



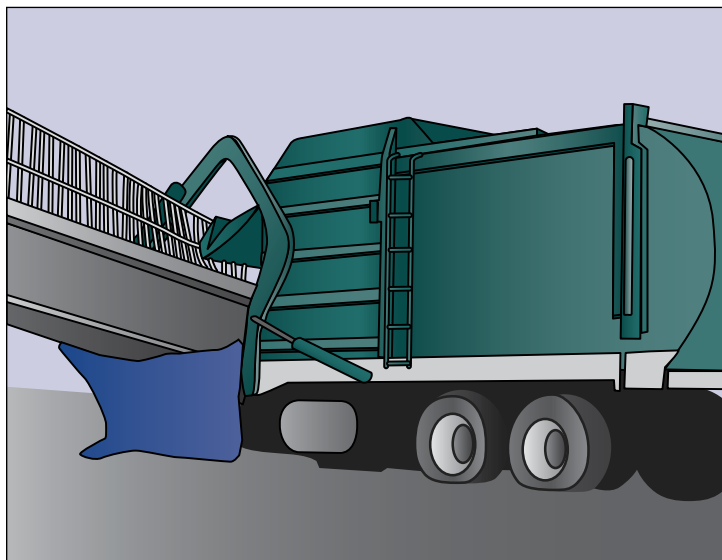
These human factors bulletins focus on how workers interact with their work environments. They are based on accident investigations that examine all the workplace factors that influence the decisions and actions of the workers involved in an accident. These factors help to identify the causes of an accident. Identifying these causes can help to prevent similar workplace accidents.

Elevated loads and feedback systems

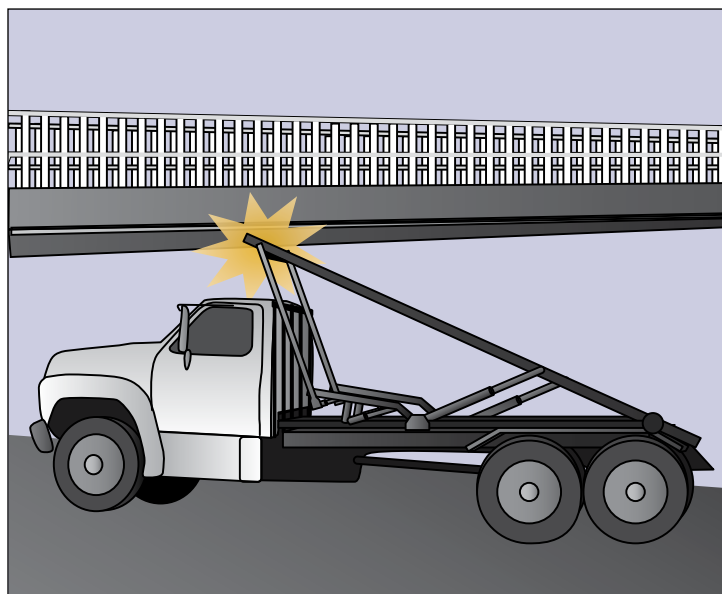
This bulletin looks at two incidents involving trucks with elevating components or parts. Without a feedback system to let drivers know that these components on their trucks are elevated during travel, significant damage to life and property can occur.

What happened?

In the first incident, the truck was traveling along the highway heading to its last garbage collection. The driver was unaware that the garbage box had become elevated during travel, and the box crashed into the side of a pedestrian overpass. The impact forced the pedestrian overpass off its support pillar on one side. The overpass then fell onto the cab of the truck, killing the driver.



The second incident was very similar, but involved a truck with a roll-off garbage system. The truck was not carrying a bin, and the center rail was elevated. The rail crashed into an overpass and caused property and vehicle damage. Fortunately this incident did not have the same catastrophic outcome as the first.



From a human factors perspective, why did these incidents happen?

The investigation into the first incident found that there were identical toggle controls to open the top sliding door of the box and to elevate the box. The positions of these controls were different in the truck that the driver normally drove. So this time, when

he operated the control to open the sliding top door, he actually elevated the box instead. In the second incident, there was a joystick control for raising and lowering the rail. It is likely that the driver simply omitted the last step of lowering the center rail before joining the highway.

Understanding human factors helps avoid workplace accidents

These incidents happened because there were no feedback mechanisms to alert the drivers that parts of their trucks were elevated. Driving is a very complex task and demands a high level of attention. Once drivers become familiar with a vehicle, little conscious attention is directed to the handling of controls. For example, most drivers do not look and check each time they operate the windshield wipers or the signal indicator. The motion of the windshield wipers and the audible clicking and visual light of the signal indicator lets drivers know immediately what action they have taken.

However, in both these trucks, there was nothing to tell the drivers that their elevating components were raised. Without a feedback system, they had to rely on their own senses to detect the elevation. From their driving position, they couldn't see the raised parts of their trucks, and did not detect any unusual sensory feedback in the way that the truck handled, such as lateral movement or an increase in noise or vibration of the truck while on the road.

Two of the principles for designing for error are: (1) to make the error known and (2) to make the error reversible. The following standards highlight the necessity for feedback systems that would make elevation known to drivers, and also give drivers the opportunity to correct the condition. The installation of a feedback device greatly increases the likelihood of drivers detecting elevated components before accidents occur.

Signals should be provided to warn personnel of impending danger, to alert an operator to a critical change in system or equipment status, and to remind an operator of a critical action or actions that must be taken. An alerting/warning signal shall provide the operator with a greater probability of detecting the triggering condition than normal observation would provide in the absence of the signal.

**Department of Defense Design Criteria Standard.
Human Engineering MIL-STD-1472F section 5.3.2.1**

A visual or audible warning signal, or both, shall be provided in the cab to indicate when lifting mechanisms, top door covers, body, tilt frame, or tailgate are extended above the minimum overhead clearance requirements, or which could create a hazardous driving condition during transit. Visual devices, when used, shall be located in the drivers scan. Audible warnings, when used, shall be distinct.

**ANSI Z245.1 – 1999 standard for Equipment Technology
and Operations for Wastes and Recyclable Materials**