of the pre-impact tire mark left by the rear wheel of the motorcycle, had the motorcycle been traveling at or around the speed limit, the motorcycle operator would have been able to brake to a stop prior to the driveway. Additionally, the defense argued the physical evidence established that the motorcyclist moved into the southbound travel lane well before reaching the area of the tractor and the collision occurred in a marked, no-passing zone.

A full-scale recreation was done at the collision site to analyze the perspective of each vehicle operator leading up to the collision. It was found that the tractor operator traveled an extended distance between the location where he first observed the motorcyclist behind him and the location of the left turn maneuver. Additionally, it was observed that parts of the tractor's roll bar obstructed the motorcyclist's view of the tractor operator's hand signals.

Plaintiff argued that since the tractor was traveling well below the speed limit and had been overtaken several times prior, the tractor operator should have been aware of the potential for overtaking vehicles, even in a no-passing zone. They also argued the tractor operator's left turn signal was not effective and, had he properly looked for traffic again just prior to attempting his turn, he would have seen the motorcycle in the southbound lane. The case settled before going to trial.