Slip, Trip, Fall Prevention for the 3rd Age of Safety and Beyond

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Agenda & Learning Objectives

• Slip, Trip, Fall Stats, Factors, Costs, & Risks
• Root Causes and Influencing Factors
• How to Fall Safely
• Prevention and Minimization Concepts
  ➢ Prevention through Design & Engineering Controls
  ➢ Applying Psychology and Physics Concepts
STF Statistics and Causal/Influencing Factors

• STFs=leading cause of accidental deaths at home
• >90% deaths occur outside work
• 25% total claims
• 65% result in lost work days
• Cost employers $70 Billion/year ($20 Billion direct costs) nationwide
• 1 Million STF injuries/year nationwide
Top Cause for STFs

Behavioral Factors; 54–94%

• Extrinsic elements
  ➢ Ice/wet/slippery surfaces, Distractions, not being careful/perceiving risks &

• Intrinsic elements
  ➢ Inattention, rushing, frustration, fatigue, age, senses, visual acuity, medical conditions, medications, attitude, complacency/autopilot
Secondary Causes for STFs

- Slippery Surfaces or Conditions; 25–54%
  - traction/friction, momentum, obstruction, gravity, footwear elements

- Housekeeping Issues; 10–16%
  - tools & waste, positioning or storing objects

- Training; 5–8% (sometimes ineffective)

- A well understood and implemented STF system/program can enhance STF prevention by an additional 60%
Endless Cycle of STFs
Costs of STFs

To the employer:
- Loss of productivity
- Loss of business
- Increased insurance premiums
- Costs associated with training a replacement employee

To the employee:
- Lost wages
- More Out-of-pocket expenses
- Pain
- Temporary or permanent disability
STF Injuries

Claim Probabilities:

• 45% – lower extremities
  • knee, ankle, foot

• 17% – major disabilities
  • back, lower extremities, many body parts

• 4% – head/neck injury

• 15% – death
Multi-tasking is a myth and consciousness is an illusion

- 90-95% of routine tasks done autonomically without thinking about details of how or when they are performed

- Highly-visible cues can become invisible when used often in normal situations, which decreases hazard recognition (this happens 2/3rd of the time)

- Changes in surface elevation or surface condition irregularities are not perceived
STF Hazards
Causal Factors - Physical

- Age & gender
- Physical conditioning level & weight
- Inner ear/balance issues
- Disabilities
- Stress or Illness
Causal Factors - Behavioral

• Process or job complexity
• Carrying objects
• Desire for control
• Risk taking behaviors
• Area/process Familiarity
Slips

• Slips occur when the resistance between surface & shoes is lowered

• Activity and gait affect force at shoe–floor interface

  ➢ wet, dry, oily, sand, food, particles, polished surfaces

  ➢ activities involving pushing, pulling, accelerating, turning corners, and throwing create higher forces when walking and moving
• Tribology=study of friction, lubrication, wear
  
  ➢ A tribometer measures friction levels of shoes, floors, tires

• A slip meter measures horizontal force

• A swinging pendulum measures drag and resistance

• An articulating arm device or James machine
Slip (Friction) Equation

- Traction or slip resistance = force that allows walking w/out slipping
  - Measured by coefficient of friction (COF)

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\text{COF} = \frac{F_{\text{horiz}}}{F_{\text{gravity}}}
\]
Trip Hazards

Uneven surface in office area

Sidewalks in need of repair
Stair Safety

• Stair safety based on uniformity of dimensions, resistance, slope, visibility, structural strength, width, tread depth, placement

• Stair riser height between 4–8”
  ➢ When riser height <4” trip likely to occur over mini-step
  ➢ Use color changes to provide visual clue to mark changes in height

• Step uniformity is essential
  ➢ Complacency/auto-pilot
Ramps

• Ramps need slip-resistant finish w/ ideal angle <15° or 1:6 ratio
  ➢ Vertical/horizontal rise/run

• Handicapped access <5° slope or 1:12 ratio

• Ramps need handrails
  ➢ Guardrails prevent falls
  ➢ Accessibility use, Ramp Length <30’ and width >35”
  ➢ ANSI suggests 6’X5’ landing
Railings and Handrails

• Railings on open sides of exposed stairways, preferably on right side descending

• Handrail height between 34-38” from upper surface of handrail to surface of tread
Falls

• Wear safety harness >4’ height

• Three main aspects of falls are:
  ➢ A. Motion and height of a falling body
  ➢ B. Impact as a fall stops
  ➢ C. Ability to withstand impact

• Other Mechanics from Physics:
  ➢ Gravity, Center of Gravity, Balance, Friction, Speed, Momentum, Inertia
Falls Formulas

- Motion and Height: \( v = \left( v_0^2 + 2gs \right)^{\frac{1}{2}} \)

- Impact: \( a = \frac{v^2}{2s} \)

- Number of Gs: \( G = \frac{v^2}{2gs} = \frac{a}{g} \)

- Force of impact: \( F_i = \frac{Wa}{g} = \frac{0.5 \cdot m \cdot v^2}{d} \)

- Ability of a material (usually human tissue) to withstand impact force: \( F = sA \)
STFs are Preventable

• Prevention Program
  ➢ Recognize
  ➢ Evaluate
  ➢ Control

• Do not think that slips, trips and falls are inevitable
What to do if you are victim of STF?

• If a STF occurs tuck chin in, turn head, and throw an arm up
  ➢ Land on arm, buttocks, or side
  ➢ Do not land on head, back, hands, or elbows
  ➢ As many square inches of body contact the surface as possible

• Walk like a penguin and be attentive when walking during slippery surface conditions
Prevention through Design

- PtD concept is most effective way to prevent and reduce injuries, illnesses, and fatalities
  - design out hazards using new technology, work methods/operations, processes, equipment, tools, products, organizational methods
Benefits of PtD

• Eliminates retrofitting to correct design shortcomings

• Increases productivity

• Improves quality

• Reduces downtime

• Reduces overall costs
Workplace/Process Design

• Proper ventilation and lighting for conditions

• Effective drainage, false floors, platforms
  ➢ Slip-resistant coatings, paints, strips for floors (carpets, mats, rugs, entryways)

• Slope angles on ramps
  ➢ Handrails, platforms, guardrails, handholds, steps
  ➢ Bridges over cables on floors (trip hazards)
Workplace/Process Design

• Contain work processes
  ➢ Extraction/collection systems and enclosures

• Avoid elevation changes & textured patterns

• Avoid sources of glare (direct & reflected)

• Make different levels different colors
Hazard Elimination or Hazard Substitution

- Use PtD to reduce risk to acceptable level
- Eliminate changes in floor levels
- Replace flooring with a more slip-resistant surface
- Prevent access to high risk areas, i.e. stairs outside, roofs outside
Hazard Elimination or Hazard Substitution

• Substitute safer materials

• Automate material handling to reduce ergonomics risks

• Remove holes & obstructions on surfaces
  ➢ Covers for openings on holes

• **Barricades** around temporary excavation
  ➢ Rope around perimeter of elevated floors
Engineering Controls

• Minimize glare & contrast
  ➢ adequate lighting

• Minimize environmental influences
  ➢ block wind, overhangs to prevent ice/snow accumulation below

• Sound footing
  ➢ ladders, work platforms

• Flags, bright colors, visual, auditory signals
  ➢ flashing lights/beepers improve recognition
Engineering Controls

- Floor treatments increase slip resistance
- Improve lighting
- Stop leaks from equipment or pipes
- Provide adequate drainage
- Clearly mark edges of steps and any changes in floor heights
- Reduce, eliminate, distribute forces, energy, speed
- Automate material handling to reduce ergonomics risks
Expectations

• Universal responsibility and accountability

• Ensure a safe work environment and reduce losses associated with injuries

• Strong safety management system and program
  ➢ Reduce or eliminate moderate and severe injuries
  ➢ Ideal to have no injuries
  ➢ Do not accept the easy road, attempt to minimize extent of injury, or pass blame
Expectations

• All accidents, illnesses, incidents, injuries, near misses

  ➢ Need to be carefully analyzed
  ➢ Lessons learnt documented
  ➢ Avoid repeating them in future
  ➢ Information shared amongst colleagues for collaboration and problem solve for an effective preventative action solution
• Slips, trips and falls are the leading cause of accidental deaths at home

• Slips, trips and falls are preventable
  ➢ Remove root causes of the STFs

• Apply Prevention through Design, Engineering Controls, Psychology, and Physics Concepts
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"An ounce of prevention is worth a pound of cure" - Benjamin Franklin