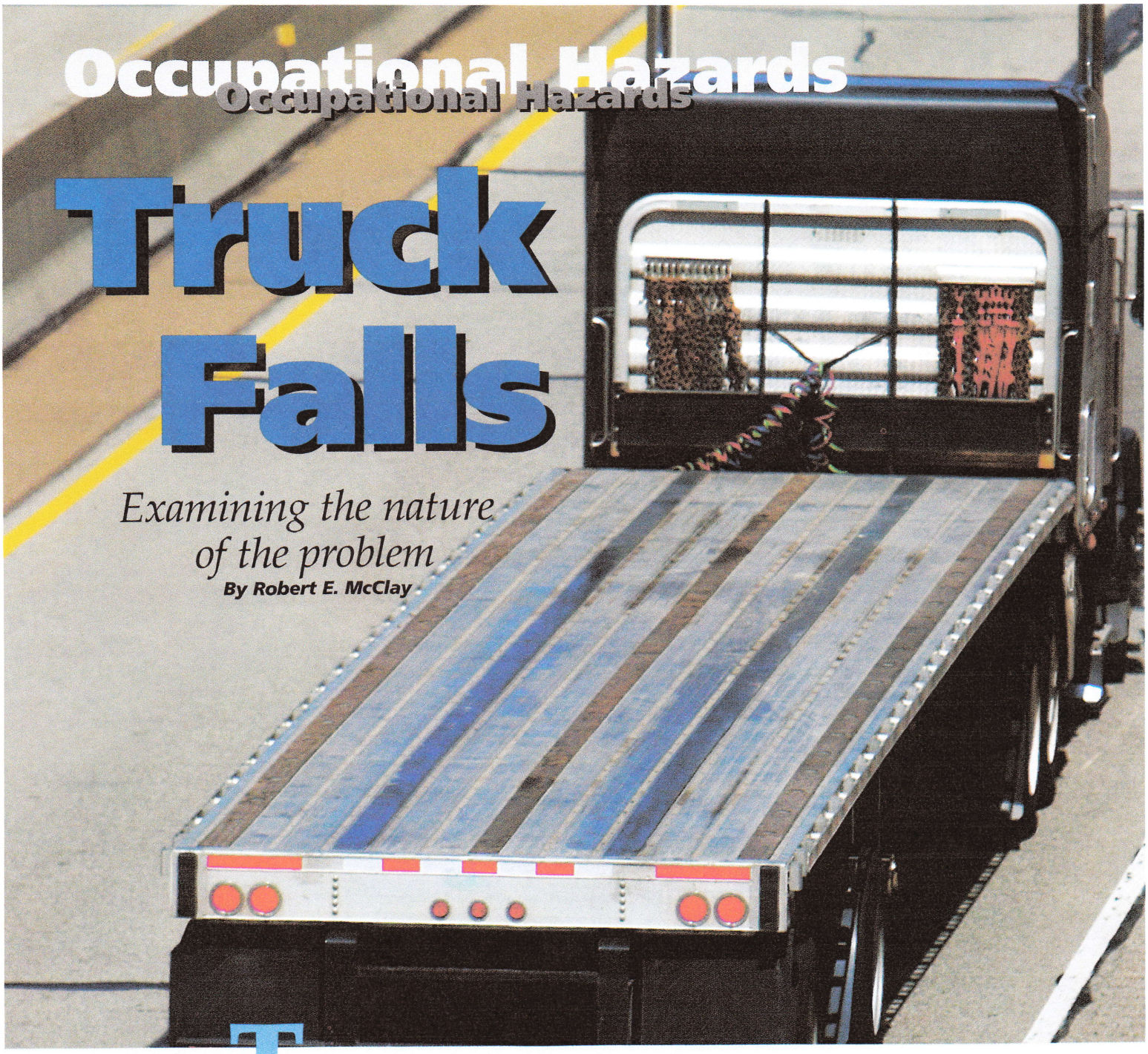
Truck Falls

Examining the nature of the problem

By Robert E. McClay



THE EXPRESSION, "If you have it, it came by truck" is well known. A quick trip to the nearest truck stop will provide ample evidence of this adage—you will see trucks of every conceivable configuration and size, driving in and refueling, drivers grabbing food and perhaps a shower, then heading back on the road. The cargoes carried by these trucks are often more diverse than the trucks themselves: bulk materials, logs, coils of sheet metal, manufactured goods, agricultural products, equipment and machinery, autos and pickups, building materials, chemicals, pipe, glass. . . .

This myriad of truck and cargo configurations makes it difficult to generalize about the hazards associated with loading and unloading semitrailer trucks, but the exposure to these hazards is significant. According to U.S. Department of Transportation (DOT) estimates, there are 2.5 million heavy trucks (those with gross weight above 26,000 lb) in the U.S. Trucks carry three-quarters of the value of freight shipped in the U.S. and two-thirds of the cargo weight. Trucks in the U.S. moved more than 6.2 trillion and 7.8 billion tons of manufactured goods and raw materials respectively in 2002, according to DOT (2005). Trucks are found on all major highways connecting logistical and industrial centers. Traffic hazards associated with truck operations on the highway are well documented and are not addressed here, as this article focuses on driver and helper falls from trucks while parked (Parker, 2006).

Robert E. McClay, CSP, *is a safety consultant based in Indiana, PA. His experience includes 27 years as a safety educator and OSHA consultant at Indiana University of Pennsylvania; 5 years as a safety consultant and educator at East Carolina University; and 2 years as a safety engineer at the Naval Ordinance Station in Indian Head, MD. McClay holds a B.S. in Chemical Engineering from Bucknell University and an M.B.A. from American University. He is a professional member of ASSE's Western Pennsylvania Chapter and a member of the Society's Academics, Consultants and International practice specialties.*

Truck Types

Flatbed Trailers

Several variations of flatbed trailers are found on

the roadways. All are 8 to 8.5 ft wide and are generally 40 to 52 ft long. A standard flatbed trailer is 48 to 54 in. off the ground and most are slippery when wet. "Drop-deck" trailers or "step-downs" are lower (height of 3 ft) and "low boys" ride even closer to the ground (Photo 1).

The flatbed load is secured with chains or tie-down straps held to the rub bar on the side of the trailer with tie binders or ratchet binders. These fastening points can usually be accessed from the ground; however, to secure the load, the tie-down straps must be thrown over the load, then secured on both sides of the trailer (Photo 2). If tarped (by placing a tarpaulin over the load), these straps must go over the tarp and be secured so that the tarp will not blow off the load or allow weather to get underneath it. If the tie-downs get caught on the load or must be moved, the driver may climb on the trailer bed in order to make any adjustments. Retightening tie binders or ratchet binders after leaving the loading dock is a normal procedure; in some circumstances, this also requires the driver to climb on the trailer bed.

Getting onto a standard flatbed trailer is difficult and it poses a hazard because such a trailer has few (if any) handholds and many slippery surfaces, even in good weather. Side kits (Photo 3) are a series of arc-shaped hoops attached to each side of the trailer bed to provide a "frame" on which tarps rest; these hoops are installed at the loading dock after the trailer is loaded. Not all flatbeds are provided with side kits, depending on the load configuration, but once the hoops are attached to the trailer, the load can be tarped. To place the hoops, the driver or helper must stand on and move around the trailer bed or on the load itself. If this is not done at the loading dock where fall protection can be provided, a significant fall hazard exists.

Car Carrier

A car carrier is a unique trailer fabricated of steel that can hold up to 10 vehicles. Personnel drive vehicles onto the trailer, secure them with chains and often climb down through the heavy steel framing. Once at the cargo's destination, personnel climb back onto the trailer to offload the vehicles. Tight quarters and slippery surfaces are common.

Tankers

A tanker is a sealed, wheeled container that carries fluids or fluidized solid materials. They are confined spaces for anyone entering the tank. A more prevalent hazard arises when the driver climbs on top of the tank to open valves, read gauges or perform other tasks. Fixed ladders are usually provided for accessing the top of the tank, but fall protection for the driver once s/he is atop the tank—at least 15 ft above the ground—is problematic (Photos 4 and 5, p. 28).

Box or Van-Type Trailers

Box trailers are the most common type of trailer. Although drivers or helpers have no reason to be on top of the box, these trailers can be hazardous to load with forklift equipment at the loading dock. The box is accessed through the rear doors; usually there is no step, so personnel must use the Interstate Commerce Commission (ICC) bar if they must climb from the ground into the trailer (NHTSA, 1998a, b) (Photo 4). The ICC bar was designed to prevent vehicles traveling behind the trailer from driving under the trailer in a rear-end accident—it was not designed as a stepping point for entry into the back of the trailer. Although grab bars are present in many situations to help personnel climb, falls still occur when attempting to access the trailer from the ground through the rear doors.

Reefers

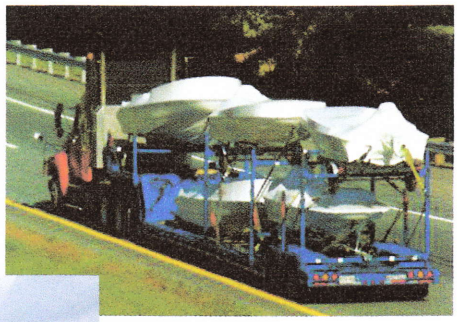
Reefers are van-type trailers equipped with refrigeration units. The fall hazards associated with them are similar to those already discussed.

Dump Trucks

A dump truck is an open-topped truck with a hydraulic unit that can raise the front end of the truck bed, causing bulk or other materials to flow toward the rear. A heavy gate at the rear is either hinged or raised mechanically to allow the materials to slide out of the bed. Hazards include the driver climbing on the load or being trapped and crushed by the falling gate or by the bed of the truck coming down (NIOSH, 2005).

These trucks are typically covered with a tarp to prevent materials from blowing out. Mechanical systems that spread the tarp over the load are the norm. These systems are usually operated from the ground, so tarping is not as hazardous as with other types of trailers. However, if a driver attempts to access the trailer bed

Abstract: *This article examines the nature and extent of the problems associated with semitrailer truck drivers falling from their trucks. The prevalent factors that comprise the fall hazards are described—including the relationship of these hazards with regulations that affect over-the-road truck operations. J. Nigel Ellis's article (starting on p. 36) discusses measures that can minimize the risks associated with these hazards.*



(Clockwise from above) Photo 1: Several variations of flatbed trailers are found on the roadways, including the low-boy flatbed truck, which rides fairly close to the ground.

Photo 2: The load is secured to the flatbed with chains or tie-down straps held to the rub bar on the side of the trailer with tie binders or ratchet binders. These fastening points can usually be accessed from the ground; however, to secure the load, the tie-down straps must be thrown over the load, then secured on both sides of the trailer.

Photo 3: Side kits are a series of arc-shaped hoops attached to each side of the trailer bed to provide a "frame" on which tarps rest; these hoops are installed at the loading dock after the trailer is loaded.

Photos 4 and 5 (from top): Tanker trucks usually have fixed ladders to help drivers access the top of the tank. Fall protection for the driver once s/he is atop the tank—at least 15 ft above the ground—is problematic.

Photo 6: If a driver attempts to access the dump truck bed to clean it, when the tarping mechanism fails or for some other reason, s/he may be exposed to several hazards, including falls.

Photo 7: Tarp tie-downs are tightened and secured to the rub bar.

to clean it, when the tarping mechanism fails or for some other reason, they may be exposed to several hazards, including falls (Photo 6).

Operations

The manner in which over-the-highway trucks are dispatched, loaded, travel and unloaded follows a fairly consistent pattern. One critical element in the process is the truck driver. This person may also be the truck owner-operator. If the driver is an employee, his/her employer is the truck owner/leaser; this person creates the schedule followed by the truck driver.

In most cases, the empty truck is driven to a site where a load awaits. The organization that owns the cargo to be loaded is called the shipper. The shipper is responsible for loading the truck, a task which normally occurs at a loading dock at the shipper's facility.

The shipper determines whether to tarp the load. This is a critical determination that affects the fall exposure for the driver/helper. The driver usually performs the tarping—often in a location away from the loading dock. This allows other trucks to be loaded since loading time is critical for efficient shipping operations, particularly when production facilities are running at full capacity. In some cases, the truck driver or other employee will help with the loading, but the driver does not assume responsibility for the load until the truck is completely loaded.

Placing a tarp over oddly shaped cargo poses stress/strain hazards as well as fall hazards. Tarps are often at least 20 x 25 ft and can easily weigh more than 100 lb. Imagine a driver wrestling with one in the wind or on a cold day and the hazards are obvious.

To perform this task, the tarp is laid out beside the truck and a few tie-downs are attached to eyelets on the edge of the tarp. The long tie-downs are then thrown over the cargo. The driver then moves to the other side of the truck to pull the tarp up and over the load and into place. The tie-downs are then tightened and secured to the rub bar (Photo 7). If the straps are twisted, snagged on the load or out of place, the driver may have to climb onto the trailer to fix the problem.

DOT regulations require (with a few exceptions) that over-the-highway truck drivers ensure that their cargo and load are properly distributed and secured [Title 49 Part 392.98(a)(1)]. For this reason, after the truck is loaded at the dock, the driver will pull the truck into a parking area on the shipper's property to secure the load and tarp it if necessary. In many cases, the driver will climb onto the flatbed truck, where s/he is exposed to a fall hazard.

Once on the highway, the driver must examine the cargo and its load-securing devices before traveling 50 miles [Title 49 Part 392.98(b)(1)]. These checks are repeated before 150 miles have been traveled [Title 49 Part 392.98(b)(3)]. At each juncture, the driver may find some reason to climb onto the trailer or the load.

Drivers

The extent of risk involved with tasks performed while the vehicle is parked is related in part to the driver's physical condition. Truck driving is largely a sedentary activity with few opportunities for aerobic exercise. The lack of physical conditioning has even more serious implications, as studies suggest that long-haul truck drivers have an elevated risk of heart disease (Robinson & Burnett, 2005).

Beilock (2005) compared the average age of truckers against the age of the overall workforce and found that truck drivers in the sample were on average age 44.4 while the general workforce average age was 40.2 years. In a small sample of truck drivers selected by the author, the average age was 48.2 years with a range of 28 to 75 years. This relatively advanced age of truck drivers should be a concern since Haight and Belwal (2006) point out that motor performance of humans begins to decline at about age 50; this could be due to fatigue or loss of strength, range of motion and motor skills.

NIOSH (2000a) states, "Even minor declines in balance, coordination and reaction times associated with the normal aging process may result in an increased risk of falls from ladders among older workers." If the risk of falling from ladders is increased by advancing age, surely the risk of a fall while climbing onto a truck and its load will also be greater.

Another condition threatens truck driver health and safety, according to University of Pennsylvania researchers (Pack, Maislin, Staley, et al., 2006). They report that 28% of commercial truck drivers tested suffer from sleep apnea, which affects their performance on alertness tests. Sleep apnea is characterized by a temporary stoppage of breathing during sleep. This produces periodic awakening and loss of restful sleep and drowsiness during the day. Coupled with

the irregular hours of sleep associated with long-haul trucking, this suggests that sleepy drivers climbing onto their trucks and loads may not be functioning at their normal capabilities during this process.

Fall Hazard Exposures

Falls from the truck cab can occur while the driver is entering or exiting; these falls may be from a height of 6 to 8 ft. Because of the high frequency of this task, one can reason that these are likely the most frequently occurring falls.

If a flatbed truck is equipped with a header board across the front edge of the trailer, then it is more difficult for the driver to get onto the load from the platform behind the cab. The driver must either climb over a tire onto the bed or climb onto the rear of the truck bed using the ICC bar (Photos 8, 9, 10, 11). A few drivers may use a portable ladder to access the truck bed; this would be a less hazardous approach as long as three-point support is provided.

If the flatbed does not have a header board, the front of the trailer is accessible from the small platform behind the cab that supports the fifth wheel. This is also not an ideal access point, as it offers no handholds or safe stepping places. None of these paths of access are without risk principally because the design of the truck and trailer often lacks features that could prevent a slip and/or fall.

Once on the flatbed, the level of risk increases, particularly if the driver must walk on or climb onto the load. Loads can be uneven, unbalanced, slippery, have holes to step into and few if any handholds to provide stability. The bed of the trailer can also be slippery.

Tanker trucks require no tarping. However, they pose significant fall hazards because of the need to access valves, gauges and other controls located atop the tank. Newer models have fixed ladders at either the front, back or side of the tank. Even with these ladders, the driver may overextend him/herself to reach the bottom of the ladder. In addition, being on top of the tank—which is 15 ft or so above the ground—requires agility as well as constant diligence to keep from falling. Railings on top of the tankers (if they exist) are not placed to provide maximum or even reasonable fall prevention.

Dump trucks carrying bulk materials or other loads are usually tarped to prevent materials from blowing or falling out. Because tarping in these cases is mandated by state jurisdictions, mechanical tarping systems that are operated from the ground are common. However, where these systems are missing or are inoperative, a driver will climb on the side of the truck to spread the tarp by hand (Photo 6) or perform other necessary tasks. Once on top of the truck bed however, minimal fall protection is provided.

Loss Experience

Extensive injury data are available on falls since they are a leading cause of injury and death. However, much of this information is dated or cannot be compared because the circumstances of the falls differ. Important parameters for fall data include the following:

- type of workplace;
- location of surface falling from;
- type of surface falling to;
- numbers of persons exposed to the fall hazard;
- number of falls, injuries and fatalities;
- economic loss associated with falls.

In the absence of such data, some partial data points can be discussed. NIOSH has published injury and fatality data collected from several sources. For example, National Traumatic Occupational Fatality (NTOF) data indicate that there were 369 fall-related deaths from 1980 to 1994 in the transportation/material moving industry, or about 26 fatalities per year. Of course, only a portion of these involve falls from trucks. NTOF data also show that 177 fatalities were caused by falls from stationary vehicles/machines from 1980 to 1994 or about 13 per year (NIOSH, 2000).

A focused study of 2004 Bureau of Labor Statistics (BLS) annual survey data found 1,500 total cases for the year in which employees fell from semitrailers, tractor trailers or truck trailers onto a surface below with a resulting days-away-from-work injury. BLS (2005) also used a count of death certificates and other data collection systems to conclude that 11 employee fatalities in 2004 were the result of falls from stationary trucks onto the ground, floor or walkway. In its Census of Fatal Occupational Injuries for 2005, BLS (2007) reported 25 fall-related deaths in the truck transportation industry.

While these statistics appear to be fairly consistent, they do not seem to agree with anecdotal reports from employers and truck drivers contacted during the course of this study. Their accounts suggest a greater number of fatalities from truck falls. It may be that gaps in the various data collection systems prevent an accurate count of fatalities resulting from truck falls; this seems all the more plausible given the large number of independent truck

Photos 8, 9 and 10 (from top): If a flatbed truck is equipped with a header board across the front edge of the trailer, then it is more difficult for the driver to get onto the load from the platform behind the cab. The driver must either climb over a tire onto the bed or climb onto the rear of the truck bed using the ICC bar.

Photo 11: A driver accesses the trailer from behind the cab.

owner/operators who work on a contract basis and are, therefore, not classified as employees.

It should also be noted that individuals who fall from the trailer or load are extremely vulnerable to serious head injury. Anecdotal reports from shippers where truck falls have occurred indicate that the severity of the injuries experienced in these falls increases dramatically when head injuries result. This has prompted some shippers to mandate the use of head protection during tarping.

Many injuries occur in trucking, but the totals include overexertion and repetitive motion injuries as well as injuries from falls. Data on specific causes for truck falls are scarce. One source reports that 8% of all injuries in trucking are related to tarping/untarping operations (Van Dyne & Christiansen, 2006).

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Regulatory Aspects

Safety regulations likely have a lesser impact on the safety and health of long-haul truck drivers because of jurisdictional issues that fragment applicable authority between DOT and OSHA. Federal OSHA issues and enforces workplace standards across the country except in state-plan states where the state exercises this authority. In those states, workplace safety and health standards may be different or may be enforced differently. In addition, the regional directors who administer federal OSHA programs have some discretion over the enforcement process in their regions, so slight variations may be seen from region to region in how standards are interpreted, when citations are issued and for what violations.

Memorandums of understanding between OSHA and DOT are subject to revision over time, so jurisdictional issues may be decided differently under different national or state administrations. For these reasons, one must be cautious in discussing regulatory requirements applicable to trailer-truck drivers.

Given this background, several generalizations can be made regarding the enforcement of regulations that cover heavy trailer-truck operations:

- Trailer-trucks on the highway are under the jurisdiction of DOT (although enforcement may be conducted by the states).
- OSHA has jurisdiction over loading and tarping of trailer trucks if these operations are occurring at the shipper's facility (Clark, 1990).
- Trailer truck owner/operators, if they are sole proprietors with no employees, are excluded from OSHA standards enforcement.
- OSHA does not have jurisdiction over truck equipment (that authority belongs to DOT) and cannot impose regulations in this area.
- DOT enforces regulations that mandate the provision of adequate handholds, steps and/or deck plates to allow employees to enter and exit the truck cab [Title 49, Part 399, Paragraph 399.207(a)].

These generalizations illustrate how DOT and OSHA share enforcement responsibilities for potential fall hazards related to over-the-highway trailer-trucks. Whether this arrangement detracts from the effectiveness of the overall enforcement effort remains to be seen, but truck owners and drivers may find it difficult to understand and comply with the related regulations coming at them from different sources.

In addition, the following issues may not find resolution in a setting where regulatory agencies do not see their responsibilities as being clearly delineated:

- If tarping were required to be performed at the loading dock, how would this rulemaking occur?
- If the driver were to be prohibited from climbing onto the trailer or the load, how would this be enforced and by whom?
- If it becomes necessary to build better fall protection into truck trailers, how would this be mandated and by whom?
- If tarping were to be required by shippers only in restricted circumstances, who would create these standards and guidelines?
- What is the role of the insurance industry?

Questionnaire Surveys

Mail Questionnaire

Two different surveys were conducted to gain more information about truck fall hazards. The first survey involved shippers who load/assist with the load and who are responsible for the integrity of the load before it reaches the highway. The survey was sent via e-mail to several groups: 1) 1,830 members of the A-List, a safety-related e-mail distribution list; 2) 110 members of ASSE's Transportation Practice Specialty; 3) 160 practicing SH&E professionals and graduates of the safety sciences program at Indiana University of Pennsylvania; 4) corporate SH&E managers who distributed the questionnaire to appropriate shipping personnel at their facilities; 5) 16 safety contacts in the lumber and paper industry; and 6) more than 50 other SH&E contacts. In all, the survey reached some 2,100 recipients; however, it is not possible to know the precise sample size because many recipients forwarded the questionnaire to one or more other people.

Eighty-one responses were received, although not all of these participants responded to each of the 27 questions. Of these, 49 (63%) were in manufacturing and another 6 (8%) were in warehousing.

Fifty-four respondents answered the question about the type of trucks loaded/unloaded at their facility. Of these, 68.5% reported that their site worked with flatbed trailers; 44.4% worked with tanker trucks; 42.6% worked with flatbed trailers with side kits; 29.6% with dump trucks; and 27.8% with hopper trucks with top hatches. Nearly 39% indicated that they worked with other types of trucks as well.

The question about tasks that drivers/helpers perform at a shipper's facility generated 58 responses. The tasks cited include: install/adjust tie-downs (69%); install/adjust tarps (55.2%); remove tie-downs (55.2%); make adjustments to secure load (50%); remove tarps (48.3%); assist with loading (46.6%); and assist with unloading (41.4%).

With respect to tasks that require drivers/helpers to climb onto the load or trailer while at the shipper's facility, 53 people responded. The tasks cited include: install/adjust tarps (49.1%); install/adjust tie-downs

(47.2%); remove tarps (47.2%); remove tie-downs (39.6%); assist with loading (39.6%); make adjustments to secure load (37.7%); install/adjust holding blocks or load binders (32.1%); and assist with unloading (28.3%). These responses indicate that truck drivers/helpers perform a substantial number of activities—several of which require them to climb onto the trailer or load while at a shipper's facility.

When asked about the types of trucks that require the handling of tarps at a shipper's facility, 26 of 36 respondents (72.2%) reported that flatbed trailers require tarping. Flatbed trailers with side kits (25%), dump trucks (19.4%) and other (36.1%) were also identified as being in need of tarping.

The questionnaire also asked where the tarping task is performed. Of the 34 responses received, 22 (64.7%) indicated that it is performed in a parking area on facility property; 16 (47.1%) said it is done on a concrete apron near the loading dock. Other areas cited include a roadway on facility property (23.5%); roadway outside facility property (5.9%); a rest stop along highway (5.9%); and other (26.5%). As noted, fall protection might be more readily available in the loading dock area.

The question regarding who is required to attach tie-downs, tarps, hoops or bows without the benefit of fall prevention or protection generated 41 responses. Of these, 33 (80.5%) indicated it is truck drivers; 11 (26.8%) reported it is helpers; 8 (19.5%) indicated it is others; and 6 (14.6%) said it is facility personnel. Only one respondent reported that fall protection is provided for all. These results indicate that fall protection may not be provided as a rule for drivers/helpers when they are adjusting or tarping a load—tasks during which these individuals are most likely to be climbing on the trailer or load.

With regard to the physical qualifications of drivers, the survey responses suggest that there are few requirements in this area. Of the 48 who responsed to this question, 20 (41.7%) said their facility required a commercial driver's license; 18 (37.5%) said no assurance was required; 6 (12.5%) require other physical exams; and 4 (8.3%) require other testing or exams.

Most respondents (32 of 44 or 72.7%) indicated that their facility provides some guidance/direction to drivers/helpers regarding the tasks they must perform on the trucks.

Verbal guidance is the primary type of information provided, according to 25 of 32 respondents (78.1%). Other types of assistance include signs and other posted warnings (50%); written guidance (40.6%); other types of guidance (37.5%); and watching a videotape (18.8%).

Because the size of the sample receiving the questionnaire cannot be determined, no statistical conclusions can be drawn as inference regarding the conditions in the entire body of shipping facilities. However, the responses received do not give much evidence to support the idea that the loads truck drivers receive are secured and tarped under conditions where drivers/helpers will not have to climb onto the truck trailer or load. Particularly disappointing is the indication that an overwhelming majority of drivers must tarp their loads away from the loading dock with no form of fall protection.

Reasons for Climbing Onto the Trailer/Load

Tarp/untarp	44%
Check the load	36%
Secure the load	25%
Load/unload	11%
Adjust chains/straps	17%
Put protectors under straps	11%
Tape load	6%
Check the tarp	6%

When asked whether it was possible to keep drivers from climbing onto the trailer or load, most of the drivers interviewed said that it would not be possible. When asked how many times s/he had climbed onto the trailer in the last month, the average was 59, with a range of 0 to 250 times. Ten drivers—nearly one-third of those interviewed—said that they had climbed onto the trailer more than 100 times in the past month.

Driver Interviews

The second survey encompassed 36 interviews conducted at five truck stops on interstate highways in western Pennsylvania. Drivers of flatbeds, dump trucks, tankers and car carriers were approached as they entered the truck stop. All drivers of these types of trucks were approached if they came into the building, and about two-thirds agreed to be surveyed.

Individual drivers were interviewed using a 32-item questionnaire designed to collect data about the driver, truck and the loads carried. Drivers were asked questions and their answers were recorded. The following discussion highlights their responses (space limitations prevent a full presentation of these results).

The average age of the interviewed drivers was 48.2 years with a range of 28 to 75 years. The types of trucks driven at the time of the interview included 15 flatbeds, 5 low boys, 4 flatbed-step decks, 3 flatbeds with side kits, 6 tankers, 2 dump trucks and 1 auto carrier. Years of experience as a truck driver ranged from 5 to 45 years, with an average of 23.5 years' experience.

When asked whether they had ever fallen from the truck, 58% reported they had nearly fallen from the trailer; 50% had nearly fallen from the cab; 44% had nearly fallen from the load; 36% had fallen from the cab; 28% had fallen from the trailer; and 19% had fallen from the load. (Response percentages are based on 36 interviewees.) Drivers who indicated they had fallen were asked whether they had also had any near-hits.

These numbers may seem alarming until one considers that some of these drivers have been driving and climbing onto their trailers for more than 40

Analysis of an Injury Event

An analysis of truck falls can explore causation mechanisms and identify hazard control strategies. One analytical approach that has shown promise is the use of the Haddon matrix (Holder, Peden, Krug, et al., 2001). Proposed by Haddon in 1970, this methodology segments the injury-causing incident into three parts: preevent, event and postevent. In each segment, the analyst considers factors associated with the human, the agent, the physical environment and the socioeconomic environment (Fowler, 2002). Table 1 shows the relationship between these factors.

The approach requires the analyst to answer the questions in each section of the matrix, then use the matrix to identify areas where better controls are needed. Table 2 shows an analysis of an actual truck fall incident. Next, a team of qualified professionals reviews and evaluates the considerations for remedial measures, which are then implemented.

The universal model is another device to help SH&E professionals better understand a loss incident (McClay, 1989a, b). This approach uses a diagram to identify proximal hazards that are the immediate causal factors and are of three types: 1) physical, chemical and biological conditions; 2) human actions or inactions; and 3) exceeded functional limitations.

A "point of irreversibility" separates these immediate causal factors and the effects of the incident. The loss incident is characterized by a release of mass and/or energy. In this case, it would be "driver strikes the ground." The loss incident is the event that causes death, injury, damage and destruction. Mitigating and aggravating factors are states or events that either reduce the severity of the final effects or make these more severe. These factors occur after the point of irreversibility and, therefore, are not regarded as incident causal factors. The symbols used in a universal model diagram are shown in Figure 1.

To identify upstream system deficiencies, the model classes these as distal causal factors and uses the 5-why technique to find them. Starting with certain proximal causal factors, the analyst asks "Why?" to find a credible reason for a hazard's existence. The answer is listed on a table and the question is reiterated until it has been asked five times. The table then lists five sets of distal causal factors that can be used to develop remedial measures to control the proximal causal factors.

Table 1

Haddon Matrix on Truck Fall Event, Incident Considerations

Tractor-trailer driver	*Preevent*	*Event*	*Postevent*
Human	1) age, size, mobility, behavior, experience, fatigue, alcohol, drugs	2) hardhat, gloves, other padded clothing; tolerance of impact	3) someone observes fall; extent of injuries
Agent and carrier	4) load must be tarped; load must be secured	5) height of fall; uneven surfaces around truck; driver caught on truck or load	6) means for rescuing driver
Physical environment	7) walking and climbing surface; handholds; fall protection; automatic tarping	8) impact surface; surface objects; utilizing fall protection	9) proximity to medical care; weather; outside temperature
Social environment	10) DOT regulations; driver training; helper to assist with tarping; shipper's concern for safety	11) enforcement of regulations	12) medical treatment of driver; rehabilitation

Table 2

Haddon Matrix on Truck Fall Event, Remedial Considerations

Tractor-trailer Driver	*Preevent*	*Event*	*Postevent*
Human	1) mandatory physical exams; test driver for drugs and alcohol before loading truck	2) protective helmet and gloves	3) have hotline that injured drivers can call
Agent and carrier	4) mandatory training in tarping and load safety; eliminate tarping	5) prohibit drivers from climbing onto the trailer	6) safety nets to deploy if driver goes onto the load; motion alarm to sound if driver fails to move
Physical environment	7) impact-absorbing surface in parking area; better handholds on cab and trailer	8) mandatory fall protection systems; impact-absorbing surface in parking area	9) have trucks parked so that injured driver is accessible to rescuers
Social environment	10) make shipper equally culpable for load stability	11) use buddy system for loading; surveillance cameras for parking areas	12) preplanned emergency response for truck falls; OSHA investigation of all truck falls

Figure 2 presents a universal model diagram that describes a hypothetical truck fall incident.

A prime proximal causal factor is a proximal hazard for which no causes are shown on the universal model diagram. For example, Figure 2 shows no causal factors for seven proximal hazards or contributing factors. These are marked with an asterisk. These are the proximal causal factors to be analyzed using the 5-why technique in order to uncover distal causal factors for correction (McClay, 2003).

As shown in Figure 2, there are seven prime proximal hazards and contributing factors (either aggravating or mitigating factors) for which no causes are shown on the diagram. These are:

1) pathway exists for climbing onto the load;
2) load needs to be better secured;
3) knowledge limitation was exceeded;
4) slippery or uneven surface was present;
5) no fall arrest system;
6) nothing for driver to grab onto;
7) no head protection.

Table 3 (p. 34) presents the results of a 5-why analysis on these seven prime proximal factors. Ideally, this analysis is performed in a team setting. That was not the case with this example, as the incident diagramed is hypothetical. The distal causal factors that appear are then analyzed further to identify corrective measures.

Figure 1

Symbols Used in the Universal Model Diagram

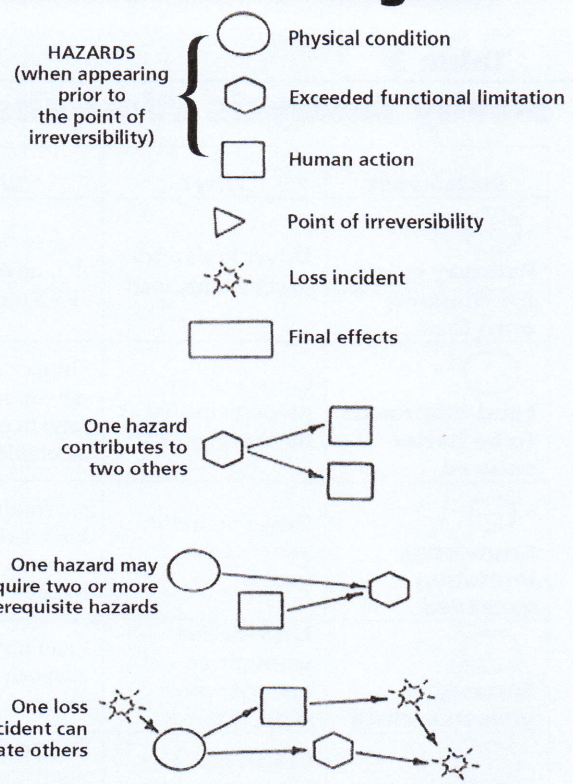
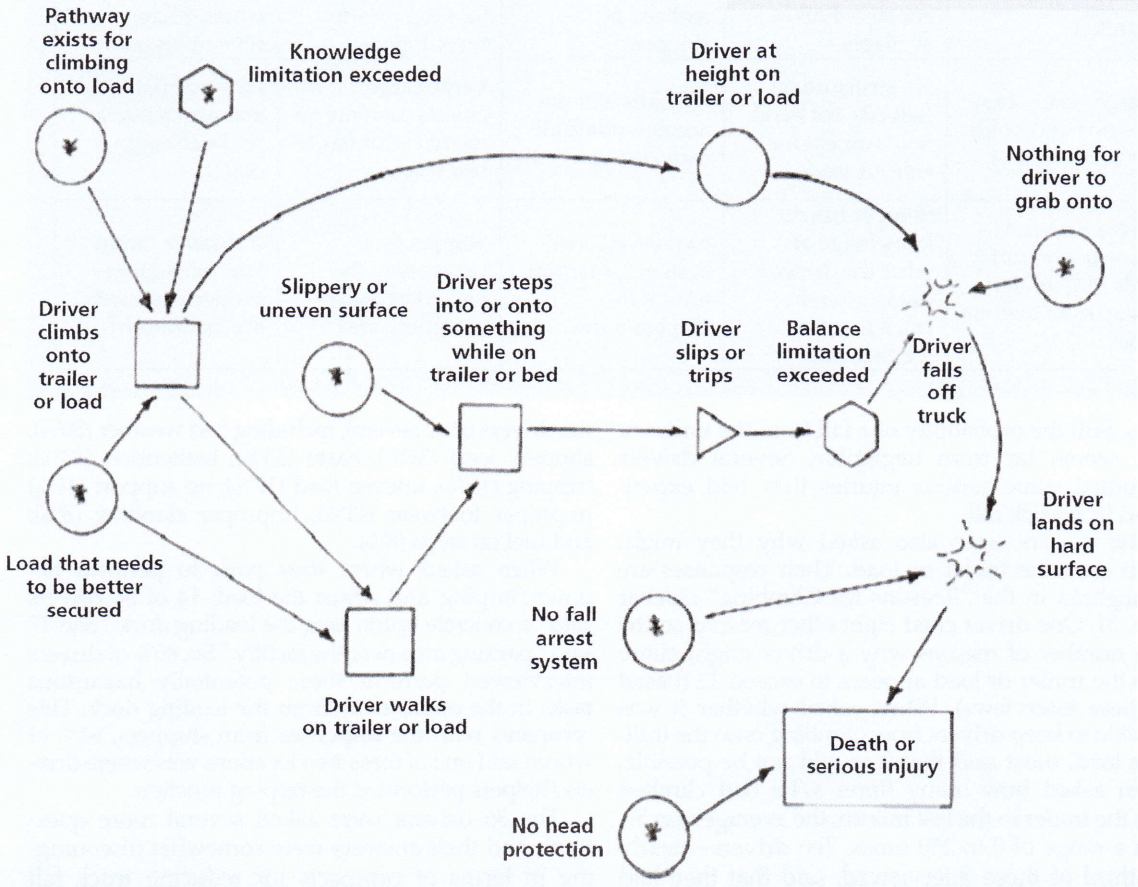


Figure 2

Universal Model Diagram of a Truck Fall



The universal model is another device to help SH&E professionals better understand a loss incident. This approach uses a diagram to identify proximal hazards that are the immediate causal factors.

Table 3

5-Why Analysis Worksheet

State/event	Why?	Why?	Why?	Why?	Why?
Pathway exists for climbing onto load	Driver finds a way to climb onto load	Driver believes that he needs to climb onto load	Load does not appear to be secure	Driver has checked stability of load	Driver is required by DOT to check load
Load that needs to be better secured	Cargo was not properly loaded at the loading dock	Shipper's personnel did not have time to properly assemble load	Shipper needs to hurry the loading process	Shipper is behind with orders	Facility is working beyond capacity
Knowledge limitation exceeded	Driver not fully aware of fall hazard	No firsthand knowledge or related experiences	Employer's training program does not address fall hazards	Employer expects driver to access load despite hazards	Insurance incentives are insufficient
Slippery or uneven surface	Load stacked unevenly or covered with slippery cover	Load not checked properly by shipper	Shipper's employees are not qualified to check load	Shipper's employees not adequately trained	Shipper's training program is inadequate
No fall arrest system (FAS)	Cost of FAS does not appear to be justified	Shippers are unaware that effective FAS is available	Extent of truck falls hazard is not realized by shippers	Drivers' and helpers' risk might not be a top priority for shippers	OSHA regulation coverage and workers' comp is for employees
Nothing for driver to grab onto	Cargo/load often has no hand holds	No structure on flatbeds for hand holds except for side kit trucks	Side kits will not accommodate all cargo types	Large cargo objects can only be moved with flat bed trucks	Low boy flatbeds are most suitable for large cargo objects
No head protection	Drivers do not wear uncomfortable PPE while away from loading dock	Shipper has no knowledge of what the driver is doing after the truck leaves loading dock	No surveillance system for tarping area at the shipper's site	Shipper is unaware of the hazard exposure in tarping area	Insurance incentives for shipper's property hazards are insufficient

years. Still the probability of a fall from the trailer or load seems far from negligible. Several drivers recounted some serious injuries they had experienced in a truck fall.

The drivers were also asked why they might climb onto the trailer or load. Their responses are highlighted in the "Reasons for Climbing" sidebar on p. 31. One driver cited eight other reasons so the total number of reasons why a driver might climb onto the trailer or load appears to exceed 12 (based on these interviews). When asked whether it was possible to keep drivers from climbing onto the trailer or load, most said that it would not be possible. When asked how many times s/he had climbed onto the trailer in the last month, the average was 59, with a range of 0 to 250 times. Ten drivers—nearly one-third of those interviewed, said that they had climbed onto the trailer more than 100 times in the past month.

When asked what factors could contribute to a fall, the drivers cited several, including bad weather (50%); slippery load (36%); haste (33%); inattention (33%); tripping (19%); uneven load (17%); no support (11%) improper footwear (11%); improper climbing (8%); and fuel on steps (8%).

When asked where they park to perform tie-down/tarping and adjust the load, 14 of 36 drivers said "a concrete apron near the loading dock" and 17 said "parking area near the facility." So, 86% of drivers interviewed perform these potentially hazardous tasks in the open, away from the loading dock. This compares with the responses from shippers, 64% of whom said one of these two locations was where drivers/helpers performed the tarping function.

The 36 drivers were asked several more questions, and their answers were somewhat discouraging in terms of prospects for reducing truck fall hazards in the near future. Two-thirds said that their employer had no work rules on getting onto the trailer or onto the load. Almost the same number

said that the sites where they pick up and deliver loads are not adding any work rules of this sort.

When asked whether their company was considering providing some sort of fall protection to afford protection when drivers/helpers had to get onto the trailer/load, 33 of 36 drivers interviewed said no. However, almost half of the drivers reported that at some point they had worn some form of fall protection when they worked on top of the trailer or load. Forty-two percent indicated that they had visited facilities where some form of assistance had been provided in tarping or attaching tie-downs. Acknowledging the perceived risks involved with their jobs, the interviewed drivers—by a count of more than two to one—indicated that climbing on a truck trailer or load is more hazardous than driving that truck on the highway.

Conclusion

Considering anecdotal evidence, the two surveys conducted, the analyses presented here as a product of inductive reasoning and evidence from what can be seen about the trucks and their drivers, it appears that some useful conclusions can be reached regarding the occurrence of truck falls. A huge number of trucks operate on U.S. highways and it appears almost certain that a substantial fall risk is present when drivers/helpers climb on truck trailers and loads to perform tasks with no fall protection and often no assistance. The potential for a slip and fall from a truck trailer is substantial and the severity of injuries from these falls is often extreme. The age and physical condition of truck drivers/helpers may be adding substantially to this risk as well.

Truck trailers are not built with adequate protection against falls and independent truckers who own their own rigs and must pay soaring fuel costs are unlikely to invest in fall protection systems for their trucks unless required to do so. Given the current regulatory environment and the jurisdictional relationship between OSHA and DOT in this area, it seems unlikely that regulation of truck fall hazards will occur any time soon. However, it might prove promising for OSHA and DOT to form a task force with industry representatives, drivers and insurers to propose appropriate regulations on truck trailer designs, trailer loading operations and driver procedures.

It also appears that a substantial number of shippers are not adequately addressing these risks, which are usually played out on their property. This may be because the truck drivers are the employees of another employer, which means their workers' compensation costs are usually not seen by the shipper. Still, shippers must be a part of any solution. Perhaps insurers could offer lower general liability premiums to shippers that install fall protection at their loading docks. Shippers also need to review their requirements for tarping and minimize the need for tarps. Where tarping is absolutely necessary, shippers should provide some form of fall protection and assistance to those performing this task.

More research is needed as well. For example, BLS data do not seem to reflect the true magnitude of the truck fall risk. It is also likely that more innovative fall protection systems are needed. Fall protection systems being used in other countries should be explored. In addition, head protection should be evaluated as one way to reduce the severity of falls from trucks.

It is time for SH&E professionals and other advocates of employee protection to address the problem of truck falls and help create safer working conditions for the highway cowboys who deliver just about everything that makes today's modern lifestyle possible. ■

It is time for SH&E professionals and other advocates of employee protection to address the problem of truck falls.

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