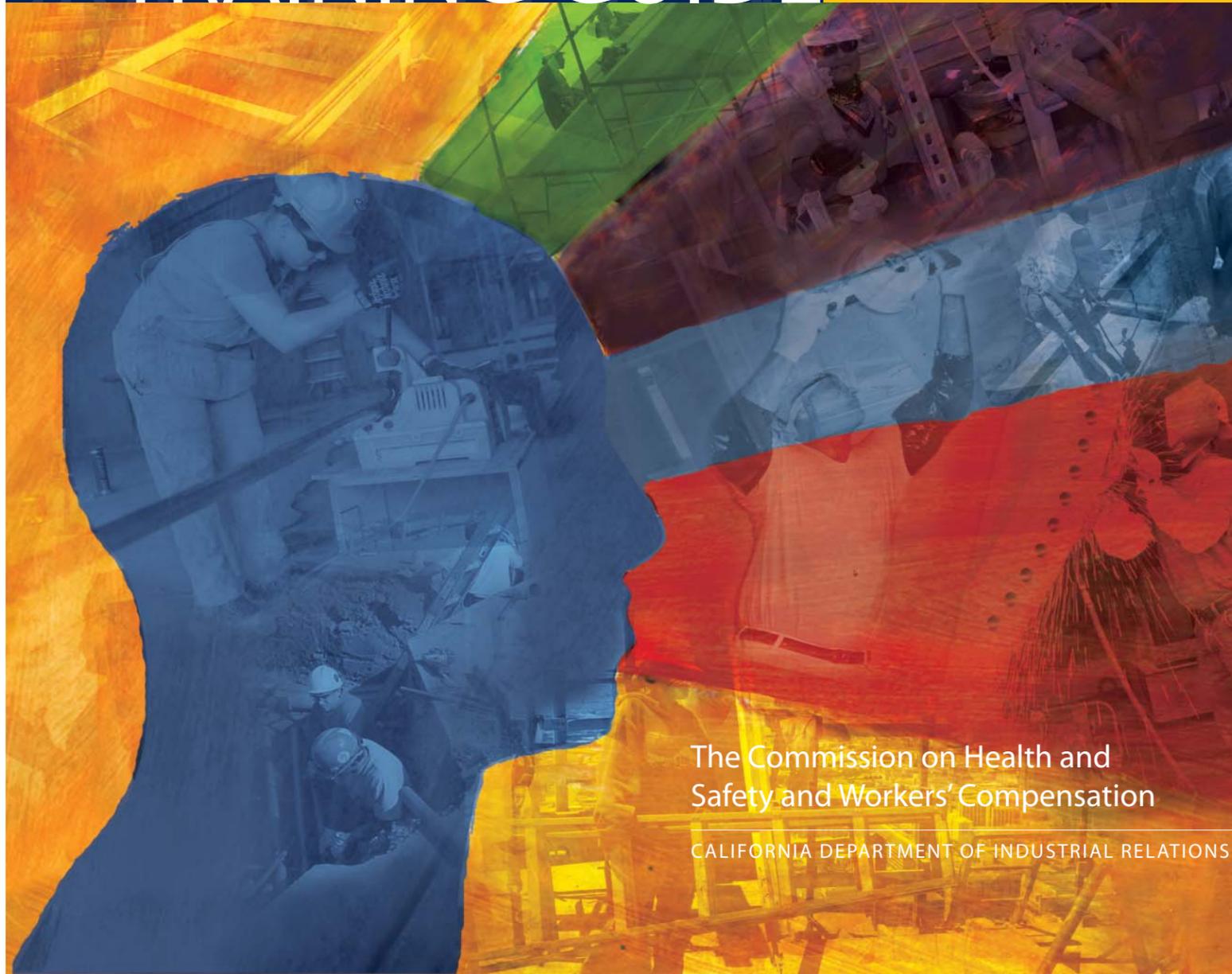


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SKILLS, PREVENT

# CONSTRUCTION CASE STUDY TRAINING GUIDE

## TRAINING GUIDE



The Commission on Health and  
Safety and Workers' Compensation

CALIFORNIA DEPARTMENT OF INDUSTRIAL RELATIONS

*The Construction Case Study Training Guide* was developed by the Labor Occupational Health Program (LOHP) at the University of California Berkeley, the Labor Occupational Safety and Health (LOSH) program at the University of California at Los Angeles (UCLA), and the State Building and Construction Trades Council of California (SBCTC), AFL-CIO.

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*A special thanks to the construction journeymen and apprentices who spent time reviewing these case studies.*

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# Introduction to the Guide

## TO THE TRAINER:

Analyzing case studies that describe real events where a worker was injured or killed at work can serve as an effective method for engaging workers in a discussion about the causes of these injuries and solutions for preventing similar occurrences. This Guide presents the stories of 13 construction workers who were injured, made sick, or killed on the job while involved in tasks common to conventional and green construction.

Each case study has been prepared as a teaching tool that encourages discussion about ways to prevent the fatal occupational injury, non-fatal occupational injury, or serious occupational illness described from occurring again. The facts of the case are summarized in a story that workers from across the building trades can relate to. Under the guidance of an instructor, trainees determine what went wrong in the example and think of ways in which the incident could have been prevented. Answers to the questions are provided on the reverse side of the page. When possible, actual findings from the investigating agency are included so that trainees can compare their ideas with what was actually determined in the official report.

Many of the case studies in this Guide are based on reports to the National Institute for Occupational Safety and Health's (NIOSH) Fatality Assessment and Control Evaluation (FACE) Program. NIOSH funds state FACE programs around the country which identify and investigate work-related fatalities in order to learn about the hazards and conditions that lead to serious injuries at work. California's FACE program is housed at the Occupational Health Branch in the California Department of Public Health. By studying the underlying causes of injuries and illnesses, more effective ways for employers and workers to prevent these work-related incidents in the future can be developed.

You can get more information about many of the case studies included in this Guide by going online to the website listed at the end of the question and answer section of the case study. If the case is based on a FACE report, the FACE report number will also be provided.

Construction is a high hazard industry and construction workers engage in activities that may expose them to serious hazards. Construction has about 5% of U.S. workers, but 18% of the fatalities—the largest number of fatalities reported for any industry sector. (Bureau of Labor Statistics, 2009)

## CASE STUDY TOPICS

The Guide includes case studies related to the following construction hazards:

- Caught-In (two case studies)
- Electrical (three case studies)
- Inadequate Emergency Response (one case study)
- Falls (two case studies)
- Heat Stress/Heat Illness (one case study)
- Musculoskeletal Injury (one case study)
- Noise Exposure (one case study)
- Silica Dust (one case study)
- Struck-by (one case study)

# Using Case Studies in your Training

The case studies, discussion questions and answers can be used in a variety of ways, depending upon the amount of time available for teaching. These include:

- **As ice breakers:** Begin a safety training session or meeting with a case study to get the attention of participants and introduce specific topics.
- **As part of tailgate training:** A case study can make these short, targeted, on-the-job trainings more focused and interesting to a work crew by showing what happened to peers facing similar immediate hazards and risk factors.
- **To augment existing comprehensive training programs:** Mandatory training can be enhanced by inserting actual stories that reinforce the message and create interactive discussion among participants. In a classroom setting where resources (such as audio/visual equipment, props, safety equipment, display boards, flip charts) are available, case studies, especially those with photos or diagrams, can be analyzed in detail to reinforce key points of safety topics.

Before teaching from this Guide, decide whether you want to make copies of the case study(ies) to hand out to your trainees or just read aloud the story(ies) and questions and answers.

## Teaching Tips When Using Case Studies

### KEEP IT RELEVANT

Choose case studies that best fit the key, targeted topic. If you don't find one here, go to the "Resource" section for more options. Or you can create your own case study. Go to the "Writing Construction Case Studies" section of this guide, Appendix A.

### KNOW YOUR AUDIENCE

Evaluate the needs of your target audience and choose a case study that best fits the group. For example, contractors will have very different perspectives and responsibilities than apprentices. Are you addressing new or experienced construction workers? What level of decision-making power do participants have? What level of safety training have they already received?

### PLAN AHEAD

Prepare yourself in advance for leading a discussion of the case(s) you choose. Identify your specific training goal and how the key points and risk factors in the case(s) relate to that topic and reinforce your goal. Anticipate possible solutions, concerns, and questions that may be generated by the group and be ready to address them. Make sure you have copies of handouts, additional materials, photos, demonstration tools/equipment on hand for your training. Know which solutions you want to focus on and what behavior you want to highlight.

### CONSIDER LITERACY/LANGUAGE/EDUCATION LEVELS

Literacy is a critical factor in delivering effective training and goes hand-in-hand with knowing your audience. Choose a case study with content that is appropriate for your participants' level of understanding. Show respect for participants by leading discussions in a way that is comprehensible to the entire audience—neither above nor below their level of experience. When leading group activities, know who may have limited literacy skills and be sure someone reads the story aloud or make other accommodations so that they can fully participate in the exercise. Plan ahead for non-English-speaking audiences by having a facilitator who knows the relevant language or by arranging for translation. Remember that some common construction terminology does not translate directly to other languages; identify those terms and how to convey the key concepts before training.

### ENCOURAGE PARTICIPATION

Case studies are a great way to get people to interact with one another and generate energy and interest during training. A general question/response dialog in which you review the case as a group and participants volunteer answers to questions prompted by the instructor is one way of doing this. If time allows, it is effective to break a class into small sub-groups and have each group analyze a case study. Then reconvene to share ideas among the whole class. Both methods elicit interaction, camaraderie, and problem-solving skills.

### SHARE STORIES

After discussing a case study, allow participants to contribute their own safety stories. Construction workers generally have a strong bond among peers and often learn from shared experiences in their trade. Also, in a multi-craft group, these stories can promote new ideas for trainees about how to work and support each other at a job site.

*If you decide to write your own case study, consult the tips in Appendix A of this Guide, page 44.*

# Case Studies

## Solar Panel Installer Dies from Fall

On the day of the incident, a worker and his co-worker were carrying and installing electrical solar panels on the roof of a warehouse. The roof contained skylights which were marked by the manufacturer as “tested in accordance with OSHA fall protection standards.” There are currently no uniform test criteria to determine material strength of skylights to withstand worker impact.



The general contractor reviewed the job safety requirements, including the fall protection plans. Based on the information that the skylights had been tested in accordance with OSHA standards, no other fall protection measures were implemented at the job site.

The solar panels were boxed and placed on the roof by a crane. Each panel was approximately two feet wide by four feet long and weighed 24 pounds. The worker and co-worker were carrying two panels at a time. As they approached a skylight, they had to maneuver around it with only 18 inches of clearance. The worker turned and walked backwards, tripping on the raised edge of the skylight. He landed on the skylight in a sitting position and then, without warning, fell through the plastic dome glazing. As the worker started to fall, the co-worker reached out and tried to grab his foot but was unable to reach him in time. The worker fell approximately 40 feet to the warehouse floor below. Numerous workers with radios immediately called the office to report the incident and those with cell phones immediately called 911. The paramedics and fire department responded within minutes. The worker was pronounced dead at the scene.

### What went wrong in this situation?

### How could this incident have been prevented?

## Solar Panel Installer Dies from Fall

### ANSWERS

#### What went wrong in this situation?

- The General Contractor assumed that fall protection was unnecessary.
- No fall protection methods were used.
- Workers were not trained in proper materials handling while working on a roof.

#### How could this incident have been prevented?

- Develop, implement and enforce a fall protection program to prevent falls through skylights. There are currently no uniform test criteria to determine the material strength of skylights to withstand worker impact. Such test criteria would include analysis of the degradation of plastic or plastic-containing materials after several years of sun exposure and the ability to withstand a point impact. One organization, ASTM International, is currently developing such testing guidelines. **At this time, employers should not assume that manufacturer testing ensures that a particular skylight can sustain the impact and weight of a worker. In order to prevent falls through skylights, employers should prepare, implement and maintain a fall protection program that includes:**
  - Skylight screens capable of safely supporting 400 pounds or twice the weight of the workers plus equipment and materials (whichever is greater), or
  - Guardrails around the skylight at least 45 inches in height with a top rail and mid rail which should be half way between the bottom surface and top rail. The rails should be able to withstand a live load of 20 pounds per square foot.
- If these two methods are not feasible, then the use of personal fall protection should be utilized. A personal fall protection system consists of a body harness, lanyard and anchor points. Had any of these fall protection methods been used at this job site, the worker would not have fallen through the skylight to the ground below.
- Pre-planning to assess all risk factors before work begins.
- Training in how to work safely.

### SOURCE

California FACE Report #09CA003

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Iron Worker Dies After Falling Off Beam

A 42-year-old structural iron worker foreman died when he fell 38 feet from a steel roof beam to the floor below while working on a warehouse that was under construction. The company was installing the final bar joist (structural steel beam) in the roof of a new cold storage warehouse. After a crane lifted the beam into place, it was not quite straight and the iron worker foreman wanted to use a beater (30# double sided hammer) to straighten it. The area where the foreman needed to work had been barricaded with wire rope safety lines on all four sides but he removed these lines to gain access. He was not using fall protection equipment. The foreman was standing on a portion of roof decking that had already been completed. To get to the beam, he reached his left foot out over an open un-decked area of the roof. He rested his left foot on the nearest joist girder. As he was preparing to strike a blow with the hammer, his foot slipped off the girder. His hands caught the bar joist but he couldn't hold on and fell.



**What went wrong in this situation?**

**How could this incident have been prevented?**

## Iron Worker Dies After Falling Off Beam

### ANSWERS

**What went wrong in this situation?**

- Safety lines were removed.
- The crew was working on an open, un-decked area of the roof.
- The iron worker was not using fall protection.

**How could this incident have been prevented?**

Cal/OSHA investigated this incident and made the following recommendations to employers:

- Require everyone working at heights to wear fall protection equipment and require that they are properly trained on how to use it.
- Make sure openings are properly covered or otherwise protected.
- If possible, provide alternate means of access to the work, such as an aerial lift (zoom boom).
- Provide Tailgate and/or other types of training on the proper way to install a bar joist.

SOURCE

**California FACE Report 98CA010**

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Construction Laborer Run Over by Front-end Loader

A 19-year-old male construction laborer, performing the duties of a grade checker and directing traffic at a construction site, was inadvertently backed over by a front-end loader and killed. The worker had entered the moving equipment's immediate work area. The equipment operator lost sight of him. The front-end loader's backup alarm was not working at the time of the incident. The worker had never received formal comprehensive safety training. The company did not have a written code of safe practices that covered the hazards of working in close proximity to moving heavy equipment.



### What went wrong in this situation?

### How could this incident have been prevented?

## Construction Laborer Run Over by Front-end Loader

### ANSWERS

#### What went wrong in this situation?

- The equipment operator lost sight of the checker because the laborer had gotten too close to the front-end loader.
- The front-end loader's backup alarm was not working.
- The checker had never received formal comprehensive safety training.
- The company did not have a written code of safe practices that covered working close to moving heavy equipment.
- There was no spotter in the area to watch out for workers working near machinery.
- Worker was doing two jobs at once.

#### How could this incident have been prevented?

In order to prevent future occurrences, as part of an Injury and Illness Prevention Program\* (IIPP), employers need to:

- Ensure that workers remain out of the immediate area where heavy equipment is operating.
- Ensure that when visual contact is lost with workers on foot, the equipment operator stops the heavy equipment and does not resume until visual contact is re-established.
- Ensure that the equipment being used has a working back-up alarm. (Equipment without a working back-up alarm should be removed.)
- Ensure that the IIPP includes a written code of safe practices on all hazards associated with the work being performed.
- Train workers to make eye contact with the operator before entering the work area. "If you can't see them-they can't see you."

\* See the Resource section for more information on Cal/OSHA's IIPP.

#### SOURCE

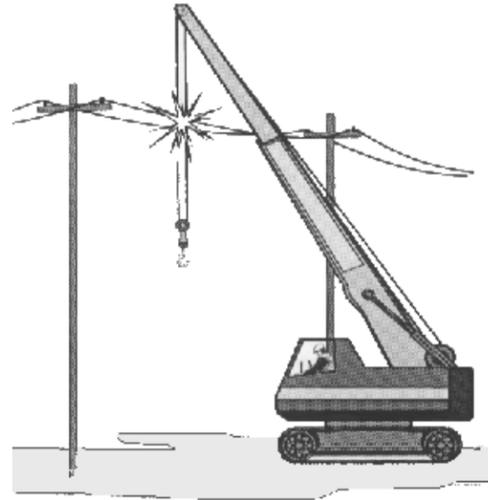
California FACE Report #02CA010

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Laborer Electrocuted by Energized Crane

A 26-year-old construction laborer was electrocuted when he tripped and came into contact with an energized crane. The crane had become energized through accidental contact with a high-voltage line overhead.

The laborer's job on the day of the incident had been to assist the crane operator in lifting plywood to the second story of a residential structure. The crane was in an area with both telephone and high-voltage lines, and the crane operator was aware of them. Earlier in the day, the crane had brushed against telephone lines and had to be repositioned. However, at this time in the late afternoon, the operator's vision of the high-voltage lines was obstructed because of the sun's position. The main hoist line was being used to attempt the lift. In the process, the auxiliary line of the crane made contact with the high-voltage line. The auxiliary line burned in two and the ball/hook assembly fell to the ground. The voltage was 16,000 volts. The laborer was carrying a choker (wire rope) over to be used to attach a pile of plywood to the crane's hook. The crane operator and laborer were both startled by the fall of the ball/hook assembly. The boom of the crane momentarily drifted, contacting the high-voltage line directly. At the same moment, the laborer tripped and the choker he was holding brushed against the corner of the energized crane electrocuting the laborer.



Cardiopulmonary resuscitation was immediately administered by co-workers until paramedics arrived. However, the laborer was pronounced dead at the scene.

### What went wrong in this situation?

### How could this incident have been prevented?

## Laborer Electrocuted by Energized Crane

### ANSWERS

#### What went wrong in this situation?

- Working too close to high-voltage lines.
- There was no communication between the operator and the laborer.
- The crane operator's vision of the high-voltage line was blocked by the sun.
- The crane had become energized through accidental contact with a high-voltage line overhead. The auxiliary line burned in two and the ball/hook assembly crashed to the ground.
- The laborer tripped and the choker he was holding came into contact with the energized crane.
- No barricades were used around the work zone.
- No spotter on site to watch out for workers working around machinery and vehicles.

#### How could this incident have been prevented?

Cal/OSHA investigated this incident and made the following recommendations to employers:

- Provide information to workers on what kinds of hazards to look for and how to avoid them.
- Develop and implement strict safety procedures when working with a crane in the vicinity of high-voltage power lines. Never operate a crane within 10 feet of high-voltage lines. Higher voltage may require greater clearances.
- Contact the local electric power company and have the power turned off when working within a certain distance of high-voltage power lines or have the lines insulated.
- Use barricades.
- Ensure that a spotter is present when working around energized power lines.

### SOURCE

California FACE Report #CA006

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Plumber Dies When Trench Collapses

A 35-year-old male plumber died when the trench he was working in caved in around him. The worker was in the trench connecting a residential sewer line to a sewer main when the incident occurred. The trench was seven feet deep and was not shored, benched or sloped. The area where the trench was located had been dug up before by other utilities. The soil that was removed from the trench was placed next to the edge of the trench. The company had shoring, but it was not available at this job site. The worker had been hired two days before the incident occurred and had not yet been to the company's orientation and safety training.



### What went wrong in this situation?

### How could this incident have been prevented?

## Plumber Dies When Trench Collapses

### ANSWERS

#### What went wrong in this situation?

- The trench was seven feet deep and was not shored, benched, sloped or shielded.
- Doesn't appear to be a Competent Person (see definition below) was on site.
- The area where the trench was located had been dug up by other utilities and the soil was left next to the edge of the trench.
- The worker was a new hire and had not received any safety training or a safety orientation.

#### How could this incident have been prevented?

In order to prevent future occurrences, employers, as part of their Injury and Illness Prevention Program (IIPP), are required to:

- Ensure that workers do not enter trenches deeper than five feet without the benefit of shoring, benching, sloping or shielding (unless it is in solid rock).
- Ensure that the excavated soil from a trench is a minimum of 2 feet away from the edge of a trench.
- Ensure that workers receive safety training before they are assigned hazardous work.
- Ensure that a competent person conducts inspections at the start of the work and as needed throughout the day.

*Note: A "Competent" Person has the ability to analyze and classify soils. The competent person conducts inspections related to excavation and trenching.*

### SOURCE

**California FACE Report #05CA002**

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Weatherization Worker Gets Electrocuted

On a hot, humid day, a two-man weatherization crew arrived at a two-story home to blow cellulose insulation into the attic and then install roof vents. They were aware of overhead power lines in front of the home and planned the job with that danger in mind.

Because the home is attached to other structures on each side, the workers could only access the home from the front or rear. After inspecting the exterior of the house, the two men determined that the best way to enter the attic was to cut a hole in the roof. The men used an extension ladder to reach the roof. One worker, who wore sneakers, stood on the front sidewalk facing the center of the house and steadied the aluminum extension ladder by holding it upright with both of his hands at shoulder height and his feet on either side of the ladder. His partner, who was standing on the porch roof, used a rope to fully extend the ladder to 32 feet. He stood with his back to the house, facing his co-worker. As he pulled the rope, he looked up but did not see that the ladder had hit the wire and sparked. He heard his partner call his name and then saw him shaking. He pulled the rope to release the worker from the ladder and the electrical contact. According to the medical examiner, death was caused by electrocution.



### What went wrong in this situation?

### How could this incident have been prevented?

## Weatherization Worker Gets Electrocuted

### ANSWERS

#### What went wrong in this situation?

- The workers were working too close to a power line and were using a metal ladder.
- The employer did not ensure that the subcontractor or workers implemented a hazard assessment plan.
- The employer did not ask the power company to de-energize the lines or request insulating sleeves.

#### How could this incident have been prevented?

- Safety hazards should be identified by the general contractor before the work takes place and in written instructions to the subcontractor; how to reduce exposure to the hazards should be addressed. The power company representative who inspects the house should look for electrical and other potential hazards in advance and inform the subcontractor about them.
- If it is determined that there is a potential for equipment to come into contact with energized power lines, the utility company should be asked to de-energize the lines or to provide insulating sleeves over the energized power lines. You must still maintain proper clearance (6 feet for ladders) even when insulators are used.
- Provide safety training that informs workers about potential hazards to which they may be exposed, particularly when working near overhead power lines.
- According to OSHA, portable metal ladders may not be used in areas in which they may make contact with electrical conductors. Fiberglass and dry wood ladders are better non-conductors.
- Make sure workers, their tools and building materials are a safe distance (at least 10 feet for most work) from high-voltage power lines.
- Have a third person as a spotter when workers are working close to power lines to watch for potential hazards.

*\*Note to instructor: You should be prepared to discuss electrocution and how the human body is affected by electrical currents.*

### SOURCE

New Jersey FACE Report #90NJ013 (formerly NJ9009)  
<http://www.nj.gov/health/eoh/survweb/face.htm>

## Wind Turbine Tower Collapses Crushing Worker

In 2007, a man died at a wind farm under construction in Oregon in what is believed to be the first death of a worker from the collapse of a wind power tower in the United States. Three wind technicians were performing maintenance on a wind turbine tower. The technicians working on the turbine each had less than two months' experience and there was no supervisor on site.



After applying a service brake to stop the blades from moving, one of the workers entered the hub of the turbine. He then positioned all three blades to the maximum wind-resistance position and closed all three energy isolation devices on the blades. The devices are designed to control the mechanism that directs the blade pitch so that workers don't get injured while they are working in the hub.

Before leaving the confined space, the worker did not return the energy isolation devices to the operational position. As a result, when he released the service brake, an over speed condition caused one of the blades to strike the tower. The tower then buckled and collapsed, crushing and killing the worker. The second worker, who was on his way down a ladder inside the turbine, was injured. The third worker outside the tower was unharmed.

### What went wrong in this situation?

### How could this incident have been prevented?

## Wind Turbine Tower Collapses Crushing Worker

### ANSWERS

#### What went wrong in this situation?

- The workers were not properly instructed and supervised in the safe operation of the machinery, tools, or equipment they were authorized to use. The workers were unaware of the potential for catastrophic turbine failure if the blades were not properly restored to their operational position.
- The company's procedures for controlling potentially hazardous energy during service or maintenance activities did not fully comply with OSHA regulations regarding developing, documenting, and applying lockout (LO) or tagout (TO) devices to secure hazardous energy in the "safe" or "off" position during service or maintenance. Several energy isolation devices in the towers (valves and lock pins) were not designed to hold a lockout device, and energy control procedures in place at the time of the incident did not include the application and removal of TO devices. The LO/TO plan should also include the proper steps to follow to put the equipment back into service.
- The workers who were required to enter the hub (a permit-required confined space) or act as attendants to workers entering the hub had not been trained in emergency rescue procedures.
- No supervisor was onsite. Workers had less than 2 months of experience on the job.

#### How could this incident have been prevented?

- Train workers on the safe operation of wind turbine machinery and about confined spaces and emergency rescue procedures. Have a safety plan in place.
- The company's procedures should comply with OSHA regulations. LO/TO procedures should be developed and applied. Wind turbine equipment should be designed for LO/TO devices.
- Design and implement a checklist of proper procedures to follow when servicing a wind turbine tower. Have a copy of the procedures on the job site.
- The wind turbine system should be designed to prevent any operator from restarting the turbine while the blades are locked in a hazardous position.
- A supervisor should be onsite or available by radio/phone.

### SOURCE

#### OR-OSHA report

[www.windaction.org/?module=uploads&func=download&fileId=1518](http://www.windaction.org/?module=uploads&func=download&fileId=1518)

## Brick Mason Exposed to Silica Dust

A brick mason was removing deteriorating mortar from bricks in a building that was being renovated. To control the spread of dust, he was using a Vacuum Dust System that included a grinder shroud, a vacuum, a vacuum hose, and filters. His employer had also provided him with a respirator. The brick mason was not allowed to wet down the work area because his employer was worried about water damage to the interior of the building.



After several days of work, the brick mason started to develop wheezing and shortness of breath. He went to his physician who told him that his symptoms were most likely caused by the silica dust. He informed his employer who subsequently hired an outside firm to collect air samples of the work area. The samples contained about 200 times the NIOSH Recommended Exposure Limit (REL) for crystalline silica. The type of respirator the worker was wearing had an Assigned Protection Factor (APF) of 25, which provided protection from hazardous concentrations only up to 25 times the NIOSH REL.

**What went wrong in this situation?**

**How could this exposure have been prevented?**

## Brick Mason Exposed to Silica Dust

### ANSWERS

#### What went wrong in this situation?

- The employer did not provide the right type of respirator to the brick mason.
- The employer did not have an effective respiratory protection program (the worker was unaware that his respirator was ineffective).
- The employer did not conduct monitoring to evaluate the dust vacuum system.
- The worker was not allowed to use a wet method (where water is sprayed at the source of the silica dust generation thus reducing the dust that can become airborne).

#### How could this exposure have been prevented?

- Provide the right type of respirator to workers exposed to silica.
- Have a written respiratory protection program that includes job site-specific procedures, such as selection of respirators, medical evaluation, fit testing, proper usage, maintenance and care of respirators, and training.
- Have ongoing exposure monitoring to ensure that controls are working properly and the appropriate level of respiratory protection is being used.

## Emergency at a Construction Site

Four laborers were installing underground PVC in trenches. There were two journeymen and two apprentices. The foreman was working on site but at a distant location.

Early one morning, the crew was told that the job was running behind schedule. As they rushed to put the pipes together, one end of a PVC pipe sprang up and struck one of the apprentices in the face, causing severe damage to the apprentice's lips and teeth.

Immediately after the incident, the workers could not decide what to do. The injured worker climbed out of the trench and drove to the supervisor's trailer looking for the foreman. There were no signs posted inside the trailer stating what to do in an emergency. There wasn't a radio available to contact the foreman. The injured worker drove around the job site looking for the foreman. Once the foreman was located, he got the worker medical treatment.



**What went wrong in this situation?**

**How could this emergency have been prevented?**

## Emergency at a Construction Site

**ANSWERS**

**What went wrong in this situation?**

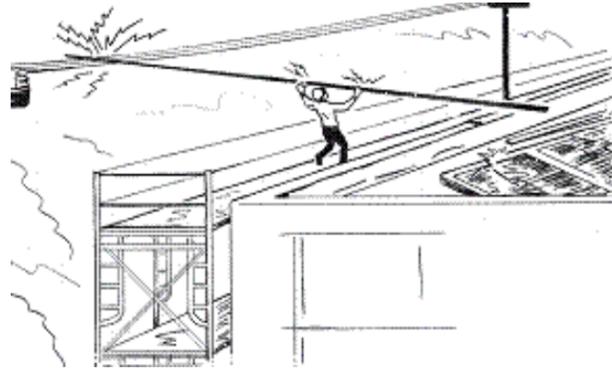
- The workers were not trained in emergency procedures.
- There should have been clearly posted signs in the trailer about what to do in case of an emergency.
- No one at the job site was trained in first aid.
- The workers did not have a radio on site to contact the foreman.
- The pace of production took priority over safety.

**How could this emergency have been prevented?**

- Before work begins, there should always be a clear plan of action regarding what to do in an emergency.
- Train workers in emergency procedures.
- Post signs on what to do and whom to call in an emergency.
- Have someone trained and available to administer first aid on the job site.
- Have first aid materials available on the job site.
- Ensure that a foreman is accessible. If the foreman is not at the job site, a radio should be available to contact him/her.

## Solar Technician Electrocuted From Contact with Overhead Power Line

A solar technician and two co-workers were installing a solar panel system on a building. Their supervisor had instructed them to strap a solar hot water tank to the roof using a 20-foot aluminum bracket. The crew tied rope around the bracket and climbed an existing scaffold at the rear of the building. The technician, positioned at the top of the scaffold, pulled the rope to raise the bracket. As he lifted the bracket to the top of the building, he turned it to a horizontal position. In the process, the bracket came in contact with high-voltage electrical lines that were 10 feet away from the scaffold. He was electrocuted and fell 35 feet to his death.



The Spanish-speaking technician had been in the United States for five years. For the past two years, he had worked off and on as a solar technician for a solar energy contractor. The contractor on this job had a safety program with written safety policies and instructions on how to work safely for most tasks, including lifting materials. However, not all of the policies and instructions were written in Spanish. There was also a solar training program that included either classroom instruction from solar equipment manufacturer representatives or on-the-job training from experienced solar technicians. The solar training covered some electrical hazards, but did not include hazard recognition and safe work procedures around high-voltage electrical lines.

### What went wrong in this situation?

### How could this incident have been prevented?

## Solar Technician Electrocuted From Contact with Overhead Power Line

### ANSWERS

#### What went wrong in this situation?

- The material the worker was carrying was not at least 6 feet away from the high-voltage line; 10 feet is better.
- The contractor should have conducted a job site analysis before the work began to identify potential safety problems.
- The technician wasn't informed of potential job site hazards, like working near overhead power lines.
- Not all of the safety policies and information were provided in Spanish.

#### How could this incident have been prevented?

Solar energy contractors should:

- Make sure workers, their tools and building materials are a safe distance (at least 10 feet for most work) from high-voltage power lines.
- Conduct a daily job hazard analysis of the work area, including any electrical hazards from high-voltage power lines.
- Establish and maintain safety programs that include electrical hazard recognition, including high-voltage power lines.
- Develop and implement strict safety procedures when working around high-voltage power lines.
- Contact the local electric power company and have the power turned off when working within a certain distance of high-voltage power lines or ask that insulating sleeves be used over the energized power lines.
- Translate all safety materials to Spanish and ensure that any new workers receive training on hazards, including how to work safely around high-voltage power lines.

\*Note: Under Cal/OSHA regulations, employers are required to provide safety training and materials in a language that workers can understand.

### SOURCE

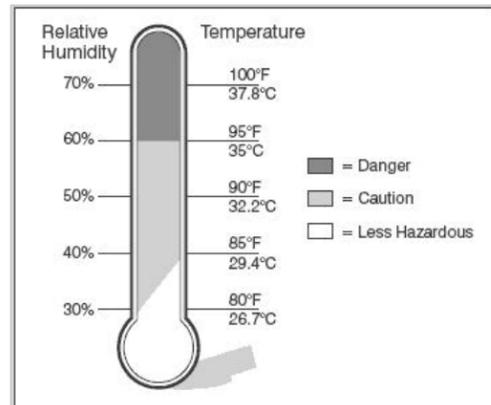
California FACE Report #08CA006

[www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx](http://www.cdph.ca.gov/programs/ohb-face/Pages/FACEReports.aspx)

## Construction Laborer Dies from Heat Stroke

A 16-year-old construction company, which primarily laid pipe, poured concrete and built foundations and walls, was contracted to expand a manufacturing facility. Workers on the job site usually numbered from 9 to 15, but on this day, only 6 workers (including the job foreman) were at the job site. The temperature that day was 90 degrees Fahrenheit and the dew point was a humid 69 degrees. There was water available at the work site for the workers to drink. The laborers took their morning, lunch and afternoon breaks in the air-conditioned construction trailer on site.

A certified welder had been hired by the construction company that day to work as a laborer sawing 2 x 4 boards in varying lengths to make wooden forms. He had only been on the job one day. Working in the direct sunlight, he wore a hard hat and tool pouch and used a hammer, a sledge hammer and a saw. He was dressed in heavy blue jeans, a tee-shirt and a long-sleeved heavy shirt. It was observed at lunch that the laborer did not eat, but did drink water. He worked until 5:00 pm, and was in the parking lot on his way to his vehicle when he apparently collapsed beside his vehicle. Another worker found him on the ground and reported it to his supervisor. One of the first witnesses on the scene observed the laborer's heart beating through his shirt and his body jerking. The ambulance arrived and transported the laborer to a hospital where he was admitted with a temperature of 108 degrees Fahrenheit. He died at the hospital the next day due to heat stroke.



### What went wrong in this situation?

### How could this incident have been prevented?

## Construction Laborer Dies from Heat Stroke

### ANSWERS

#### What went wrong in this situation?

- A job that normally requires 16 people was done with 6 people. People were probably working quickly to get the job done. It's not clear if all the workers took all of their breaks during the day.
- The workers should have had extra rest breaks in hot conditions.
- Apparently there was no training on heat illness (i.e., symptoms of heat illness, acclimatization, proper hydration, proper clothing, shade, rest breaks, etc.).
- The new construction laborer did not have time to acclimatize to the heat. The amount of time he spent in the direct sun should have been reduced.

#### How could this incident have been prevented?

- Provide heat illness prevention training to supervisors and workers.
- Give workers frequent breaks in high heat to avoid dehydration and heat stress/stroke.
- Adjust work hours to accommodate environmental work conditions such as high heat and/or high humidity. When high temperatures are predicted, consider changing work hours to accommodate the weather. Instead of working in the heat of the day, work hours could be changed from 6:00 am to 2:30 pm, or at a time when heat and humidity exist at a lower level.
- Work hours for the laborer should have been adjusted to allow him to slowly acclimatize to the heat and humidity.
- Besides drinking plenty of fluids, workers should wear light colored clothing and fabrics that wick away moisture from the skin.
- Provide shade over the work area so the worker does not have to work in the direct sunlight.

### SOURCE

#### Kentucky FACE report #03KY053

Go to the following website for more information: <http://www.kiprc.uky.edu>.

This case study was from another state, Kentucky. California has a Heat Illness standard that employers must follow in construction. For a copy of the standard, go to: <http://www.dir.ca.gov/title8/3395.html>

## Laborer Hurts Back

For the two weeks that a laborer had been on the job, he worked at digging a trench with a shovel every day. He had not received any training on ergonomics or proper lifting techniques, including proper body positioning while shoveling. After several days, he began to notice twitches and pain in his lower back. He didn't want to report it because he was a new hire and wanted to prove that he could do the work. At the end of the second week, he couldn't get out of bed one morning because of the pain in his lower back. When he stood up, he felt a shooting pain down his right leg.



**What went wrong in this situation?**

**How could this incident have been prevented?**

## Laborer Hurts Back

### ANSWERS

**What went wrong in this situation?**

- There was no training on ergonomics, proper lifting techniques, or ways to shovel properly to prevent back injuries. The worker twisted his back while shoveling.
- The worker was shoveling for two weeks without a break—the employer did not rotate the job.
- The worker did not report pain in his lower back for fear of losing his job. Therefore, he did not get early medical treatment.

**How could this incident have been prevented?**

Ways for employers and workers to prevent back injuries:

- Provide training on repetitive strain injuries, proper lifting, and proper work procedures (like shoveling).
- Rotate workers so that they are not doing the same task over and over again.
- Workers should take rest breaks when they are tired.
- Workers should stretch and warm up before work starts. The goal is to slightly elevate the heart rate and get blood flowing to the muscles as well as to the discs between the vertebrae in the spine.

**Ways to minimize twisting while shoveling:**

- When lifting, put your weight on your front foot.
- Before throwing, shift your weight to your rear foot.
- When throwing, turn your front foot in the direction of the throw.

## Operating Engineer Suffers Hearing Loss

An operating engineer who operated heavy equipment for many years was having ringing/buzzing in his ears. He was also having problems understanding what people were saying if there was a lot of loud background noise, like at a noisy restaurant. His employers at various construction sites provided hearing protection for workers, but he didn't think he needed it because he was just operating equipment. He had never received any training about hearing loss or how to use hearing protection. None of his employers provided hearing testing. His wife told him to go to a doctor to get his hearing checked. When he finally went, the doctor ordered audiometric testing. The engineer found out that he had significant hearing loss in his left ear and mild hearing loss in his right ear.



**What went wrong in this situation?**

**How could this have been prevented?**

## Operating Engineer Suffers Hearing Loss

**ANSWERS**

**What went wrong in this situation?**

- The worker did not receive any training about the dangers of long-term exposure to noise or how to recognize if a work environment is too loud.
- The worker did not get trained by his employers on the need for hearing protection or how to properly use and care for it; therefore, he did not use it.
- The employer did not monitor noise on the job site.
- The worker did not report the ringing/buzzing in his ears (tinnitus) and did not know that it could be an early symptom of hearing loss.
- The employer did not enforce a hearing protection program.

**How could this have been prevented?**

- Train workers on the dangers of exposure to noise and hearing loss.
- Provide training on the importance of using hearing protection and how to use it properly.
- Provide audiometric testing on an annual basis (not required in construction, but it is recommended).
- Use appropriate hearing protection.

## General Resources

### Cal/OSHA

<http://www.dir.ca.gov/dosh/>

Cal/OSHA is a division of California's Department of Industrial Relations whose mission is to protect the health and safety of California's workers. It is divided into three main parts: The Division of Occupational Safety and Health (DOSH) enforces the state's regulations and provides technical assistance to employers and employees to help employers comply with the regulations; the California Occupational Safety and Health Standards Board, establishes regulations to help keep workers safe and healthy; and the Occupational Safety and Health Appeals Board hears appeals from employers who have received a citation from a DOSH inspector. Cal/OSHA Consultation, the part of DOSH that provides technical assistance, has created many helpful guides to workplace hazards which you can find for free on this website under the Publications link.

### Cal/OSHA's Injury and Illness Program (IIPP) for construction

In California, every employer is required by the Cal/OSHA to provide and maintain a safe and healthful workplace. To help employers achieve this, employers are required by section 3203 of the General Industry Safety Orders to have an effective Injury and Illness Prevention Program (IIPP) in writing. The construction industry has a few other specific requirements listed in section 1509 of the Construction Safety Orders. An IIPP must include: the employer's assignment of responsibilities; a two-way safety communications system with employees; a system for assuring employee compliance with safe work practices; scheduled inspections and an evaluation system to identify hazards; accident investigation procedures; procedures for correcting unsafe/unhealthy conditions; safety and health training and instruction; and recordkeeping and documentation.

As additional safeguards for construction workers, the Construction IIPP requires employers to adopt a few other protections specific to their work sites. They must post a Code of Safe Practices at each job site, hold periodic meetings of supervisors to discuss the safety program and accidents that have occurred, and require supervisors to conduct tailgate or toolbox safety meetings at least every ten working days.

Cal/OSHA has an e-tool to help employers start creating an IIPP at <http://www.dir.ca.gov/dosh/etools/09-031/how.htm>. Construction industry employers need to remember to include the additional requirements for the Construction IIPP listed above and at: <http://www.dir.ca.gov/title8/1509.html>.

### Cal/OSHA Construction Pocket Guide, for the Construction Industry

OSHA 2011

[http://www.dir.ca.gov/dosh/dosh\\_publications/ConstGuide8x11Online.pdf](http://www.dir.ca.gov/dosh/dosh_publications/ConstGuide8x11Online.pdf)

**Commission on Health and Safety and Workers' Compensation (CHSWC)**

<http://www.dir.ca.gov/chswc/>

CHSWC, a joint labor-management unit, is made up of four members that represent workers and four that represent employers. CHSWC's mission is to examine the health and safety and workers' compensation systems in California and to recommend changes when appropriate. It conducts ongoing studies and makes recommendations to improve the workers' compensation system and the state's activities to prevent job injuries. These studies, reports, and issues papers are freely available online at their website.

**Construction Chart Book**

CPWR – The Center for Construction Research and Training 2007

<http://www.cpwr.com/rp-chartbook.html>

**Construction eTool**

OSHA 2009

<http://www.osha.gov/SLTC/etools/construction/index.html>

**Construction Industry Compliance Page**

OSHA 2010

<http://www.osha.gov/doc/compliance.html>

**Construction Solutions Database**

CPWR – The Center for Construction Research and Training

<http://www.cpwrconstructionsolutions.org/>

This database gives users suggestions for controlling hazards in a wide variety of construction jobs. It describes the level of risk, offers assessment information, and provides solutions along with information on their effects on productivity and more.

**eLCOSH-Electronic Library of Construction Occupational Safety and Health**

CPWR – The Center for Construction Research and Training 2007

<http://www.elcosh.org/en/>

A rich source of useful materials arranged by hazard, trade, job site, training materials, images, Spanish language materials, and more.

**Pocket Guide for the Construction Industry**

Cal/OSHA 2007

[http://www.dir.ca.gov/dosh/dosh\\_publications/ConstGuide8x11Online.pdf](http://www.dir.ca.gov/dosh/dosh_publications/ConstGuide8x11Online.pdf)

# CONSTRUCTION-SPECIFIC RESOURCES

## CRUSHED-BY/STRUCK-BY

**Operating Heavy Equipment**

CPWR Hazard Alert 2004

<http://www.cpwr.com/hazpdfs/OpHyvyEq.pdf>

**Struck-By e Tool**

OSHA Construction e Tool (note at bottom of page says: page current as of 2009)

<http://www.osha.gov/SLTC/etools/construction/struckby/mainpage.html>

## ELECTRICAL

**Electrical Incidents eTool**

OSHA Construction eTool (note at bottom of page says: page current as of 2009)

[http://www.osha.gov/SLTC/etools/construction/electrical\\_incidents/mainpage.html](http://www.osha.gov/SLTC/etools/construction/electrical_incidents/mainpage.html)

**Electrical Safety: Safety and Health for Electrical Trades Student Manual**

NIOSH 2009

<http://www.cdc.gov/niosh/docs/2009-113/default.html>

**Electric Safety in Construction for Non-Electricians**

CPWR Hazard Alert 2002

[http://www.cpwr.com/pdfs/pubs/hazard\\_alerts/kfelectrocutions.pdf](http://www.cpwr.com/pdfs/pubs/hazard_alerts/kfelectrocutions.pdf)

**High Voltage Overhead Lines**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/tb\\_highvoltage.html](http://www.dir.ca.gov/dosh/dosh_publications/tb_highvoltage.html)

**Working Safely Around Downed Electrical Wires**

OSHA Factsheet

[http://www.osha.gov/OshDoc/data\\_General\\_Facts/downed\\_electrical\\_wires.pdf](http://www.osha.gov/OshDoc/data_General_Facts/downed_electrical_wires.pdf)

**Working Safely with Electricity**

OSHA Factsheet

[http://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/elect\\_safety.pdf](http://www.osha.gov/OshDoc/data_Hurricane_Facts/elect_safety.pdf)

## EMERGENCY RESPONSE

**Principle Emergency Response and Preparedness: Requirements and Guidance**

OSHA 2004 (Section V is devoted to construction)

<http://www.osha.gov/Publications/osha3122.pdf>

**ERGONOMICS****Checklist for the ergonomic evaluation of nonpowered hand tools.**

Occup Environ Hyg 2004 Dec; 1(12):D135-D145

<http://www.elcosh.org/record/document/796/d000745.pdf>

**Ergonomic Guidelines for Manual Material Handling**

Cal/OSHA 2007

[http://www.dir.ca.gov/dosh/dosh\\_publications/mmh.pdf](http://www.dir.ca.gov/dosh/dosh_publications/mmh.pdf)

**Ergonomic Survival Guide for Carpenters and Framers**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/erg\\_CarpFramer.pdf](http://www.dir.ca.gov/dosh/dosh_publications/erg_CarpFramer.pdf)

**Ergonomic Survival Guide for Cement Masons**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/CErg\\_CementMasons.pdf](http://www.dir.ca.gov/dosh/dosh_publications/CErg_CementMasons.pdf)

**Ergonomic Survival Guide for Electricians**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/ElectriciansErgo.pdf](http://www.dir.ca.gov/dosh/dosh_publications/ElectriciansErgo.pdf)

**Ergonomic Survival Guide for Laborers**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/Erg\\_Laborer.pdf](http://www.dir.ca.gov/dosh/dosh_publications/Erg_Laborer.pdf)

**Ergonomic Survival Guide for Sheet Metal Workers**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/CErg\\_SheetMetal.pdf](http://www.dir.ca.gov/dosh/dosh_publications/CErg_SheetMetal.pdf)

**Keys to Success and Safety for the Construction Foreman: An Ergonomic Approach to Cost Reduction**

Cal/OSHA

[http://www.dir.ca.gov/dosh/dosh\\_publications/foremanweb.pdf](http://www.dir.ca.gov/dosh/dosh_publications/foremanweb.pdf)

**Proceedings from a Meeting to Explore the Use of Ergonomics Interventions for the Electrical and Mechanical Trades**

NIOSH 2006

<http://www.cdc.gov/niosh/docs/2006-119/default.html>

Proceedings from a 2-day meeting involving researchers, contractors and trades people representing the piping (or plumbing), heating and air-conditioning and electrical sectors of the U.S. construction industry. Results include risk factors and injury or illness data for the mechanical and electrical trades, as well as ergonomics “best-practices” examples from participants.

**Simple Solutions: Ergonomics for Construction Workers**

NIOSH 2007

<http://www.cdc.gov/niosh/docs/2007-122/>

**FALLS****Fall-Protection Harnesses**

CPWR Hazard Alert 2004

[http://www.cpwr.com/pdfs/pubs/hazard\\_alerts/hazharnesses.pdf](http://www.cpwr.com/pdfs/pubs/hazard_alerts/hazharnesses.pdf)

**Falls**

OSHA Construction eTool 2009

<http://www.osha.gov/SLTC/etools/construction/falls/mainpage.html>

**Cal/OSHA Portable Ladder eTool**

<http://www.dir.ca.gov/dosh/etools/08-001/index.htm>

**Preventing Falls**

OSHA Factsheet

[http://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/fall.pdf](http://www.osha.gov/OshDoc/data_Hurricane_Facts/fall.pdf)

**Preventing Falls of Workers Through Skylights and Roof and Floor Openings**

NIOSH 2004

<http://www.cdc.gov/niosh/docs/2004-156/>

**Portable Ladder Safety**

CPWR Hazard Alert 2004

[http://www.cpwr.com/pdfs/pubs/hazard\\_alerts/hazladders.pdf](http://www.cpwr.com/pdfs/pubs/hazard_alerts/hazladders.pdf)

**Roofing Safety: Slips and Falls**

Cal/OSHA 2006

[http://www.dir.ca.gov/dosh/dosh\\_publications/RoofSlip.pdf](http://www.dir.ca.gov/dosh/dosh_publications/RoofSlip.pdf)

## HEAT STRESS

### Heat Illness Prevention

Cal/OSHA 2010

<http://www.dir.ca.gov/DOSH/HeatIllnessInfo.html>

### Heat Stress in Construction

CPWR Hazard Alert 2005

<http://www.cpwr.com/hazpdfs/hazheat.pdf>

### Protecting Workers from the Effects of Heat

OSHA Factsheet

[http://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/heat\\_stress.pdf](http://www.osha.gov/OshDoc/data_Hurricane_Facts/heat_stress.pdf)

## NOISE/HEARING LOSS

### Construction Noise

CPWR Hazard Alert 2003

[http://www.cpwr.com/pdfs/pubs/hazard\\_alerts/kfnoise.PDF](http://www.cpwr.com/pdfs/pubs/hazard_alerts/kfnoise.PDF)

### Effectiveness of Hearing Protection Among Construction Workers

Journal of Occupational and Environmental Hygiene, 2005 April 2: 227–238

[http://staff.washington.edu/rneitzel/HPD\\_effectiveness.pdf](http://staff.washington.edu/rneitzel/HPD_effectiveness.pdf)

Study includes carpenters, cement masons, electricians, heat/frost/asbestos insulation workers, Iron Workers, masons, operating engineers, and sheet metal workers.

### NIOSH Hearing Loss Research Program Review

[http://www.cdc.gov/niosh/nas/hlr/wdpd\\_stragGoal3\\_3.html](http://www.cdc.gov/niosh/nas/hlr/wdpd_stragGoal3_3.html)

### Noise and Hearing Damage in Construction Apprentices

Noah S. Seixas, PhD, Principal Investigator, University of Washington; September, 2004

Funded by the National Institute for Occupational Safety and Health

[http://staff.washington.edu/rneitzel/NIPTS\\_final\\_report.pdf](http://staff.washington.edu/rneitzel/NIPTS_final_report.pdf)

### Occupational Noise and Hearing Conservation

School of Public Health and Occupational Medicine, University of Washington

<http://depts.washington.edu/occnoise/>

Here you can find a series of brochures for various construction trades and occupational noise, including electricians, ironworkers, masonry restoration workers, bricklayers, and supervisors

with details on the noise levels generated by various tools and data on exposure levels for each trade. You can also view their final report: Noise Exposure and Hearing Protection Use Among Construction Workers in Washington State, September 2004 at [http://depts.washington.edu/occnoise/content/Noise\\_HPDPDF.pdf](http://depts.washington.edu/occnoise/content/Noise_HPDPDF.pdf)

### Prospective noise induced changes to hearing among construction industry apprentices.

Occup Environ Med 2005;62:309-317

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1741009/pdf/v062p00309.pdf>

## PERSONAL PROTECTIVE EQUIPMENT

### Personal Protective Equipment

OSHA 2003

<http://www.osha.gov/Publications/osha3151.pdf>

## SILICA EXPOSURE/RESPIRATORS

### Assigned Protection Factors for the Revised Respiratory Protection Standard

OSHA 2009

<http://www.osha.gov/Publications/3352-APF-respirators.pdf>

### Controlling Silica Exposures in Construction

OSHA 2009

<http://www.osha.gov/Publications/3362silica-exposures.pdf>

### Health Effects of Occupational Exposure to Respirable Crystalline Silica

NIOSH 2002

<http://www.cdc.gov/niosh/docs/2002-129/02-129a.html>

### Respirators QuickCard

OSHA 2005

[http://www.osha.gov/OshDoc/data\\_Hurricane\\_Facts/respirators.pdf](http://www.osha.gov/OshDoc/data_Hurricane_Facts/respirators.pdf)

### Silica

CPWR Hazard Alert 2004

[http://www.cpwr.com/pdfs/pubs/hazard\\_alerts/KFsilica.pdf](http://www.cpwr.com/pdfs/pubs/hazard_alerts/KFsilica.pdf)

### Silica Hazard Alert

Cal/OSHA 2008

[http://www.dir.ca.gov/dosh/dosh\\_publications/P08-019V3.pdf](http://www.dir.ca.gov/dosh/dosh_publications/P08-019V3.pdf)

## APPENDIX A

## Tips for Writing an Effective Case Study

*Adapted from: Handbook for a Train-the-Trainer Program, AFL-CIO Department of Education*

Case studies describe events and situations in which decisions are made. The object of the case study is to present information about a situation that workers and employers can use to solve a real life problem.

While the case studies found in this guide were created from various injury and fatality reports, you may find that your own work experience in the construction industry could make good case studies that are relevant to your own trade. When developing a case study from something that happened to you or a co-worker, there are some guidelines to follow. The bullet points below will serve as a template for translating your own experience into a teaching tool for other construction workers and employers.

### Qualities of a good case study:

- Must be relevant and interesting.
- Portrays a real life situation.
- Contains enough specifics and details for workers to get engaged.
- Must be easy for workers to identify with so they can see themselves in the shoes of the individual(s) in the case.
- Should promote discussion about problems and solutions.

### Writing tips:

- Start with a good title. The title should indicate the problem being explored in the case study.
- Be objective. A good case study reveals all the factors that may have contributed to the incident including root causes (or underlying causes that might not be immediately obvious). Case studies are not designed to assign individual blame but to analyze ways to prevent future incidents.
- Explain what led up to the incident with as much relevant detail as possible, but don't get bogged down with too many details.
- When possible, use facts and numbers to give background information. You can use specifics from the California FACE Fatality report.
- Write up case studies from your own experiences on the job.

- Write in an easy-to-read format, keeping literacy in mind. Be descriptive and clear.
- Use photos or illustrations. Be sure they are clear and easy to understand so they contribute to the case study.
- For case studies, focus on the following:
  1. What caused the incident identified in the case study?
  2. How could the incident be prevented? Include ideas of what workers and contractors can do.

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[www.lohp.org](http://www.lohp.org)