

Smart Safety Design to Prevent Slips, Trips and Falls

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Introduction

Safety affects everyone and is an integral component to the operations of any corporation. Safety not only affects the way employees and customers view a company, it affects worker productivity, efficiency, and the quality of workmanship employees' provide. All of these factors directly affect sales. Slips, trips and falls have proven to be one of the leading causes of workplace injuries. Floors, walkways and ground surfaces are shown to be the main areas where these accidents occur. Days away from work, litigation and workers compensation caused by slips, trips and falls cost companies billions of dollars each year.

Defining Slips, Trips and Falls

Falls are the result of when a person is too far off balance. There are two types of falls, same-level falls and falls from elevation. Statistics show that the majority of falls (60%) result from slips and trips. The remaining 40% are falls from height, which can include stairs, ladders and platforms (CCOHS 2008). Slips are when a person's shoe slides across a walking surface due to too little traction. Causes of slips include low friction (a static coefficient of friction that is less than 0.4), slippery substances, inadequate footwear and flooring that has different degrees of traction in all areas. Trips are when a person's foot comes in contact with an object or uneven surface, causing imbalance. Trips are caused by uneven or damaged flooring, unexpected increases in friction, objects and an obstructed view. As shown in Table 1, according to the National Floor Safety Institute, flooring is 50% of the reason for slip and fall accidents. The Bureau of Labor Statistics also reports that floors, walkways and ground surfaces are the largest reason for occupational injuries and the main reason for days away from work (as shown in Table 2).

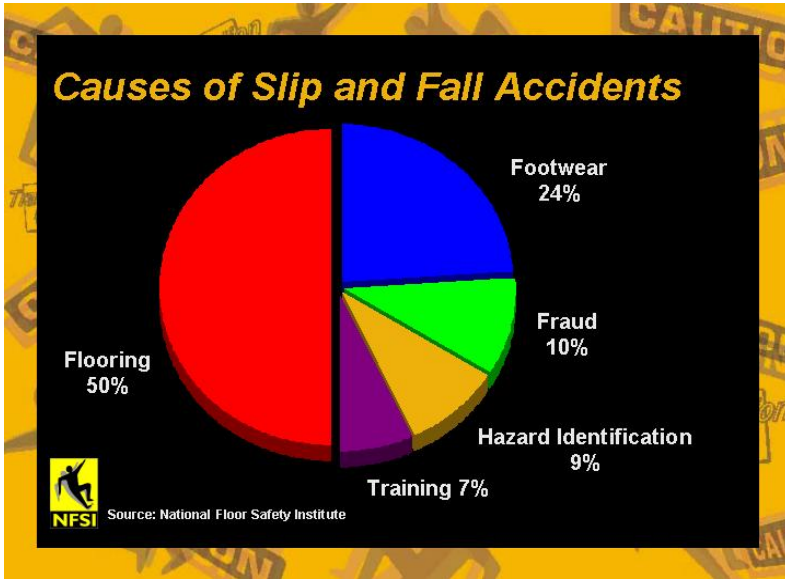


Table 1. National Floor Safety Institute Chart.

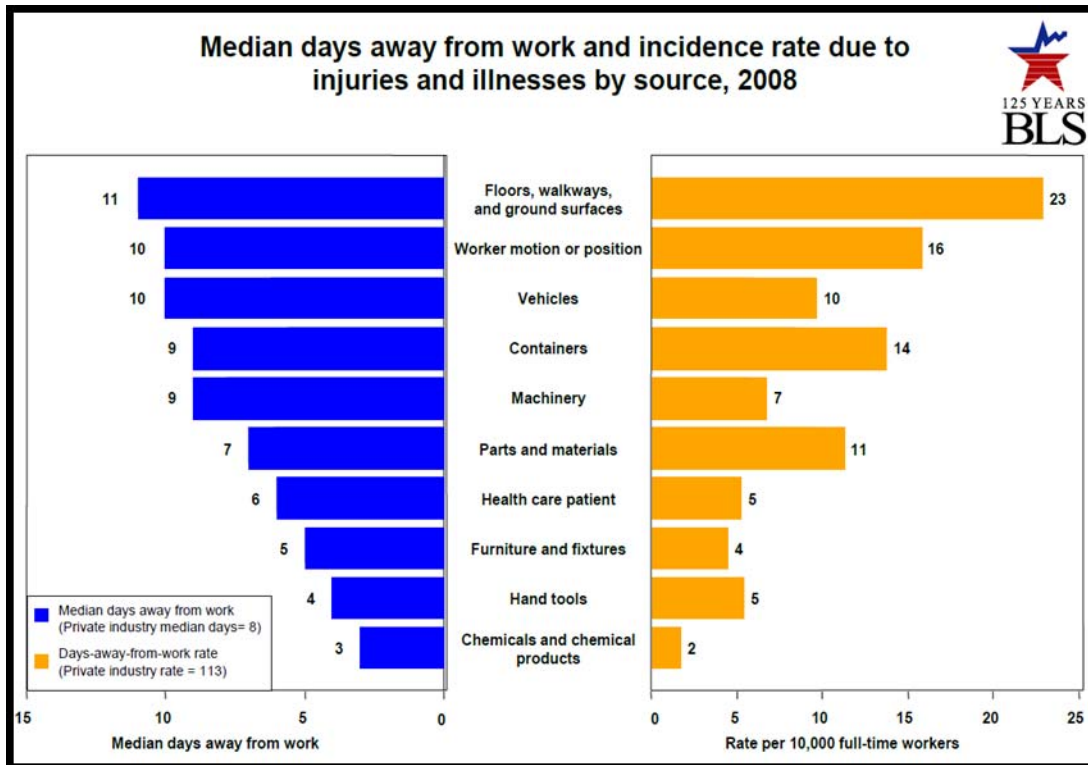


Table 2. Bureau of Labor Statistics Chart.

Coefficient of Friction (COF)

Coefficient of friction (COF) is a measurement most commonly used by regulatory agencies to measure slip resistance. It is the ratio of force causing a body to slide along a plane to the normal force pressing the two surfaces together. There are two types: static and dynamic. Static is the ratio of horizontal force needed to start an object sliding to the force pressing an object normal to the surface. In other words, static coefficient of friction can prevent an object from sliding down a sloped surface. Dynamic, also referred to as kinetic, is the ratio of horizontal force needed to keep an object sliding to the force pressing an object normal to the surface. In other words, the resistance felt when pushing a book across a desk.

American Society for Testing Materials (ASTM)

The American Society for Testing and Materials (ASTM) is an international standards organization that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems and services. There are various standards for measuring coefficient of friction: ASTM 1679 utilizes the English XL, ASTM E303 measures frictional properties for wet and oily surfaces using the British Pendulum Tester, ASTM D2047 measures static coefficient of friction for dry surfaces by utilizing the James Machine, ASTM F1677 uses a portable inclinable articulated strut slip tester for determining slip resistance of footwear against wet, dry and contaminated conditions and ASTM C1028 covers the measurement of static coefficient of friction of surfaces in wet and dry conditions utilizing a neolite sole and a 50lb drag sled.

Test Methods and Machines

Some of the testing methods used to determine coefficient of friction are the English XL Variable Incidence Tribometer, the British Pendulum, the James Machine and the Brungraber Mark. The English XL uses simultaneous application of vertical and horizontal forces, mimicking a human stepping motion. The British Pendulum measures energy loss when the rubber slider is propelled over a test surface. The James Machine measures dry static coefficient of friction of shoe sole and heel materials on controlled walking surfaces. The Brungraber Mark, also known as a portable inclinable articulate strut slip tester, tests dry static coefficient of friction of shoe sole and heel materials on controlled walking surfaces. The Brungraber Mark, in accordance with ASTM F1677, is the most accurate.

Agencies

There are various agencies that use the coefficient of friction measurement to set standards and recommendations for slip resistance. The Occupational Safety and Health Administration (OSHA) makes reference to a 0.5 coefficient of friction and also states that all stair treads shall be reasonably slip resistant and the nosings shall be of a non-slip finish. The Americans with Disabilities Act (ADA) states that general floor surfaces and ramps shall be slip resistant in the standards for accessible design. The act also recommends that flat surfaces have a COF of at least 0.6 and inclined surfaces should have a COF of at least 0.8. The National Floor Safety

Institute (NFSI) and the American National Standard Institute (ANSI) define high traction surfaces as those walking surfaces whose wet static coefficient of friction is greater than 0.6. Underwriters Laboratories define slip resistant surfaces as those that possess a dry (leather) static coefficient of friction that is greater than 0.5.

Costs of Slip and Fall Accidents

Exposing the public to unsafe conditions can lead to injury and/or fatality, bad public relations such as negative press, insurance costs such as increased premiums and ratings, liability and litigation, as well as personal trauma to the person and family. Statistics by the National Safety Council show the average number of days away from work for a slip and fall accident is 38 days and the average cost to defend a slip and fall lawsuit is \$50,000. Also, according to the National Safety Council, slip and fall injuries represent over 65 percent of all work days lost and the average workers' compensation claim per slip, trip or fall is \$20,000.

Industries

Slip and fall accidents can happen on stairways, ladders, platforms, catwalks, platforms, drainage areas, entrance ramps, walkways and many other places. These accidents can occur from ice, oil, waxes, grease, cleaning substances, high traffic and lack of visual contrast, among other possibilities.

Any industry will benefit from safe working and walking surfaces. This includes but is not limited to; the utility, municipal, water / wastewater, transportation, food processing, manufacturing, oil and gas, metal and mining, military, commercial and education industries. The utility and municipal industry should incorporate non-slip products on sidewalk access covers, trench plates, road plates, bridges, manhole covers and ladders to keep pedestrians safe. Water and wastewater facilities may have slippery areas on walkways, areas around sludge tanks, stairways, areas around setting and aerating basins, ladders and applications where grating or plank are required. The transportation industry can utilize slip resistance on road plates, bumper covers, truck lifts, manhole covers, expansion joint covers and transit platforms and steps. Food processing facilities use slip resistant products on mezzanines, processing lines, loading docks, drain covers, floor scales, handrails and any area where fats, oils, water and cleaning solutions are prevalent. Manufacturing and automotive plants should incorporate non-slip products into conveyor lines, machine platforms, assembly lines, catwalks, ladders and stairs. Slip resistance has proven to be critical on crane ladders, ramps, pits, helidecks and areas in and around oil and gas facilities, onshore and offshore. Pickling and oil areas, coil storage, cold mill operation areas, casting areas, flow lines, crossovers, lift tables and recycling trenches are just a few places heavy oil is present in steel mills where anti-skid products are necessary. Military applications such as tarmac plates, barge decking, automated guide vehicles, barrack walkways, access hatches, training stations and waterway maintenance facilities require safe surfaces. Commercial and recreational industries should incorporate non-slip products on entrance ways, roof decking, fire escapes, fountain grating, commercial kitchens, sidewalk grating and amusement parks to keep pedestrians safe. Schools and universities may require slip resistance for parking garage expansion joints, bell towers, athletic stadiums, theatre gangways, ADA compliant ramps and walkways.

Slip-Resistant Options

Various industries and applications benefit from slip-resistant safe working and walking surfaces. There are countless types of products that can be used for these applications. Factors to consider when choosing a product are the cost, aesthetics, environment, maintenance and operations (higher initial costs may save money down the road and lower-cost products can lead to unexpected costs of maintenance or reapplying). The product chosen must be able to stand up to the environment and traffic it is exposed to. Some products that are offered include epoxy (can be applied to many surfaces but stripping and re-application is time consuming), tape on products (inexpensive but needs to be replaced often) as shown in Table 3 below, fiberglass (lightweight but can fracture or splinter), extruded aluminum with aluminum oxide grit (available in a variety of colors but pre-manufactured), diamond plate (cost effective but slippery when wet), perforated plank grating (cost effective but only provides slip resistance on raised portions), manufactured steel plank (sharp edges provide initial traction but edges become worn), and slip-resistant metal coated products (durable and long lasting but higher initial investment) as shown in Table 4 below.



Table 3. Tape-On Products.



Table 4: Slip Resistant Metal Coated Products

Preventative Measures

From the beginning stages of design to daily operations, everyone plays a key role in developing and sustaining safety. Architects and engineers have the ability to incorporate safe walking surfaces into building design. Plant, maintenance and safety managers have the ability to create and enforce guidelines. Safety committees play a large role in keeping a facility safe and a safety plan up to date. Employees have the ability to follow regulations and make safety a priority.

Safety Plan

To create a safety plan you should identify problem areas, consult a safety professional, invite a safety representative to assess problem areas, research options, talk to other companies and develop a plan for correcting problems. Plans should always be compliant with OSHA and ADA standards and training and educational programs for employees should be held. Safety plans should be re-evaluated quarterly or by season, periodic inspection of work areas should also be performed. Training that is offered to employees should be documented and employees should be encouraged to discuss and contribute to safety plans and enforcement. Another way to ensure safety is a number one priority within a company is to form a safety committee. Safety committees are formed of employees from various rankings and departments and the responsibility of the committee is to review accidents, evaluate safety plans and provide suggestions and feedback. The idea of a safety committee is to get employees involved and boost morale, as well as get an insider's perspective on workplace hazards and procedures. No one knows what needs maintenance or what hazards are present more than the workers who use the machinery and utilize the facility daily.

In Conclusion

Preventative measures are the key to creating and maintaining a safe work environment. Accidents can be prevented and safety is everyone's responsibility, from the architect that designs a building to the employee who works in it. The cost and time associated with safety prevents higher costs down the road and even more time spent later. An accident not only costs money but could cost someone's life.

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