COST OF ACCIDENTS: WHY SAFETY IS IMPORTANT?

LEARNING OBJECTIVES

- Summarize the cost of accidents in the United States on an annual basis.
- List the most common causes of accidental deaths in the United States.
- Compare and contrast accidental deaths with other causes of death.
- Explain the costs and rates of workplace accidents.
- Describe how much time is lost on the job annually due to workplace accidents.
- Describe how many deaths typically occur on the job annually.
- List the most common injuries by type of accident.
- List the death rates by industry in order from highest to lowest.
- List the most common types of accidents that occur on construction jobs sites.
- Explain what is most disturbing about chemical burn injuries in construction.
- Explain the special challenge to construction professionals posed by heat burn injuries.
- Demonstrate how to estimate the cost of accidents.
- Explain how to use *Construction Solutions Database* to improve safety in construction.
- Explain how Building Information Modeling can help improve safety in construction.

Accidents and the corresponding damage they cause to employees, property, equipment, and morale can have a detrimental effect on a construction company's profit and loss statement. Although it can be difficult to measure precisely the economic impact of accidents, the impact is significant.

There is a long history of debate in this country concerning the effect of accidents on industry (the workers and the companies) and the cost of preventing accidents. Historically, the prevailing view was that accident-prevention programs were too costly. The more contemporary view is that the accidents are too costly and that **accident prevention** makes sense economically. As a result, accident prevention, which had been advocated on a moral basis, is now justified also in economic terms.

Accidents are the fourth leading cause of death in this country after heart disease, cancer, and strokes. This ranking is based on all types of accidents, including motor vehicle accidents, **drownings**, fires, **falls**, **natural disasters**, and work-related accidents.

Although deaths from natural disasters tend to be more newsworthy than workplace deaths, their actual impact is substantially less. For example, natural disasters cause fewer than 100 deaths per year on average. **Workplace accidents**, on the other hand, cause more than 10,000 deaths every year in the United States.[1] The following quote from the National Safety Council (NSC) puts workplace accidents and deaths in the proper perspective, notwithstanding their apparent lack of newsworthiness.

> In less time than it takes to read this chapter two people will be killed in America and another 170 will be seriously injured. The costs of these deaths and injuries will approach $3 million. On average accidental deaths in the United States exceed 10 every hour and injuries exceed 1,000 every hour (24 hours a day and seven days a week).[2]

This chapter provides prospective and practicing construction professionals with the information they need to have a full understanding of workplace accidents and their effect on industry in the United States, which helps professionals to play a more effective role in keeping both management and labor focused appropriately on safety and health in the workplace.

COST OF ACCIDENTS

To gain a proper perspective on the economics of workplace accidents, we must view them in the context of all accidents. The overall cost of accidents in the United States is approximately $800 billion annually. This includes **lost wages**, **medical expenses**, **insurance administration**, **fire-related losses**, **property damage**, and **indirect costs**.

As Figure 1–1 reminds us, workplace accidents are costly. When the costs of the most common accidents are broken down by categories, construction accidents are second only to motor vehicle accidents as the following list shows:

- Motor vehicle accidents (approximately $725 billion annually)
- Workplace accidents (approximately $50 billion annually)

FIGURE 1–1 Workplace accidents are costly.
Source: Photographee.eu/Fotolia

- Home accidents (approximately $20 billion annually)
- Public accidents (approximately $13 billion annually)

As Figure 1–2 illustrates, the costs of accidents and injuries are both direct and indirect. Accident costs in a typical year can be seen in the following list:

- Wages lost (approximately $40 billion annually)
- Medical expenses (approximately $25 billion annually)
- Insurance administration (approximately $30 billion annually)
- Motor vehicle damage (approximately $30 billion annually)
- Fire losses (approximately $10 billion annually)
- Indirect costs (approximately $25 billion annually)

This list shows that the highest cost of accidents and injuries is in wages lost to workers. The category of indirect losses from work accidents consists of costs associated with responding to accidents (i.e., giving first aid, filling out accident reports, handling work slowdowns).

Clearly, accidents on and off the job cost U.S. industry dearly. Every dollar spent responding to accidents is a dollar that could have been reinvested in modernization, employee training, and other competition-enhancing activities.

FIGURE 1–2 Accident costs are direct and indirect.
Source: Rukxstockphoto/Fotolia

ACCIDENTAL DEATHS IN THE UNITED STATES

Accidental deaths in the United States result from a variety of causes, including motor vehicle accidents, falls, **poisoning**, drowning, fire-related injuries, **suffocation** (ingested object), firearms, **medical complications**, air transport accidents, injuries from machinery, **mechanical suffocation**, and the impact of falling objects. The NSC periodically computes death totals and **death rates** in each of these categories. The statistics for a typical year are as follows:

- *Motor vehicle accidents.* As the leading cause of accidental deaths in the United States every year, this category includes deaths resulting from accidents involving mechanically or electrically powered vehicles (excluding rail vehicles) that occur on or off the road. In a typical year, there are approximately 47,000 deaths from motor vehicle accidents in the United States.
- *Falls.* This category includes all deaths from falls except those associated with transport vehicles. For example, a person who is killed as a result of falling while boarding a bus or train would not be included in this category. In a typical year, there are approximately 13,000 deaths in the United States from falls.
- *Poisoning.* This category is divided into two subcategories: (1) poisoning by solids and liquids and (2) poisoning by gases and vapors. The first category includes deaths that result from the ingestion of drugs, medicine, recognized solid and liquid poisons, mushrooms, and shellfish; it does not include poisoning from spoiled food or *Salmonella* species. The second category includes deaths caused by incomplete combustion (e.g., gas vapors from an oven or unlit pilot light) or from carbon monoxide (e.g., exhaust fumes from an automobile). In a typical year, there are approximately 6,000 deaths in the first category and 1,000 in the second.
- *Drowning.* This category includes work-related and nonwork-related drowning incidents, but excludes those associated with floods or other natural disasters. In a typical year, there are approximately 5,000 deaths from drowning in the United States.
- *Fire-related injuries.* This category includes deaths from burns, asphyxiation, and falls, as well as from being struck by falling objects in a fire. In a typical year, there are more than 4,000 deaths resulting from fire-related injuries in the United States.

- *Suffocation (ingested object).* This category includes deaths from the ingestion of an object that blocks the air passages. In many such deaths, the ingested object is food. In a typical year, there are approximately 4,000 such suffocation deaths in the United States.
- *Firearms.* This category includes deaths that result when recreational activities or household accidents that involve firearms result in death. For example, a person killed in the home while cleaning a firearm would be included in this category; however, a person killed in combat would not be included. In a typical year, there are approximately 2,000 deaths in this category in the United States.
- *Others.* This category includes deaths resulting from medical complications arising out of mistakes made by health-care professionals, air transport injuries, interaction with machinery, mechanical suffocation, and the impact of falling objects. In a typical year, there are more than 14,000 deaths overall in these subcategories.[3]

ACCIDENTS VERSUS OTHER CAUSES OF DEATH

Although there are more deaths every year from heart disease, cancer, and strokes than from accidents, these causes tend to be concentrated among people at or near retirement age. Among people 37 years of age or younger—prime working years—accidents are the number one cause of death, Figure 1–3. The following list shows deaths by category for people between 25 and 44 years of age—the prime working age group (notice that the leading cause of deaths is accidents):

- Accidents (approximately 30,000 annually)
- Cancer (approximately 21,000 annually)
- Heart disease (approximately 16,000 annually)
- Motor vehicle (approximately 17,000 annually)
- Poison (approximately 3,000 annually)
- Drowning (approximately 1,500 annually)
- Falls (approximately 1,200 annually)
- Fire related (approximately 1,000 annually)

FIGURE 1–3 Accidents are a leading cause of disability and death to people of prime working age.
Source: Vladimirfloyd/Fotolia

Figure 1–3 shows that accidents represent a serious detriment to productivity, quality, and competitiveness in today's workplace. Yet accidents are the one cause of death and injury that companies can most easily control. Although it is true that companies may have some success in decreasing the incidence of heart disease and stroke among their employees through activities such as wellness programs, their impact in this regard is limited. However, employers can have a significant impact on preventing accidents.

WORK ACCIDENT COSTS AND RATES

Workplace accidents cost employers millions every year. For example, one company—the steel-making division of USX—once paid a $3.25 million fine to settle numerous health and safety violation citations.

This example shows the cost of fines only. In addition to fines, employers incur costs for safety corrections, medical treatment, survivor benefits, death and burial costs, and a variety of indirect costs. Clearly, work accidents are expensive. However, the news is not all bad. The trend in the rate of accidents is downward.

Work **accident rates** in this century are evidence of the success of the safety movement in the United States. As the amount of attention given to workplace safety and health has increased, the accident rate has decreased.

> Accident rates have fallen significantly over the years due to advances brought about by the safety movement. For example, in 1912 approximately 21,000 workers were killed on the job in the United States. Now with a workforce that is more than three times the size of the 1912 workforce that number is down to approximately 10,000 annually.[4]

However, the cost of these 10,000 deaths is approximately $50,000.[5]

Although statistics are not available to document the supposition, many safety and health researchers believe that the major cost of accidents and injuries on the job results from damage to morale. Employee morale is a less tangible factor than measurable factors, such as **lost time** and medical costs. However, it is widely accepted among management professionals that few factors affect productivity more than employee morale. Employees with low morale do not produce up to their maximum potential, which is why so much time and money are spent every year to help supervisors and managers learn different ways to help improve employee morale.

Since few things are so detrimental to employee morale as seeing a fellow employee injured, accidents can have a devastating effect. Whenever an employee is injured, his or her colleagues silently think, "that could have been me," in addition to worrying about the employee. Morale is damaged even more if the injured employee is well-liked and other employees know his or her family.

TIME LOST BECAUSE OF WORK INJURIES

An important consideration when assessing the effect of accidents on industry is the amount of time lost due to work injuries.[6] According to the NSC, approximately 35 million hours are lost in a typical year as a result of accidents. This is actual time lost from disabling injuries and does not include additional time lost for medical checkups after the injured employee returns to work. Accidents that occurred in previous years often continue to cause lost time in the current year.

DEATHS IN WORK ACCIDENTS

Deaths on the job have decreased markedly over the years. However, they still occur. For example, in a typical year, there are 10,400 work deaths in the United States. The causes of death in the workplace vary. They include those related to motor vehicles, falls, electric current, drowning, fires, air transport, poison, water transport, machinery, falling objects, rail transports, and mechanical suffocation,[7] Figure 1–4.

WORK INJURIES BY TYPE OF ACCIDENT

Work injuries can be classified by the type of accident from which they result. The following are the most common causes of work injuries:

- Overexertion
- Impact accidents
- Falls
- Bodily reaction (to chemicals)
- Compression
- Motor vehicle accidents
- Exposure to radiation or caustic chemicals
- Rubbing or abrasions
- Exposure to extreme temperatures

Overexertion, the result of employees working beyond their physical limits, is the leading cause of work injuries. According to the NSC, almost 31 percent of all work injuries are caused by overexertion. The second leading cause, **impact accidents,** involves a worker being struck by or against an object. The next most prominent cause of work injuries is falls.[8] The remaining accidents are distributed fairly equally among the other causes just listed.

FIGURE 1–4 Falls are a leading cause of injuries in construction.
Source: Soja Andrzej/Fotolia

DEATH RATES BY INDUSTRY

A variety of agencies and organizations, including the Bureau of Labor Statistics, National Center for Health Statistics, and NSC, collect data on death rates within industrial categories.[9] Such information can be used in a variety of ways, not the least of which is in assigning workers' compensation rates. The most widely used industrial categories are agriculture, including farming, forestry, and fishing; mining and quarrying, including oil and gas drilling and extraction; construction; manufacturing; transportation and public utilities; trade, both wholesale and retail; services, including finance, insurance, and real estate; and federal, state, and local government.

When death rates are computed on the basis of the number of deaths per 100,000 workers in any given year, the industry categories rank as follows (from highest death rate to lowest):

1. Mining and quarrying
2. Agriculture
3. Construction
4. Transportation and public utilities
5. Government
6. Manufacturing
7. Services
8. Trade

The construction industry ranks third in workplace deaths, but first in workplace injuries. The rankings sometimes change slightly from year to year. For example, agriculture and mining and quarrying may exchange the first and second ranking in any given year. This is also true at the lowest end of the rankings, with services and trade. However, generally, the ranking is as shown.

COMMON ACCIDENT EXAMPLES ON CONSTRUCTION SITES

Experience has shown that certain types of accidents are common on construction sites. What follows are representative examples of the types of accidents that occur every year on construction sites:

- Victim fell from a scaffold 60 feet to a concrete surface
- Victim was buried in an excavation
- Victim was crushed between two backhoes
- Victim was working on a circuit breaker when he was electrocuted
- Victim was struck in the head by a crane that was moving
- Victim was installing roofing and fell 40 feet to the ground
- Victim was welding a water tank when the tank collapsed on him
- Victim was backed over by a dump truck
- Victim was working on a platform that collapsed
- Victim was operating a nail gun when his foot was impaled
- Victim was operating a power saw when he cut off a finger
- Victim was hit in the head by a falling object
- Victim sprained his back while attempting to pick up a heavy box
- Victim slipped and fell on a wet spot on a concrete subfloor
- Victim was severely burned when he spilled a barrel containing a toxic chemical

These are just a few examples of the types of workplace accidents that occur on construction sites every year in the United States. The important point to remember is that every one of these accidents could have and can be prevented.

PARTS OF THE BODY INJURED ON THE JOB

To develop and maintain an effective safety and health program, it is necessary to know not only the most common causes of death and injury but also the parts of the body most frequently injured.

Typically, parts of the body prone to injury are as follows (from most frequent to least):

1. Back
2. Legs and fingers
3. Arms
4. Trunk
5. Hands
6. Eyes, head, and feet
7. Neck, toes, and body systems

This ranking shows that one of the most fundamental components of a safety and health program should be instruction on how to lift without hurting the back.[10]

CHEMICAL BURN INJURIES

Chemical burn injuries are a special category with which prospective and practicing construction professionals should be familiar. The greatest incidence of chemical burns occurs in construction and manufacturing.[11]

The chemicals that frequently cause burn injuries include acids and alkalis; soaps, detergents, and cleaning compounds; solvents and degreasers; calcium hydroxide (a chemical used in cement and plaster); potassium hydroxide (an ingredient in drain cleaners and other cleaning solutions); and sulfuric acid (battery acid). Almost 46 percent of all chemical burn injuries occur while workers are cleaning equipment, tools, and vehicles.[12]

What is particularly disturbing about chemical burn injuries is that a high percentage of them occur despite the use of personal protective equipment (PPE), the provision of safety instruction, and the availability of treatment facilities. In some cases, the PPE is faulty or inadequate. In others, it is not properly used, despite instructions.

Preventing chemical burn injuries presents a special challenge to construction professionals. The following strategies are recommended:

- Familiarize yourself, the workers, and their supervisors with the chemicals that will be used and the inherent dangers.
- Secure the proper PPE for each type of chemical that will be used.

SAFETY FACTS & FINES

Failure to properly dispose of hazardous materials can be an expensive mistake for construction companies. It can also subject construction professionals to criminal charges. A construction company in Pensacola, Florida, was fined $100,000 and its site superintendent was sentenced to five years of probation when a woman died from exposure to rodent poison left behind at a job site. The site superintendent had been ordered to remove the rodent poison from the job site, but had failed to do so. The company and the site superintendent were charged with failure to properly dispose of hazardous materials.

- Provide instruction on the proper use of PPE, and then make sure that supervisors confirm that the equipment is used properly every time.
- Monitor workers who are wearing PPE, and replace the equipment when it begins to show wear.

HEAT BURN INJURIES

Heat burn injuries present a special challenge to construction professionals in the modern workplace. The most frequent causes are flame (includes smoke inhalation injuries), molten metal, petroleum asphalt, steam, and water. The most common activities associated with heat burn injuries are welding, cutting with a torch, and handling tar or asphalt—all common activities in construction.[13]

Construction professionals who understand the following negative factors that contribute to heat burn injuries in the workplace are in a better position to prevent heat burn injuries.

- Employer has no health and safety policy regarding heat hazards.
- Employer fails to enforce safety procedures and practices.
- Employees are not familiar with the employer's safety policy and procedures concerning heat hazards.
- Employees fail to use or improperly use PPE.
- Employees have inadequate or worn PPE.
- Employees work in too small a space.
- Employees attempt to work too fast or are pushed to work too fast.
- Employees are careless.
- Employees have poorly maintained tools and equipment.[14]

These factors should be carefully considered by construction professionals when developing accident-prevention programs. Employees should be familiar with the hazards, know the appropriate safety precautions, and have and use the proper PPE. Construction professionals should monitor to ensure that safety rules are being followed and that PPE in good condition is being used correctly.

ESTIMATING THE COST OF ACCIDENTS

Even decision makers who support accident prevention must consider the relative costs of such efforts. Clearly, accidents are expensive. However, to be successful, safety-minded construction professionals must be able to show that accidents are more expensive than their prevention. To do this, they must be able to estimate the cost of accidents.

Cost Estimation Method

To have value, a cost estimate must relate directly to the specific company in question. Applying broad industry cost factors does not suffice. To arrive at company-specific figures, the costs associated with an accident should be divided into *insured* and *uninsured* costs.[15]

Determining the insured costs of accidents is a simple matter of examining accounting records. The next step involves calculating the uninsured costs. Simonds recommends that accidents be divided into the following four classes:

- *Class 1 accidents.* Lost workdays, permanent partial disabilities, and temporary total disabilities
- *Class 2 accidents.* Treatment by a physician outside of the company's facility
- *Class 3 accidents.* Locally provided first aid, property damage of less than $100, or the loss of fewer than eight hours of work time
- *Class 4 accidents.* Minor injuries that do not require the attention of a physician, result in property damage of less than $100, and cause less than eight hours of work to be lost[16]

Average uninsured costs for each class of accident can be determined by pulling the records of all accidents that occurred during a specified period and sorting the records according to class. For each accident in each class, record every cost that was not covered by insurance. Compute the total of these costs by class of accident and divide by the total number of accidents in that class to determine an average uninsured cost for each class, specific to the particular company.

Figure 1–5 is an example of how the average cost of a selected sample of Class 1 accidents can be determined. In this example, there were four Class 1 accidents in the pilot study. These four accidents cost the company a total of $554.23 in uninsured costs or an average of $138.56 per accident. Using this information, accurate cost estimates of an accident and accurate predictions can be calculated.

Other Cost Estimation Methods

The costs associated with workplace accidents, injuries, and incidents fall into broad categories, such as the following:

- Lost work hours
- Medical costs
- Insurance premiums and administration
- Property damage
- Fire losses
- Indirect costs

Class of Accident	Accident Number							
Class 1	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Cost A	16.00	6.95	15.17	3.26				
Cost B	72.00	103.15	97.06	51.52				
Cost C	26.73	12.62	—	36.94				
Cost D	—	51.36	—	38.76				
Cost E	—	11.17	—	24.95				
Cost F	—	—	—	13.41				
Cost G	—	—	—	—				
Total	114.73	185.25	112.23	142.02				

Grand Total: $554.23

Average Cost per Accident: $138.56 (grand total 4 number of accidents)

Signature: Date:

FIGURE 1–5 Uninsured costs worksheet form.

Calculating the direct costs associated with lost work hours involves compiling the total number of lost hours for the period in question and multiplying the hours times the applicable loaded labor rate. The loaded labor rate is the employee's hourly rate plus benefits. Benefits vary from company to company, but typically inflate the hourly wage by 20–35 percent. A sample of cost-of-lost-hours computation follows:

$$\text{Employee hours lost (fourth quarter)} \times \text{Average loaded labor rate} = \text{Cost}$$

$$386 \times \$13.48 = \$5{,}203.28$$

In this example, the company lost 386 hours due to accidents on the job in the fourth quarter of its fiscal year. The employees who actually missed time at work formed a pool of people with an average loaded labor rate of $13.48 per hour ($10.78 average hourly wage plus 20 percent for benefits). The average loaded labor rate multiplied times the lost hours reveals an unproductive cost of $5,203.28 to this company.

By studying records that are readily available in the company, a construction professional can also determine medical costs, insurance premiums, property damage, and fire losses for the time period in question. All of these costs taken together result in a subtotal cost. This figure is then increased by a standard percentage to cover indirect costs to determine the total cost of accidents for a specific time period. The percentage used to calculate indirect costs can vary from company to company, but 20 percent is a widely used figure.

FINDING SAFETY SOLUTIONS IN ONLINE DATABASES

Construction professionals have an invaluable tool in their safety tool chest for finding potential solutions to problems that are causing accidents and injuries. This invaluable tool is the Internet, Figure 1–6. An example of an excellent source of potential safety solutions is the *Construction Solutions Database*. This particular database contains strategies for preventing accidents and injuries associated with common construction hazards. It may be found at www.cpwrconstructionsolutions.org.

The database is organized so that users pursue solutions in a systematic, well-organized manner. First, the user identifies the "line of work" in question. Next the specific "task" within that line of work is identified. Then the "hazard" related to the task in question is identified. This is followed by a "hazard analysis" for the user. Finally, the user is provided with potential solutions that have the benefit of having been used and tested. The "Line of Work" box where the database

FIGURE 1–6 The Internet gives construction professionals access to safety databases.

Source: Maksym Yemelyanov/Fotolia

begins contains the following categories of construction work:

- Carpentry
- Drywall, glass, and floor coverings
- Electrical
- Excavation and demolition
- General labor
- Heavy equipment
- Insulation and lagging
- Masonry, tile, cement, and plaster
- Paints and coatings
- Pipes and vessels
- Reinforced concrete
- Residential construction
- Roofing
- Sheet metal and HVAC
- Structural steel

This database and other sites on the Internet give construction professionals the benefit of having access to colleagues from around the world who have faced the same or similar situations they are now facing. Using this database and others is the online version of sitting in a room with seasoned professionals and being able to ask their advice on pressing issues relating to construction safety.

BUILDING INFORMATION MODELING

Building Information Modeling is yet another tool for construction professionals. A **Building Information Model** or **BIM** is a digital representation of the physical and functional aspects of a building. A BIM allows construction professionals to view all aspects of a building before it is even built. As such it can be a powerful tool for construction professionals responsible for preventing accidents and injuries as the building is being constructed. Because a BIM allows construction professionals to observe the virtual construction of a building, it provides the advantage of being able to predict hazardous conditions and predetermine solutions to them. The better systems even allow users to introduce possible scenarios and analyze their potential effect on work-site safety. The goal of safety personnel in using BIM is to identify hazardous conditions before construction begins so they can be either eliminated or planned for, Figure 1–7.

Summary

The approximate cost of accidents in the United Sates is $150 billion annually. This includes the direct and indirect costs of accidents that occur on and off the job.

FIGURE 1–7 Building Information Models can be powerful safety tools for construction professionals.
Source: Yulyla/Fotolia

The leading causes of accidental deaths in the United States are motor vehicle accidents, falls, poisoning, drowning, fire-related injuries, suffocation, firearm injuries, medical complications, air transport accidents, machinery-related injuries, mechanical suffocation, and the impact of falling objects.

The leading causes of death in the United States are heart disease, cancer, and stroke. However, these causes are concentrated among people at or near retirement age. Among people aged 37 and younger, accidents are the number one cause of death. Since 1912, the number of accidental work deaths per 100,000 population has declined by 81 percent—from 21 to 4. The leading causes of death in work accidents are motor vehicle-related, falls, electric current, drowning, fire-related and air transport-related injuries, poisoning, and water transport-related injuries.

Approximately 35 million work hours are lost annually as a result of accidents. This is actual time lost from disabling injuries and does not include additional time lost to medical checkups after the injured employee returns to work.

The leading causes of work injuries are overexertion, impact accidents, falls, bodily reaction, compression, motor vehicle accidents, exposure to radiation and caustic chemicals, rubbing or abrasions, and exposure to extreme temperatures.

When death rates are computed on the basis of the number of deaths per 100,000 workers, the industry categories are ranked as follows (from highest death rate to lowest): mining and quarrying, agriculture, construction, transportation and public utilities, government, manufacturing, services, and trade.

Typically, injuries to specific parts of the body are ranked by frequency as follows (from most frequently injured to least): back; legs and fingers; arms; trunk; hands; eyes, head, and feet; and neck, toes, and body systems.

The chemicals most frequently involved in chemical burn injuries include acids and alkalis; soaps, detergents, and cleaning compounds; solvents and degreasers; calcium hydroxide; potassium hydroxide; and sulfuric acid.

The most frequent causes of heat burn injuries are flame, molten metal, petroleum, asphalt, steam, and water. The Internet makes construction safety solutions easily available to construction professionals. Databases such as the *Construction Solutions Database* can be an important tool for construction professionals looking for specific solutions to specific safety problems, hazards, and situations. Building Information Models can be powerful tools for helping construction safety personnel identify hazardous conditions before construction begins so that those hazards can be either eliminated or planned for.

Key Terms and Concepts

Accident prevention
Accident rate
Accidents
Building Information Model
Chemical burn injuries
Death rates
Drowning
Falls
Fire-related losses
Heat burn injuries
Impact accidents
Indirect costs
Insurance administration
Lost time
Lost wages
Mechanical suffocation
Medical complications
Medical expenses
Natural disasters
Overexertion
Poisoning
Property damage
Suffocation
Work injuries
Workplace accidents

Review Questions

1. What are the leading causes of death in the United States?
2. When the overall cost of an accident is calculated, what elements make up the cost?
3. What are the five leading causes of accidental deaths in the United States?
4. What are the leading causes of death in the United States of people between the ages of 25 and 44?
5. Explain how today's rate of accidental work deaths compares with the rate in the early 1900s.
6. What are the five leading causes of work deaths?
7. What are the five leading causes of work injuries by type of accident?
8. When death rates are classified by industry type, what are the three leading industry types?
9. Rank the following body parts according to frequency of injury from highest to lowest: neck, fingers, trunk, back, and eyes.
10. Name three chemicals that frequently cause chemical burns in the workplace.
11. Identify three factors that contribute to heat burn injuries in the workplace.
12. Explain why a construction professional would use a construction-safety related database.
13. Describe how a construction professional might use a *Building Information Model* to enhance safety at a construction site.

Critical Thinking and Discussion Activities

1. "Nobody can prove with hard data that accidents cost the construction industry more than all of these safety and health regulations we have to deal with," said Mike Flint, CEO of Flint Construction Company. As a recent graduate with a degree in construction technology, you are the newest member of Flint's staff. You are worried about what you have seen at the company's various job sites. There are flagrant safety violations occurring at all of Flint's job sites. In your opinion, it is only a matter of time before a tragedy occurs. What should you say to your CEO to try to convince him that establishing a comprehensive safety and health program makes good business sense?
2. You have made your case about developing a comprehensive safety and health program to your CEO, Mike Flint (see Case 1 above). It is two weeks later, and he has called you into his office to discuss your proposal further. Clearly, Flint has been thinking about what you told him earlier. This time he says, "You claim that back and hand injuries are typically the most common injuries in construction. I believe in zeroing in on the heart of the problem. Why not develop a safety program that targets back and hand injuries and leave out all of these other components you say we need?" You are pleased to have made some progress, but are still concerned that a narrowly focused program might leave the company vulnerable in several other critical areas. What should you do? Start small and hope to expand the program over time, or try once again to convince Flint that a more comprehensive program is needed. Explain your reasoning either way.

Application Activities

1. Find a construction company in your community that will work with you and do the following: (1) determine the most common types of accidents that occur in this company each year and (2) determine the amount of time lost annually because of work injuries.
2. Find a construction company in your community that will work with you or conduct a research project in the library to determine how a specific company calculates the annual cost of accidents.
3. Find an insurance company in your community that provides workers' compensation coverage for construction companies. Meet with a representative of the company and determine the following: (1) What are the most frequently reported injuries when construction workers file claims? and (2) What are the most costly types of claims they receive from construction workers?
4. Go to the construction safety database found at http://www.cpwrconstructionsolutions.org and select a "Line of Work" that interests you (e.g., carpentry). Enter a specific task in that line of work (e.g., building roof joists). Go to the "Hazard" step and respond with the hazard you are concerned about (e.g., falling from heights). Summarize the "Hazard Analysis" and potential solutions offered.

Endnotes

1. National Safety Council, *Accident Facts* (Chicago: NSC, 2016), 37.
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