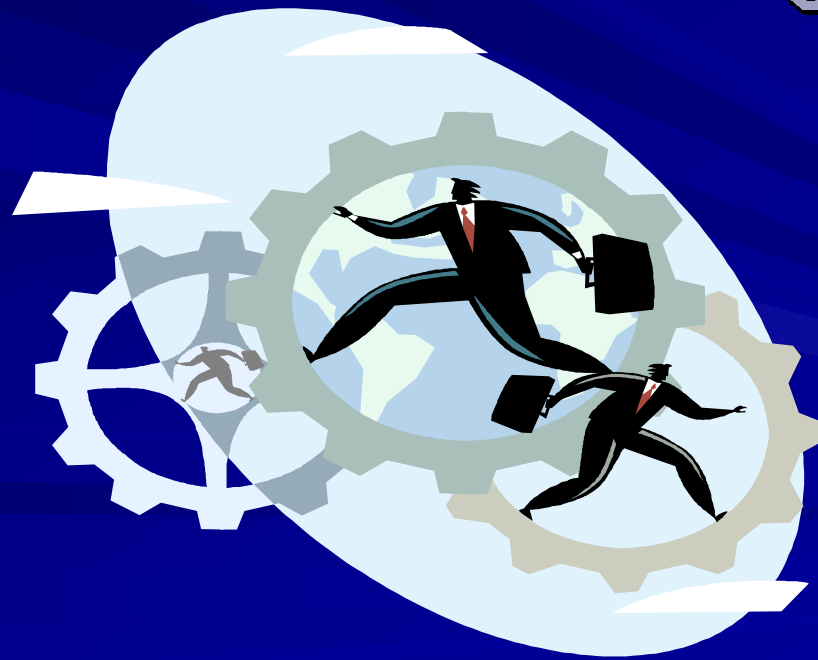


# ACCIDENT INVESTIGATION



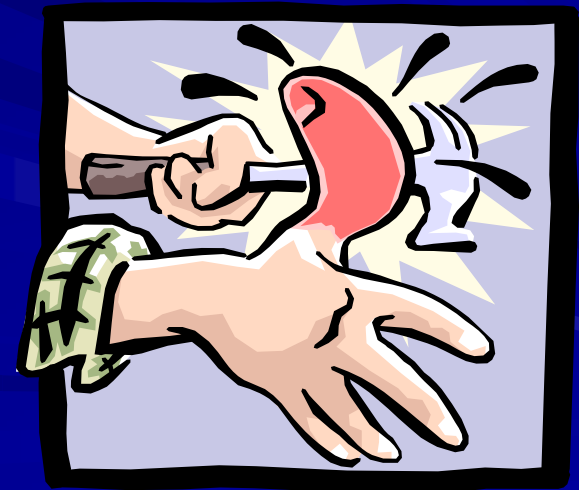


© KURT JONES 2003

# Objectives

- Types of accidents
- Causes or contributing factors of accidents
- How to perform an accident investigation
- What documentation should be completed

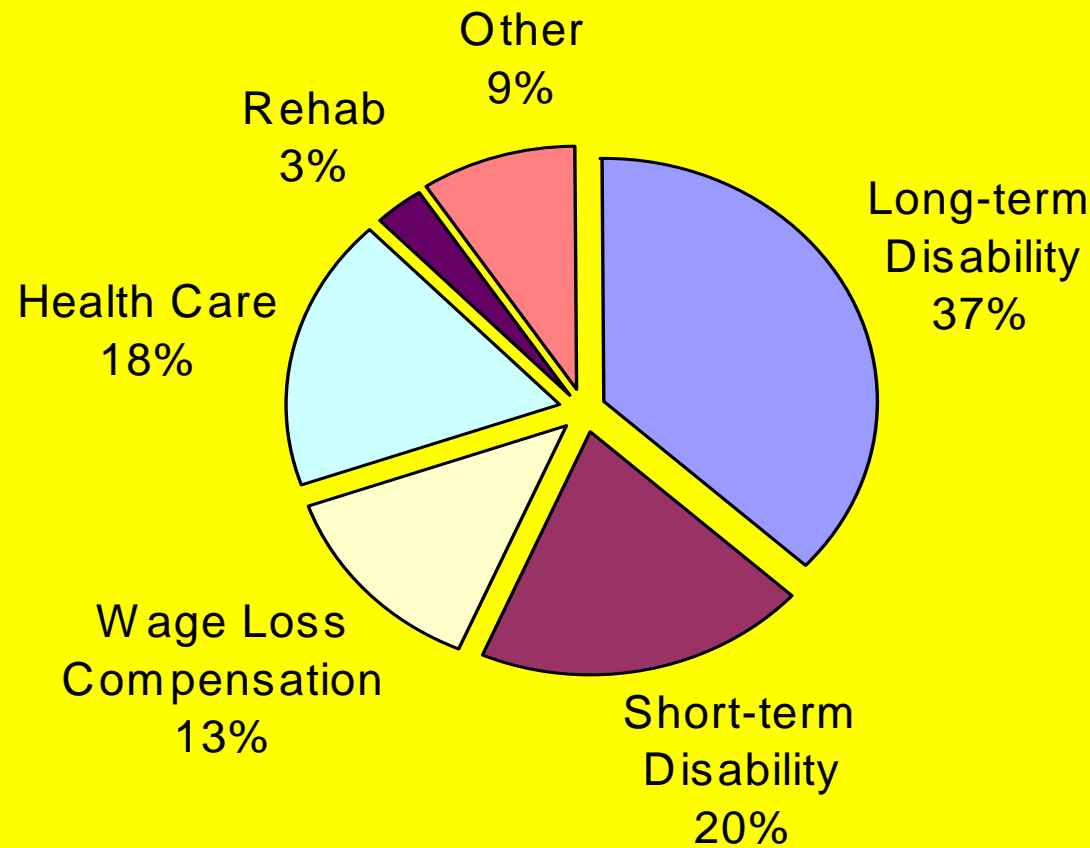
# Accident and Safety at work place



# *Reducing Injury Risk*

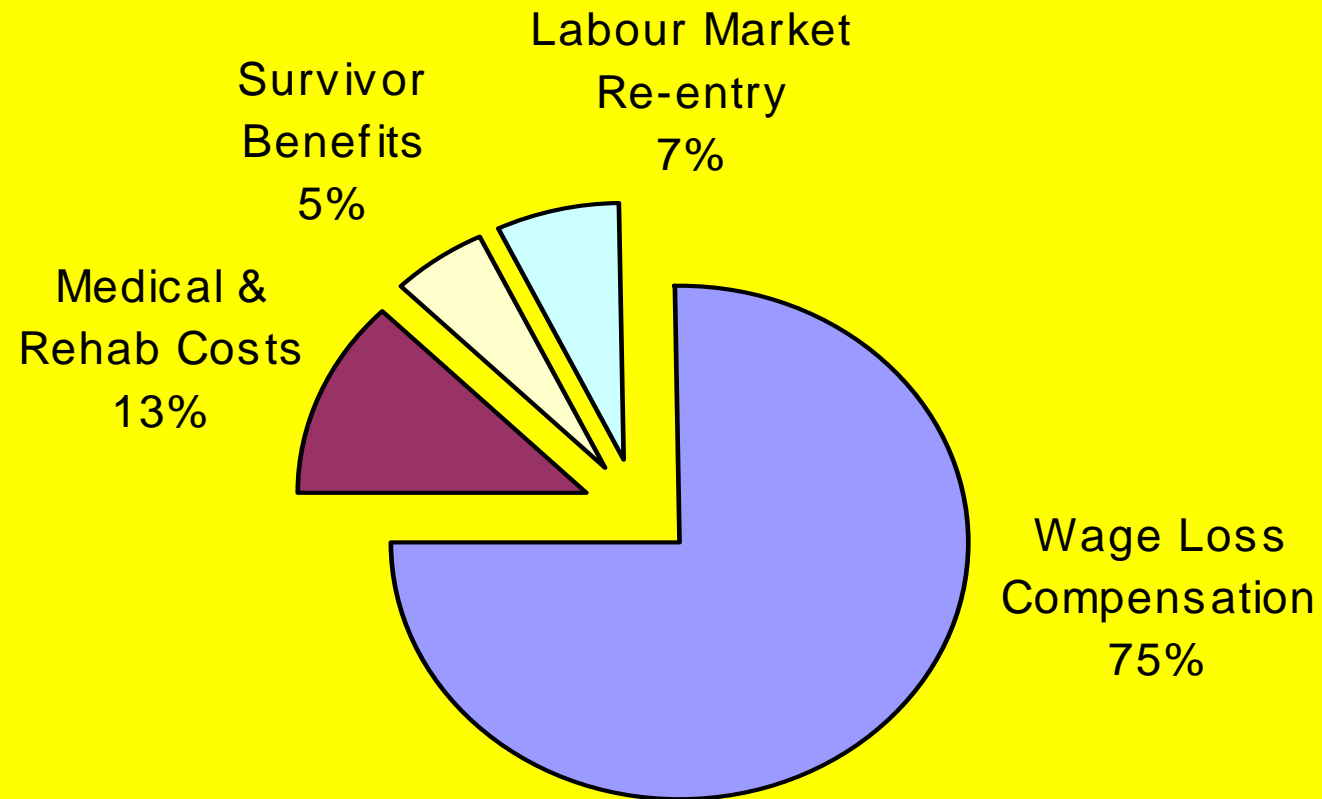
- avoid mismatch between worker's physical capabilities and limits with job demands
- worker's injury compensation claims and costs to employer and insurance companies
- personal, physical, emotional, social, financial, and career costs and losses for injured employee
- **e.g. Canada** (year 2000): \$5.7 billion in worker injury and associated costs
- **e.g. Ontario** (year 2000): \$ 2.3 billion in worker injury and associated costs

## Canada (2000) Worker Injury Costs



[Institute for Work and Health, [www.iwh.on.ca](http://www.iwh.on.ca)]

## Ontario (2000) Worker Injury Costs



[Institute for Work and Health, [www.iwh.on.ca](http://www.iwh.on.ca)]

# *Performance*

- Are there minimum strength, agility, speed, or other physical levels required for execution of task?
- What is the minimum level of “skill” or “excellence” needed for a successful performance of task?
- Are potential workers able to perform as well as seasoned workers?
- How much training or re-training may be required?
- Are there several potential “job postings” that the newly hired worker can fill successfully?



# Legal Cases

**Case 1:** female applicant to police force, but could not scale 6 foot walls. City allows 6 foot walls/fences.

**Ruling 1:** reasonable for police to be required to scale 6 foot walls.

**Case 2:** police applicants required to run 1 mile track

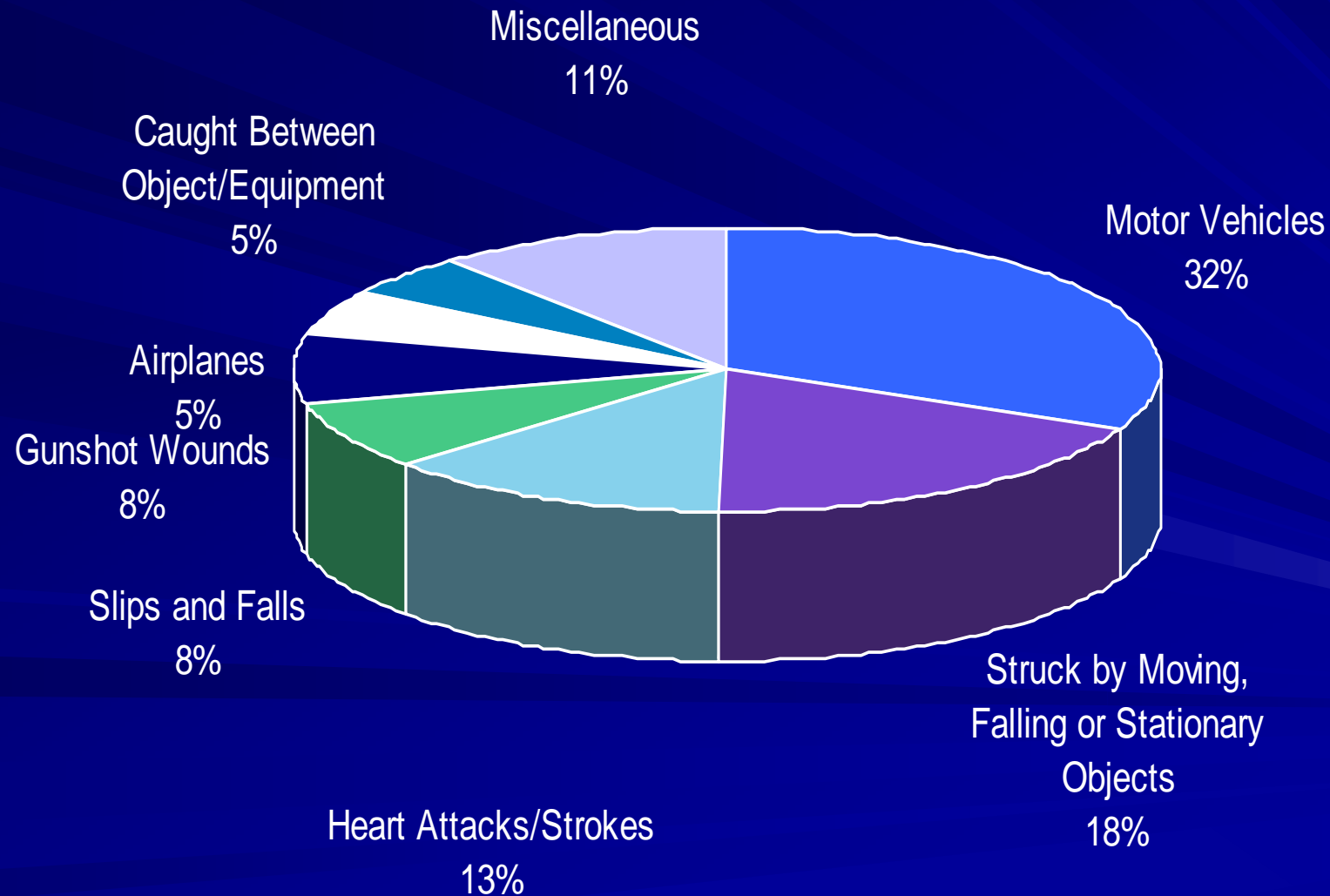
**Ruling 2:** job analysis showed that foot chases were usually only for short distances

**Case 3:** fire-fighters tests included carrying a dummy and showing agility

**Ruling 3:** tests did not arise from systematic analysis of work

[adapted from Callaghan, 2002]

# Leading Causes of Workplace Deaths



# What is the aim of an investigation

- EXONERATE INDIVIDUALS OR MANAGEMENT
- SATISFY INSURANCE REQUIREMENTS
- DEFEND A POSITION FOR LEGAL ARGUMENT
- OR, TO ASSIGN BLAME

# The Aim of the Investigation



- THE MAIN GOAL SHOULD BE TO PREVENT A RECURRENCE OF THE SAME ACCIDENT
- WE SHOULD LEARN FROM OUR MISTAKES

# THE ACCIDENT

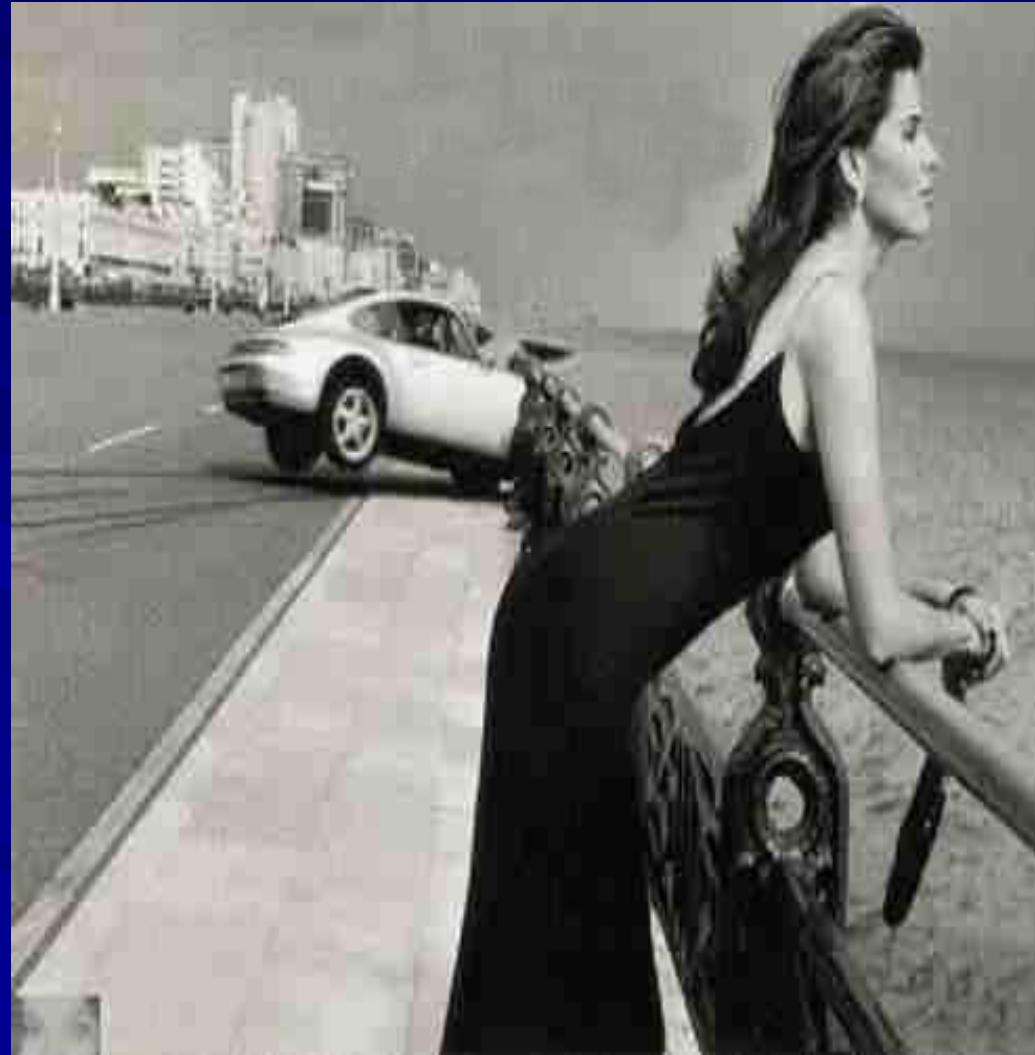
WHAT IS AN ACCIDENT?



KNTV-TV

# THE ACCIDENT

**AN UNPLANNED  
AND  
UNWELCOMED  
EVENT WHICH  
INTERRUPTS  
NORMAL  
ACTIVITY.**



# THE ACCIDENT

THREE BASIC TYPES OF ACCIDENTS

# THE ACCIDENT

## MINOR ACCIDENTS:

SUCH AS PAPER CUTS TO FINGERS OR  
DROPPING A BOX OF MATERIALS

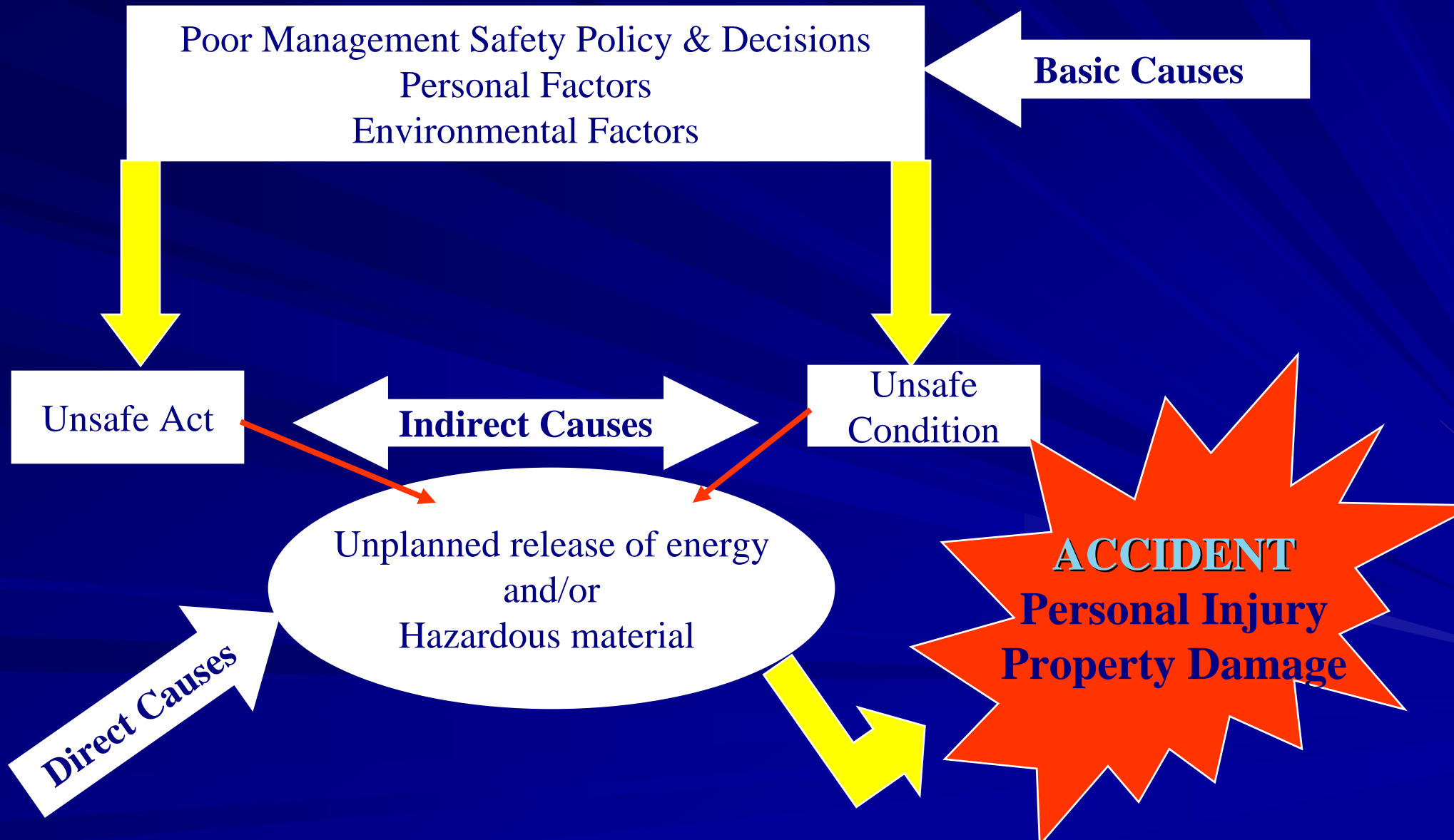




# Example



# The Basic Causes



# THE ACCIDENT

## MORE SERIOUS

ACCIDENTS THAT CAUSE INJURY OR DAMAGE TO EQUIPMENT OR PROPERTY:

SUCH AS A FORKLIFT DROPPING A LOAD OR SOMEONE FALLING OFF A LADDER



We sometime invite accidents by becoming complacent or simply acting stupid



# THE ACCIDENT

ACCIDENTS THAT OCCUR OVER AN EXTENDED TIME FRAME:

SUCH AS HEARING LOSS OR AN ILLNESS RESULTING FROM EXPOSURE TO CHEMICALS, NOISE, VIBRATION



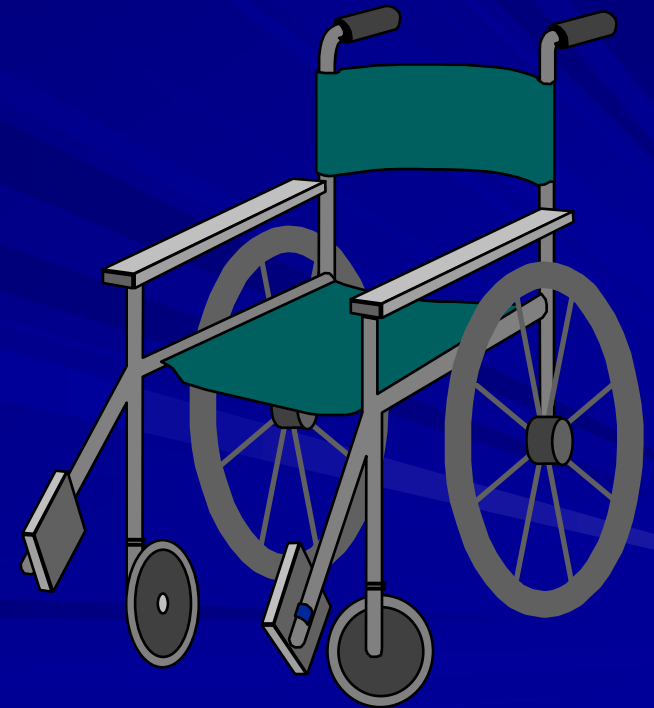
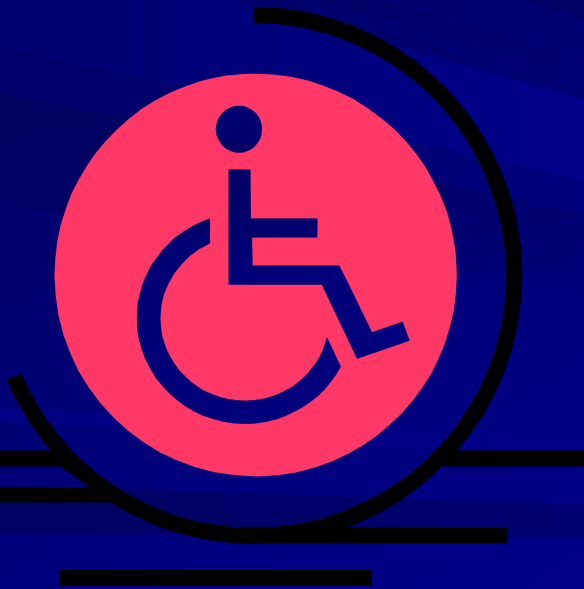
# THE ACCIDENT

ACCIDENTS HAVE **TWO**  
**THINGS** IN COMMON



# THE ACCIDENT

THEY ALL HAVE  
OUTCOMES FROM THE  
ACCIDENT



# THE ACCIDENT

THEY ALL HAVE CONTRIBUTORY FACTORS  
THAT CAUSE THE ACCIDENT





# OUTCOMES OF ACCIDENTS

## ■ NEGATIVE ASPECTS

- DEATH & INJURY
- DISEASE
- DAMAGE TO  
EQUIPMENT &  
PROPERTY
- LITIGATION COSTS
- LOST PRODUCTIVITY
- DEMORALIZING THE  
WORKFORCE

You can seriously harm yourself as well as others



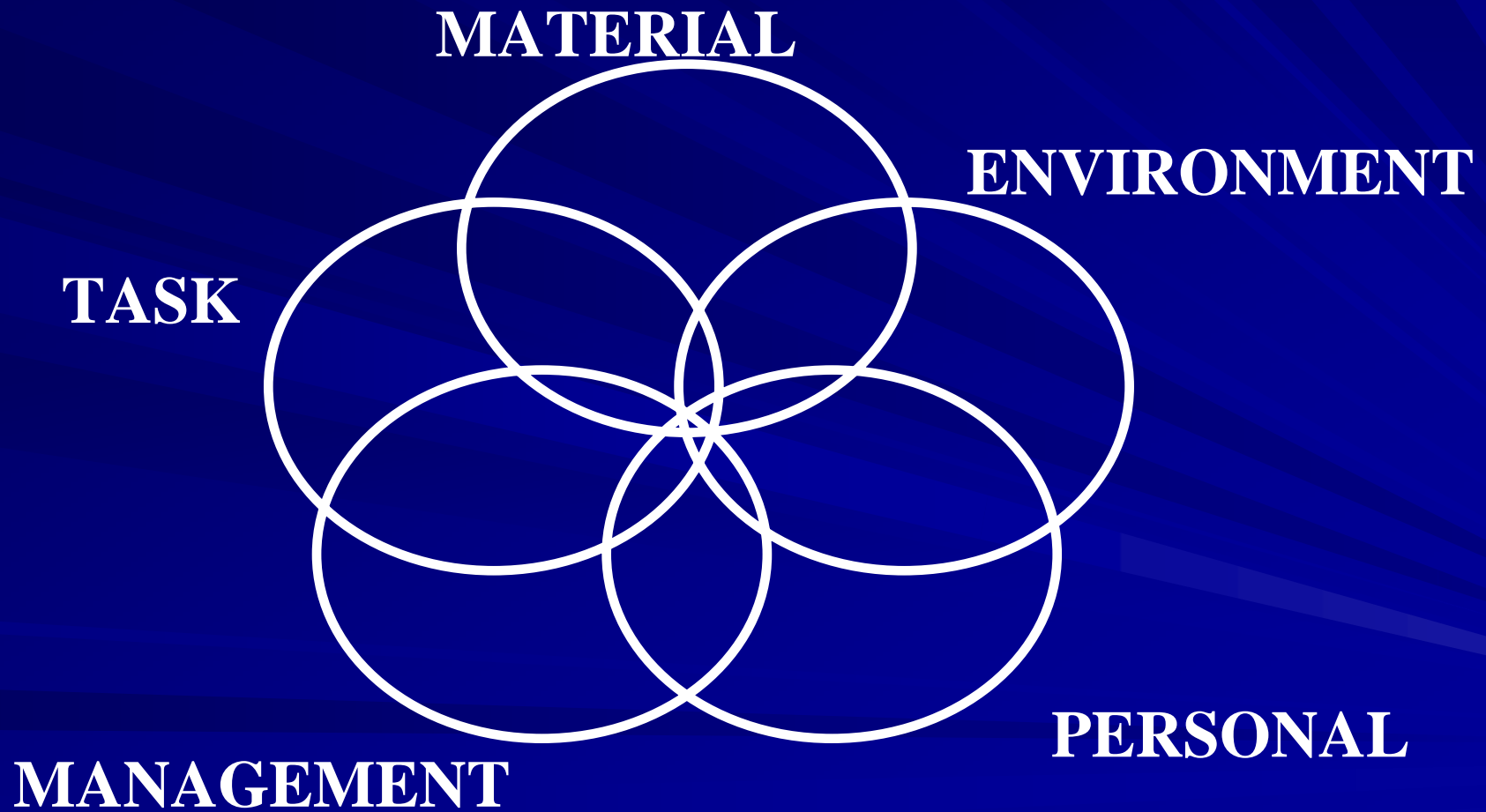
# OUTCOMES OF ACCIDENTS

## ■ POSITIVE ASPECTS

- ACCIDENT INVESTIGATION
- CHANGE TO SAFETY PROGRAMS

increase productivity,  
improve operations,  
raise awareness and  
prevent recurrence

# CONTRIBUTING FACTORS



# (1) Task

- ✦ Ergonomics
- ✦ Safety work procedures
- ✦ Condition changes
- ✦ Process
- ✦ Materials
- ✦ Workers
- ✦ Appropriate tools/materials
- ✦ Safety devices (including lockout)

## (2) Material

- ✦ Equipment failure
- ✦ Machinery design/guarding
- ✦ Hazardous substances
- ✦ Substandard material

WORKPLACE LAYOUT  
DESIGN OF TOOLS & EQUIPMENT

# (3) Environment

- ☀ Weather conditions
- ☀ Housekeeping
- ☀ Temperature
- ☀ Lighting
- ☀ Air contaminants
- ☀ Personal protective equipment

NOISE  
VAPORS, FUMES, DUST  
LIGHT  
HEAT  
ANIMALS

# (4) Human Factor

- ✦ Level of experience
- ✦ Level of training
- ✦ Physical capability
- ✦ Health
- ✦ Fatigue
- ✦ Stress



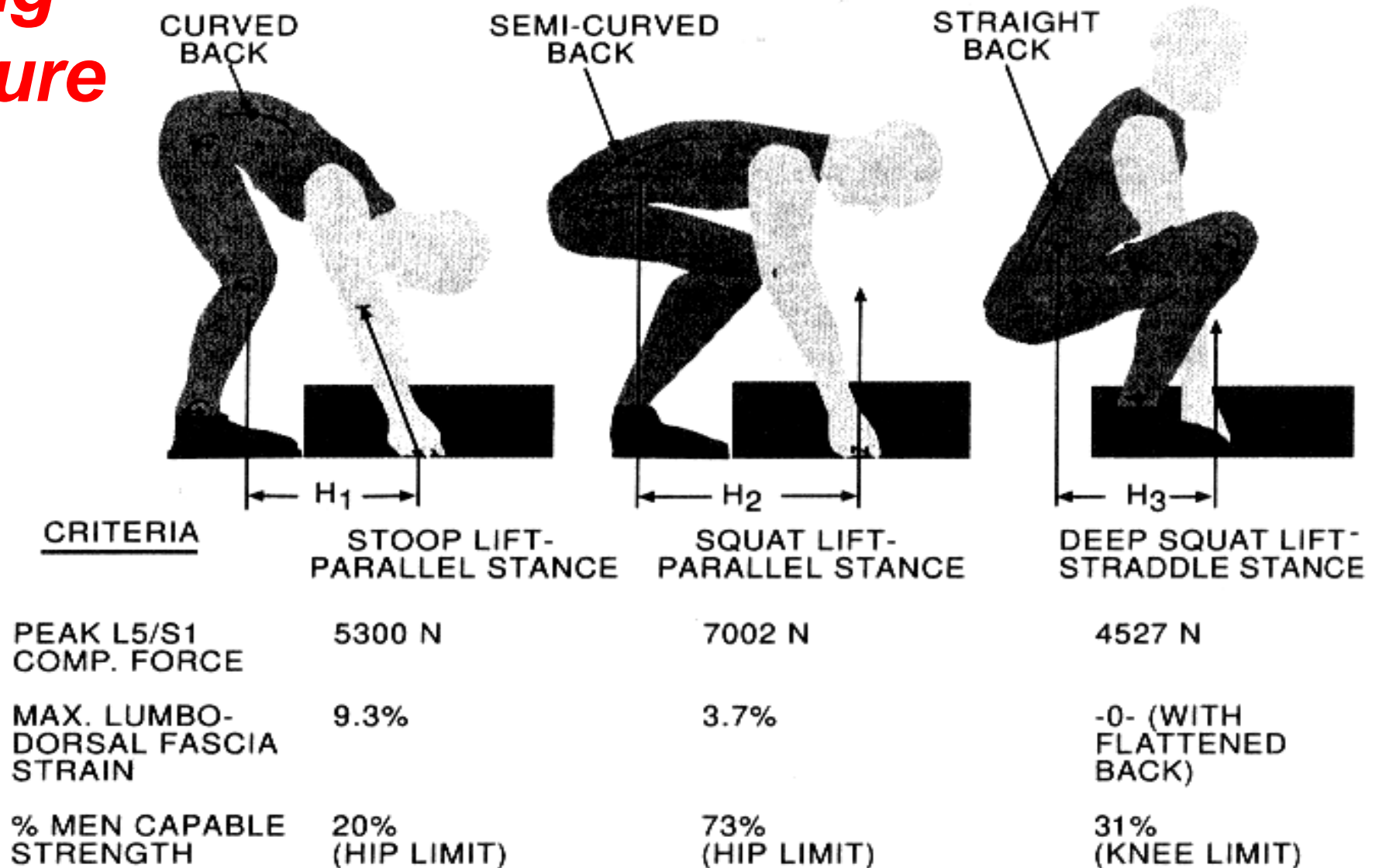
# *Specific Task Training*

*E.g. “LIFTING” Training Should Specifically Cover ...*

1. Risks to health of unskilled lifting
2. Basic biomechanics of lifting
3. Effects of lifting on the body
4. Individual’s awareness of their strengths and weaknesses – using trials from moderate to heavy
5. How to avoid the unexpected – shifting loads
6. Lifting skills – posture, leverage, timing
7. Lifting aids – back belts, dollies, hoists, gloves, pads
8. Warnings – when to have individual vs. team lifting

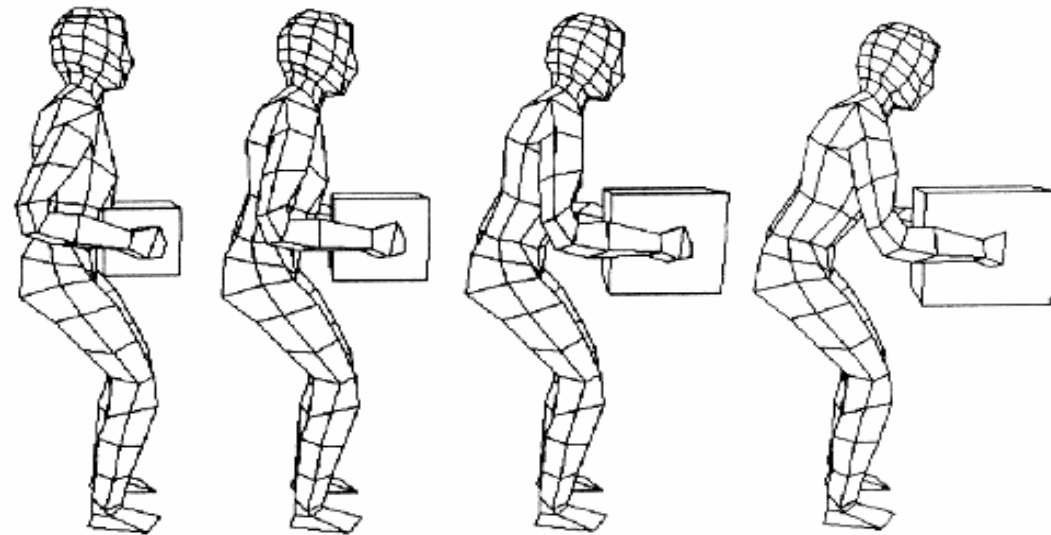
[source: NIOSH, 1981]

# Lifting Posture



**Figure 13.3** The typical "stoop lift" posture on the left is compared with two different types of squat lifting of a 400-N box (as adapted from Anderson and Chaffin, 1986).

# Lifting Distance

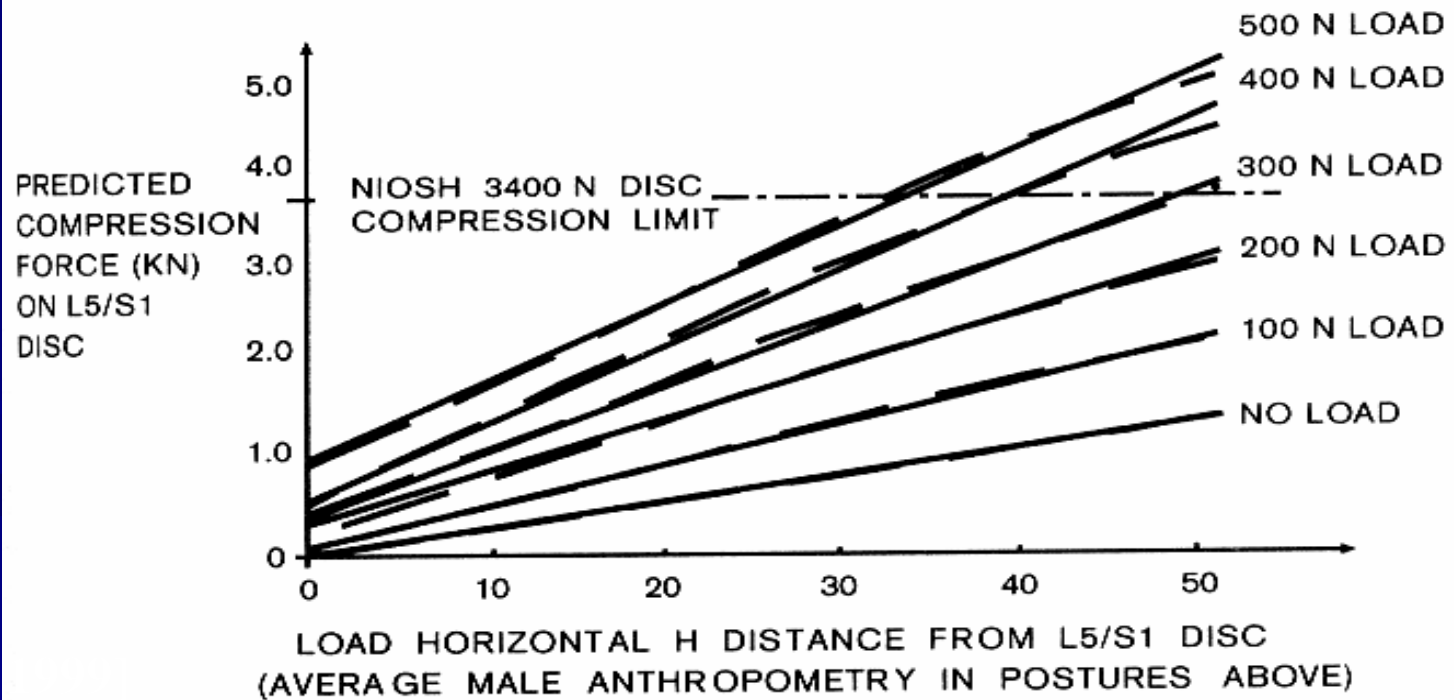


LOAD-TO-L5/S1 = 20 CM

30 CM

40 CM

50 CM



[Chaffin et al,

# Lifting Speed

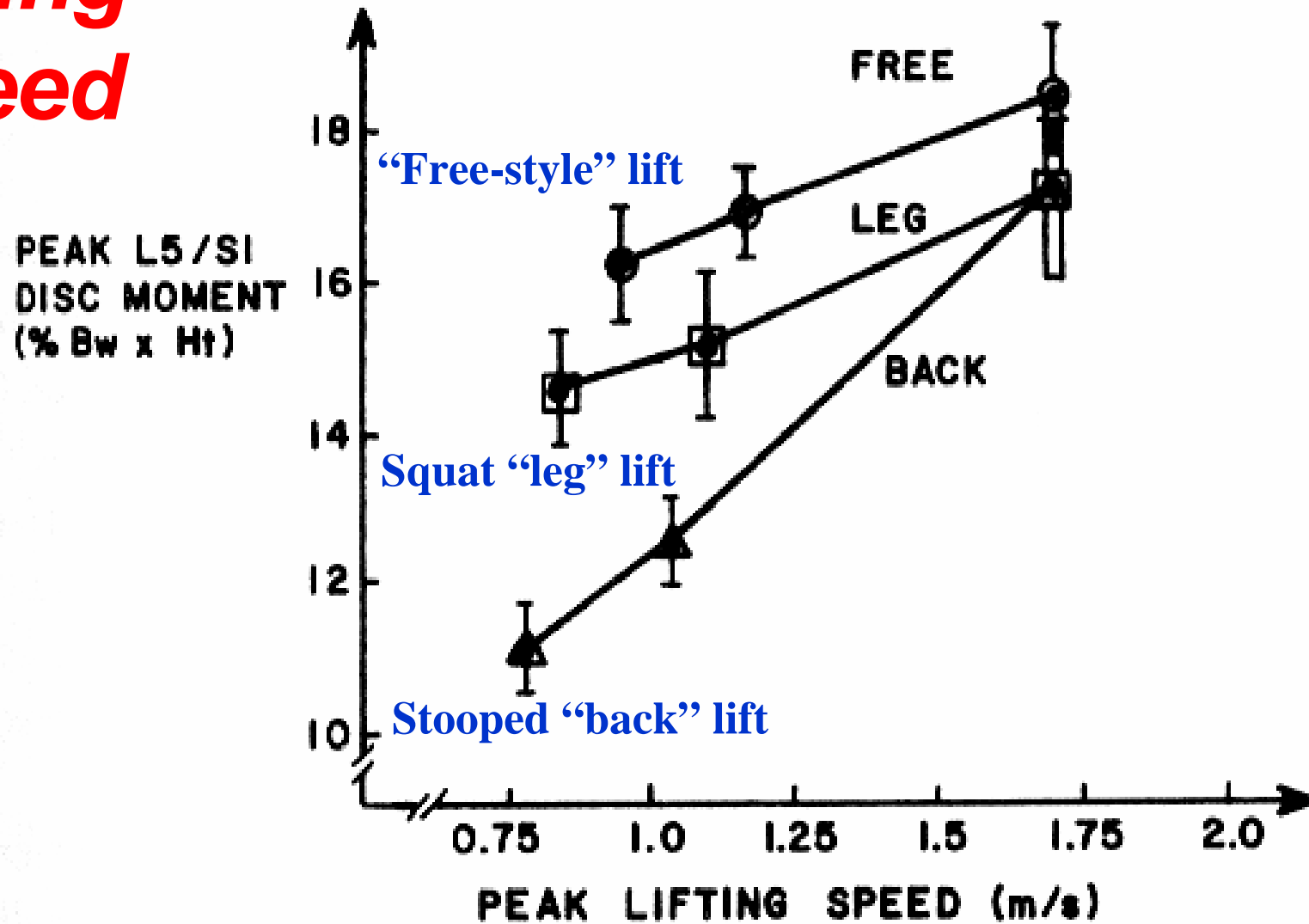


Figure 6.38 Mean and SD values for the peak moments at the L5/S1 disc in relation to speed of lifting a 150-N box from the floor (Bush-Joseph et al., 1988).

# Lifting Cycle

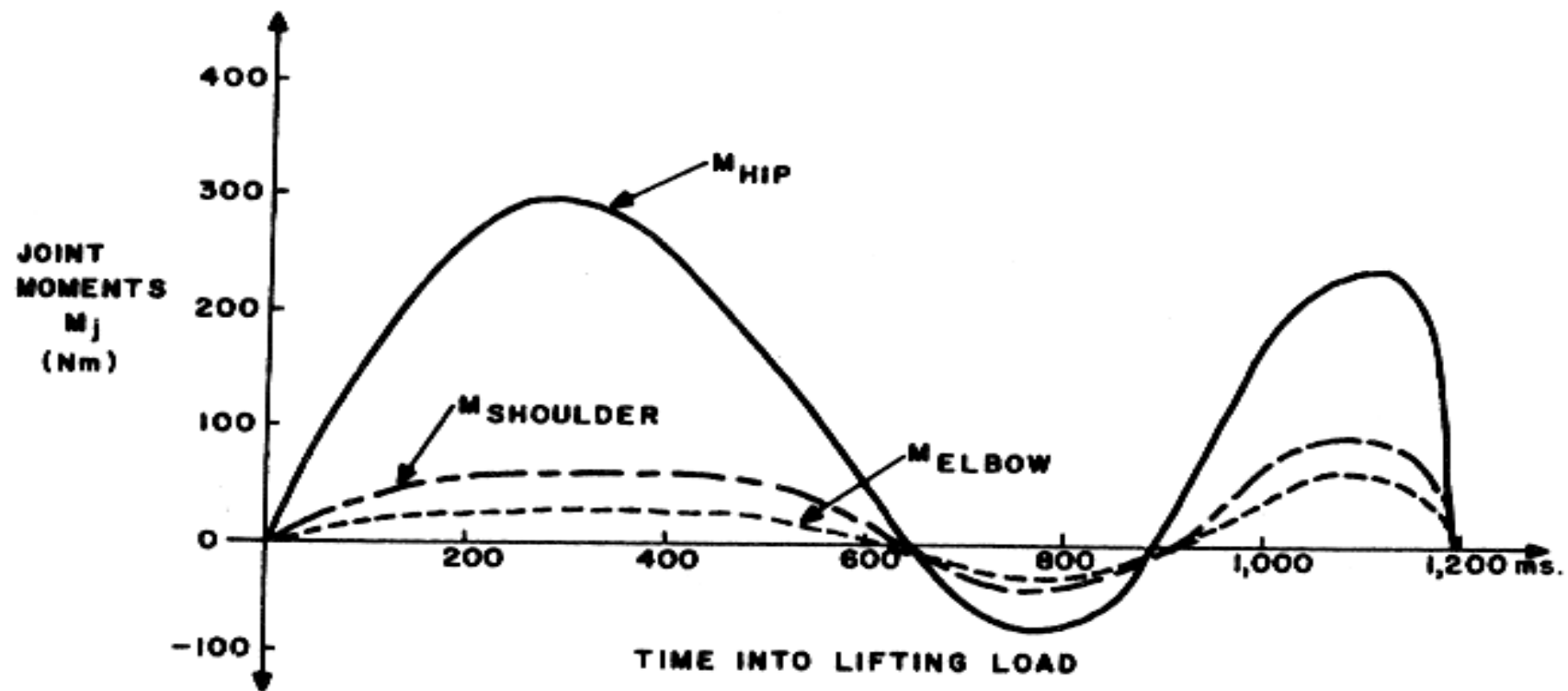
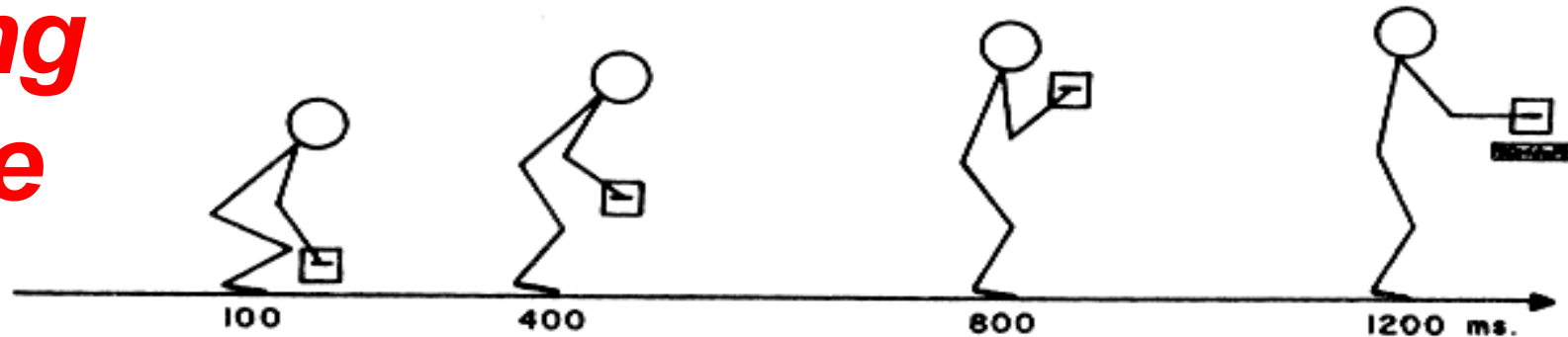


Figure 6.19 Typical moments at joints during lifting of 18-kg load from floor to shelf 108 cm above floor and 38 cm in front of ball of foot (Fisher, 1967).

# Workers Safety

# Accident Theories

## *Accident Proneness Theory*

- some people more prone to accidents due to peculiar set of constitutional characteristics (e.g. age, job experience, etc.)
- **e.g. Age:** young workers more prone due to inattention, lack of discipline, impulsiveness, recklessness, misjudgment, overestimation of capacity, pride
- **e.g. Age:** older workers more prone due to deterioration of motor skills, sensory functions, mental agility

# Accident Theories

## ***Job Demand vs. Worker Capability Theory***

- accident liability increases when job requirements exceeds worker capacities and skills

## ***Adjustment-to-Stress Theory***

- psychological stress or physiological stress exceeds worker endurance
- e.g. noise, poor lighting, anxiety, lack of sleep, anger, etc.

## ***Arousal-Alertness Theory***

- accidents more likely to occur when job stimulation is too low (e.g. underloaded or bored) or too high (e.g. overloaded or overly motivated)



# Accident Theories

## ***Goals-Freedom-Alertness Theory***

- less freedom for workers to set job goals yields lower-quality job performance and more accidents

## ***Psychoanalytic Theory***

- Some accidents are self-punitive actions due to anger, guilt, or aggression
- Account for isolated incidents but of no really value explaining typical accidents

# Accident Factors

## 284 Chemical Industry Accidents (Japan)

Inadequate Standard Operational Procedure	19 %
Error in Recognition or Confirmation	15
Error in Judgment	14
Poor Inspection	12
Inadequate Directives	10
Inadequate Operational Information	10
Operational Error	6
Unskilled Operation	6
Imperfect Maintenance	2
Other	6

[Source: Hayashi, 1985]

# Accident Factors

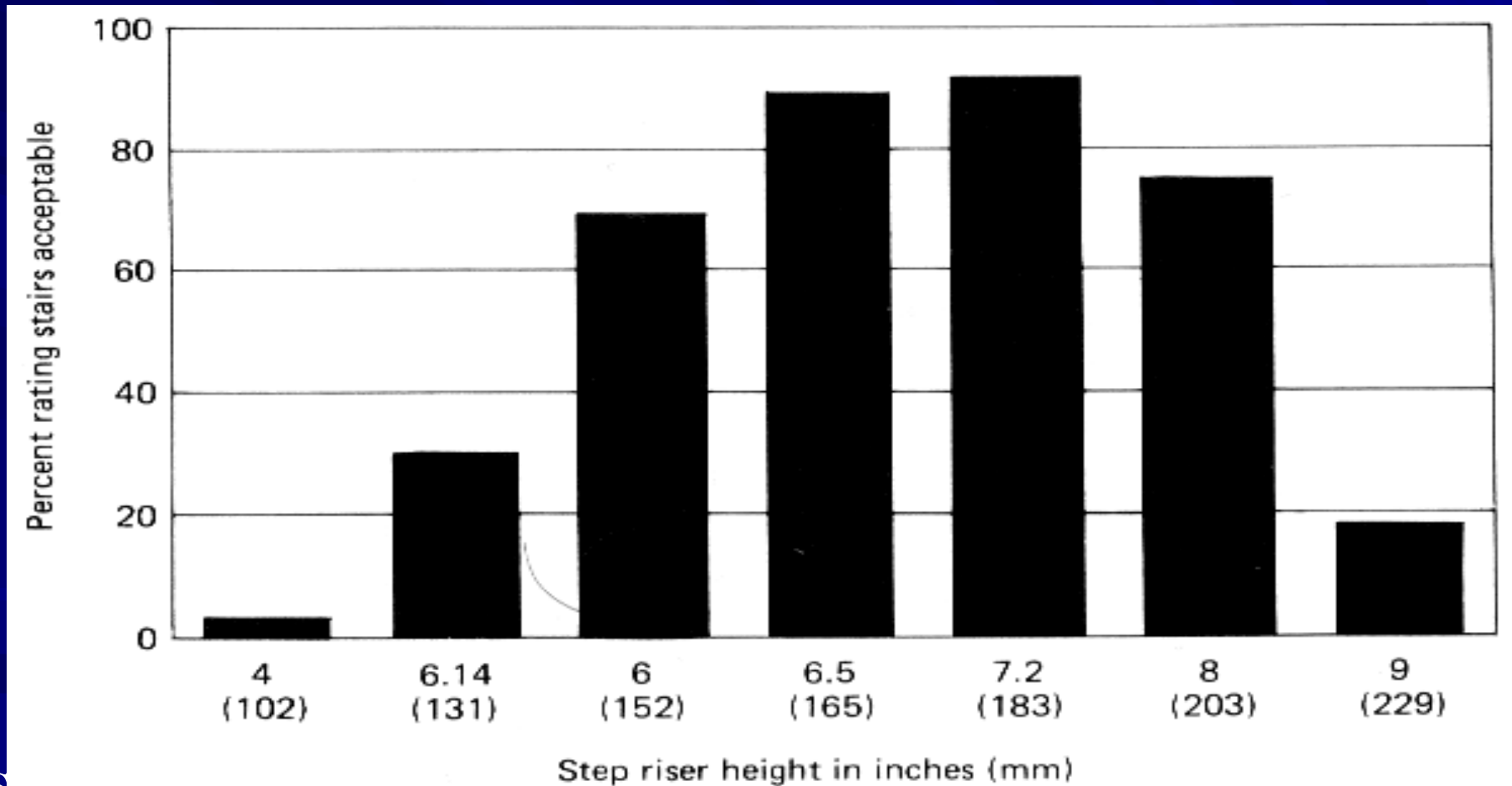
## 405 Gold Mining Accidents (South Africa)

Failed to Perceive Hazard	36 %
Underestimated Hazard	25
Failed to Respond to a Recognized Hazard	17
Responded to Hazard Ineffectively	14

[Source: Lawrence, 1974]

# Accident Factors

## “Perception” as Contributing Factor



[Source: Irvine et al.]

# Accident Data Collection

## ***Data on accidents routinely taken by ....***

- Insurance companies
- Police departments
- Trade Associations and Unions
- Industry: occupational health unit
- Researchers

## ***Accident Reports typically include ...***

- Nature of injury (strain, impact, amputation)
- Area of Body (head, back, finger, etc.)
- Type of Accident (“struck by”, “caught between”, “fell”)
- Source (equipment, hand tools, body movement, etc.)

# Accident Data Collection

## *Critical Incident Technique*

- **Purpose:** detailed documentation of unsafe activities or near-miss accidents to develop preventative measures
- **Basis:** many more “close calls” rather than actual accidents in workplace
- **Pros:**
  - correlation between observed “unsafe” acts & actual accidents
  - preventative approach
- **Cons:**
  - selective worker recall on details of incidents over which they had no control vs. ones they were responsible for
  - definition of “critical” or “near miss” is vague

# Accident Prevention

## ***Procedural Checklists***

- Substitute for memory and task lag time
- e.g. aircraft operation, military operations

## ***Warning Signs***

- “danger”, “warning”, “hazard”, “caution”

## ***Training***

- ensure safe and productive job behavior

## ***Feedback***

- management to give workers encouragement re: preferred methods of executing tasks and jobs

## ***Incentive Programs (“The Carrot”)***

- bonuses, promotions, privileges (e.g. time off, better parking space locations), group safety records, tokens redeemable for catalog products

# Workers Safety

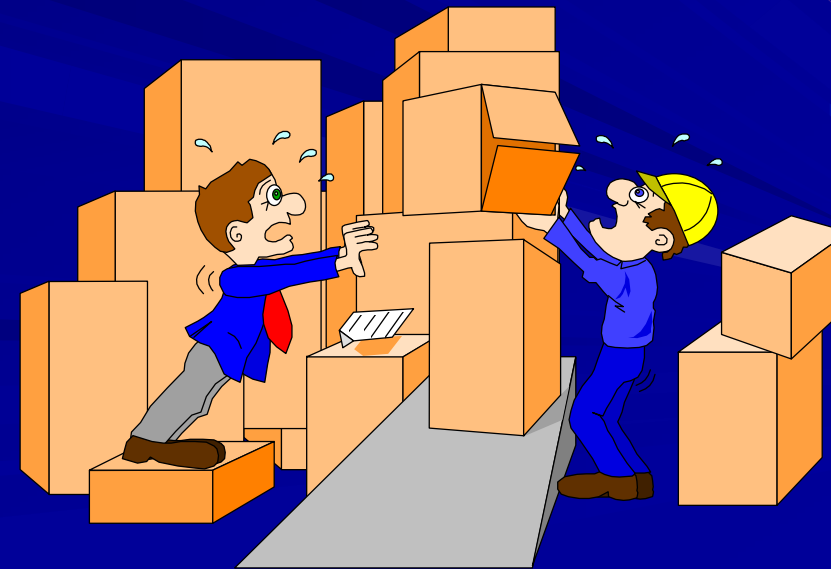


# (5) Management/Process Failure

- ✦ Visible active senior management support for safety
- ✦ Safety policies
- ✦ Enforcement of safety policies
- ✦ Adequate supervision
- ✦ Knowledge of hazards
- ✦ Hazard corrective action
- ✦ Preventive maintenance
- ✦ Regular audits

SYSTEMS &  
PROCEDURES

LACK OF SYSTEMS  
& PROCEDURES  
INAPPROPRIATE  
SYSTEMS &  
PROCEDURES



# CONTRIBUTING FACTORS

## ■ SYSTEMS & PROCEDURES

- LACK OF SYSTEMS & PROCEDURES
- INAPPROPRIATE SYSTEMS & PROCEDURES

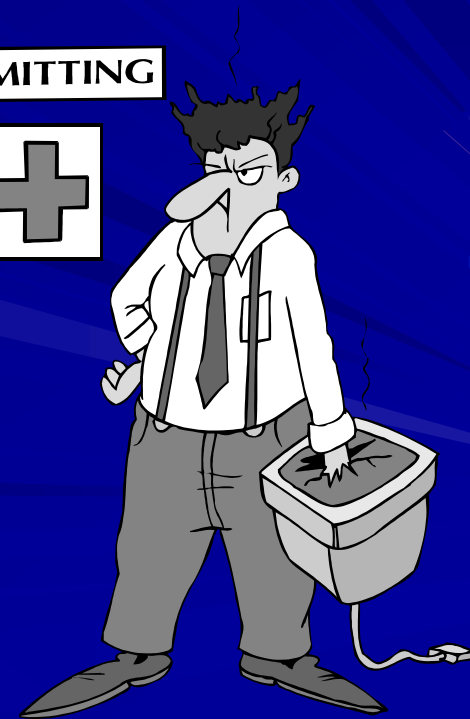
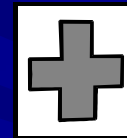


# CONTRIBUTING FACTORS

## ■ HUMAN BEHAVIOUR

- COMMON TO ALL ACCIDENTS
- NOT LIMITED TO THE PERSON INVOLVED IN THE ACCIDENT

ADMITTING



It is Important to bear in Mind that

- Investigation is not intended to place blame.

# WHO SHOULD INVESTIGATE

■ DEPENDENT ON SEVERITY OF THE ACCIDENT

– INVESTIGATION TEAM

- INDIVIDUALS INVOLVED
- SUPERVISOR
- SAFETY SUPERVISOR
- UPPER MANAGEMENT
- OUTSIDE CONSULTANTS



# INVESTIGATION STRATEGY

- GATHER INFORMATION & ESTABLISH FACTS
- ISOLATE ESSENTIAL CONTRIBUTORY FACTORS
- DETERMINE CORRECTIVE ACTIONS
- IMPLEMENT CORRECTIVE ACTIONS



# INVESTIGATION STRATEGY

## ■ FACT GATHERING

- BE IMPARTIAL & OBJECTIVE
  - DO NOT BE INFLUENCED BY EITHER SIDE
- COMPILE PROCEDURES & RULES FOR THE AREA
- Gather information not only from the management but very much from the labour force and the ones near the accident.
- GATHER MAINTENANCE RECORDS ON EQUIPMENT INVOLVED

# INVESTIGATION STRATEGY

## ■ FACT GATHERING (CONTINUED)

- ISOLATE ACCIDENT SCENE
- PHOTOS & DIAGRAMS (even Video )
- DO NOT DISCARD OR DESTROY ANYTHING



# INVESTIGATION STRATEGY

## ■ FACT GATHERING (CONTINUED)

- TIME IS OF THE ESSENCE
- OBTAIN INFORMATION

- INJURED
- WITNESSES
- SUPERVISORS
- OTHER PERSONNEL

# INVESTIGATION STRATEGY

## ■ FACT GATHERING (CONTINUED)

### INTERVIEWS (SEPARATELY)

- WHAT WERE YOU DOING?
- HOW DO YOU THINK THE ACCIDENT OCCURRED?
- HOW WERE YOU TRAINED FOR THE JOB?
- WHAT WAS THE ENGINEER INSTRUCTION?
- WHAT IS THE SAFETY PROCEDURE FOR THIS JOB?

# INVESTIGATION STRATEGY

## ■ FACT GATHERING (CONTINUED)

- OBTAIN FACTS NOT OPINIONS

- MAKE IT CLEAR THE OBJECT OF THE INVESTIGATION IS TO AVOID RECURRENCE, NOT TO APPORTION BLAME

# Interview Do Not's

- Intimidate the witness
- Interrupt
- Prompt
- Ask leading questions
- Show your own emotions
- Make lengthy notes while the witness is talking

# Analysis and Conclusion

## ■ Isolate contributory factors

- Would the accident have occurred if this particular factor was not present?

## ■ Determine

- Why the accident occurred
- A likely sequence of events and probably causes

## ■ Draw conclusions and make recommendations based on key contributing factors and causes.

## ■ Implement corrective actions and set a time table to complete them.

# REPORT

- ✓ Statement of injured or ill employee concerning the incident and injured employee information
- ✓ Witness statements
- ✓ Equipment involved
- ✓ Other factors or contributing causes
- ✓ Corrective action plan

# INVESTIGATION STRATEGY

- ISOLATE ESSENTIAL CONTRIBUTORY FACTORS

- INVESTIGATION TEAM

- EVALUATES ALL FACTORS CONCERNED

# INVESTIGATION STRATEGY

## ■ ISOLATE ESSENTIAL CONTRIBUTORY FACTORS

### - INVESTIGATION TEAM

- ISOLATES THE KEY FACTOR(S) BY ASKING THE FOLLOWING QUESTION....



# INVESTIGATION STRATEGY

WOULD THE ACCIDENT HAVE HAPPENED IF  
THIS PARTICULAR FACTOR WAS NOT  
PRESENT?

# INVESTIGATION STRATEGY

## ■ DETERMINE CORRECTIVE ACTIONS

### – INVESTIGATION TEAM

- INTERPRETS & DRAWS CONCLUSION
- DISTINCTION BETWEEN INTERMEDIATE & UNDERLYING CAUSES

# INVESTIGATION STRATEGY

## ■ DETERMINE CORRECTIVE ACTIONS

### – INVESTIGATION TEAM

- RECOMMENDATIONS BASED ON KEY CONTRIBUTORY FACTORS AND UNDERLYING CAUSES

# INVESTIGATION STRATEGY

## ■ IMPLEMENT CORRECTIVE ACTIONS

### – INVESTIGATION TEAM

- RECOMMENDATION(S) MUST BE COMMUNICATED CLEARLY
- STRICT TIME TABLE ESTABLISHED
- FOLLOW UP CONDUCTED

# BENEFITS OF ACCIDENT INVESTIGATION

- PREVENTING RECURRENCE
- IDENTIFYING OUT-MODED PROCEDURES
- IMPROVEMENTS TO WORK ENVIRONMENT

# BENEFITS OF ACCIDENT INVESTIGATION

- INCREASED PRODUCTIVITY
- IMPROVEMENT OF OPERATIONAL & SAFETY PROCEDURES
- RAISES SAFETY AWARENESS LEVEL

# BENEFITS OF ACCIDENT INVESTIGATION

WHEN AN ORGANIZATION REACTS SWIFTLY AND POSITIVELY TO ACCIDENTS AND INJURIES, ITS ACTIONS REAFFIRM ITS COMMITMENT TO THE SAFETY AND WELL-BEING OF ITS EMPLOYEES

Are we to leave our children a country  
ridden with accidents and their  
corresponding burden of human and  
economic loss?

Raymond J. Colvin, Sr.  
NYU.....1959



# Summery

- What are the different types of accidents?
- What causes or contributes to accidents?
- How do you perform an accident investigation?
- What documentation should be completed?

# Food Service Accident Analysis

Retail Grocery Store Accident

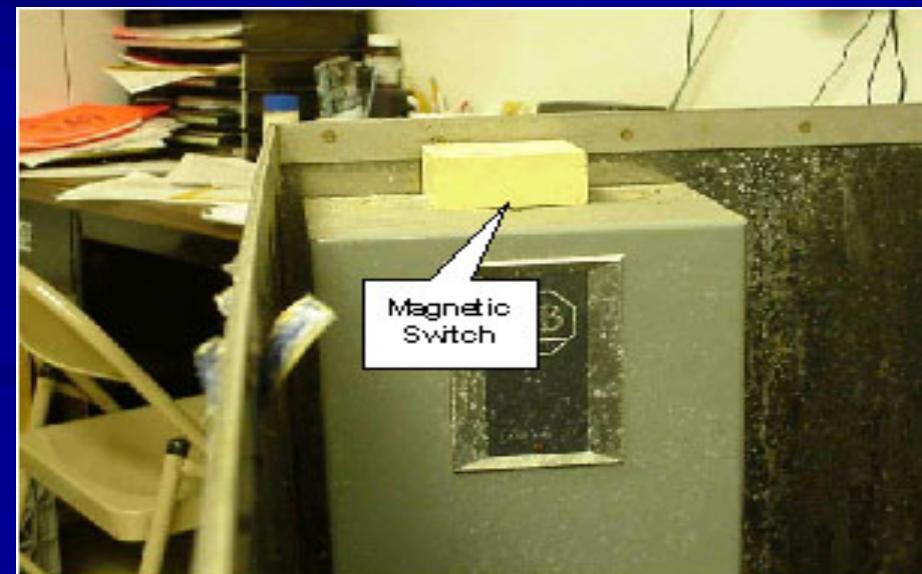
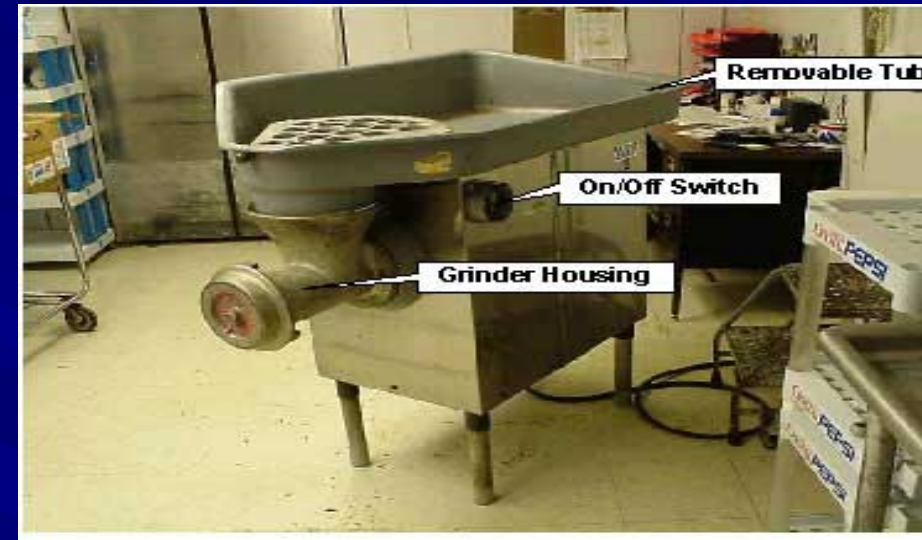
# Accident Information

## ■ Pre-event

- 15-year old Part –Time Worker in retail grocery store
- Hired to clean meat department and wash down tables
- Instructed not to touch any of the equipment except meat grinder
- Training offered by employer
  - Written Policy – Did not address age specific info regarding control of hazardous energy
  - Management On-The-Job Department-Specific Training
- Company's First Serious Injury

# Accident Information

- Electric cord for meat grinder was still attached to energized receptacle
  - Receptacle was located behind a desk and not accessible for routine disconnect
  - Therefore, was connected at all times
- On/Off switch, located on left side of grinder
  - Was unprotected from inadvertent operation
- Magnetic Safety Switch, located under plastic tub used for feeding meat into machine
  - Not functional since store was purchased 16 years prior
  - Store employees were not aware of its presence



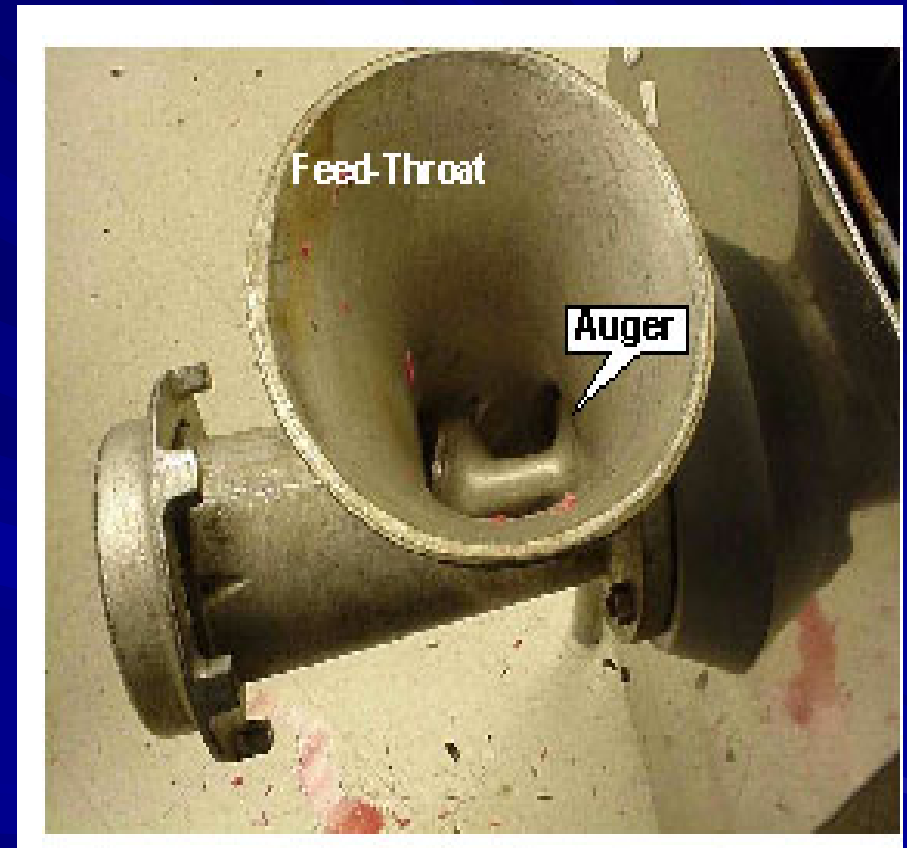
# Accident Information

## ■ During Accident

- Employee arrived and began to perform regular duties
- Grinder had already been disassembled and shut down
  - Cord was not disconnected from receptacle
- Employee cleaned parts and began reassembly

# Accident Information

- Attached barrel shape housing to transmission case
- Inserted to the grinder's auger through the front of the housing
- Then, he reached through the feed hopper (throat) with his right hand to guide the auger into engagement
- During this process he accidentally leaned against the on/off switch – activating it
- The grinder started and the auger began to feed his hand and arm through the grinder housing



# Accident Information

## ■ Post-Accident

- Employee Shut Down Machine and withdrew his arm
- He left the meat department room and made his way to the front of the store
- Store manager assisted employee by applying pressure to the injured right arm while another employee dialed 911
- EMS arrived within 10 minutes and employee was transported to local hospital
- Employee suffered amputation of lower right arm

# Accident Investigation

- Safety Equipment and measures
  - Power cord not located in easily accessible location
  - On/Off switch not protected from inadvertent operation
  - Magnetic Safety switch not functional
    - Switch mounted on top of motor started designed to be pulled closed when contact made with magnet on underneath side of plastic meat feeding tub.
    - Magnet mounted underneath plastic tub had fallen off
    - Switch was then bypassed by previous store owner
    - Employer and staff were unaware of this safety device
    - Would have prevented this accident



# Accident Investigation

## ■ Regulation Violations

### – Child-Labor Laws

- 14 & 15 year olds prohibited from occupations:
  - Requiring the performance of duties in work rooms or work places where goods are manufactured, mined, or processed
  - Involving the tending, including the cleaning and assembling of power-driven machinery
  - Involving operating, setting-up, cleaning, oiling, or repairing *power-driven food grinders* .
  - *A minimum age of 18 has been established for operating powered meat grinders*

# Accident Investigation

## ■ Human Error

- Miscommunication between management and employee

- Management

- **Instructed employee to clean disassembled parts and assemble partially (unclear)**
- **Management reports that he had instructed employee to only attach auger-housing and to tighten the bolts and nuts finger-tight**
- **Did not inform employee of what hazards the restrictions are designed to guard against**
  - **Activating the On/Off switch while assembling the parts**

- Employee

- **Believed the assembly process was more extensive**
- **Only 4 parts to reassemble and could easily be deduced without instruction**

# Accident Investigation

## ■ Primary Cause of Accident

- Haddon's 10 Countermeasures – Energy Transfer Model
  - Pre-accident countermeasures most applicable to this accident
    - Prevent Energy Release
      - Move cord to easily accessible location
      - Protect on/off switch from unintended operation
      - Repair Magnetic Safety Switch
- Training of Employees should be corrected to include hazard recognition – dangers working with energized equipment
- Child-Labor Laws need to be followed

# Recommendations

- Employer should develop and implement appropriate procedures to control the release of hazardous energy, including lockout/ tag out procedures
  - After Accident, cord was relocated to easily accessible receptacle
  - Established procedures to lockout/tagout equipment at end of day and while servicing or repairing

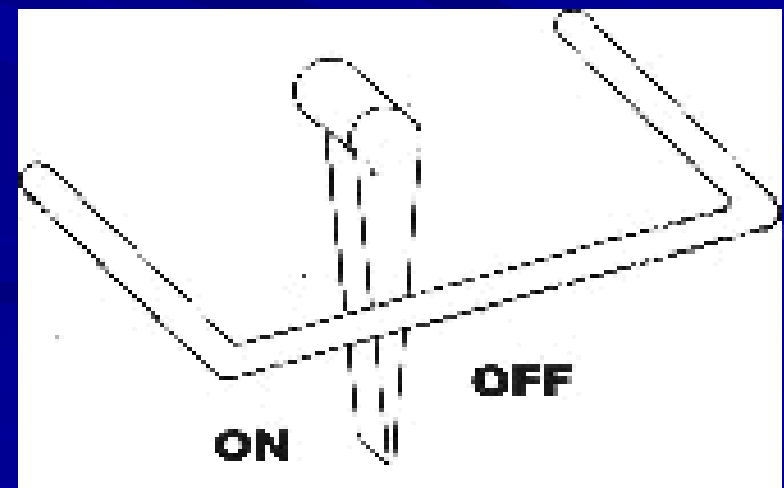
# Recommendations

- Employer should ensure that all equipment, including manufacture-provided safety devices, is maintained in safe operating conditions
  - Have manufacturer or distributor inspect equipment at time of purchase or especially if previously owned
  - Should be regularly examined by employees who have been trained to recognize the hazards
  - Defects should be corrected before returning equipment to service
  - After accident, owner contacted technician to repair Magnetic Safety Switch

# Recommendations

Employer should ensure that all equipment is surveyed regularly to identify appropriate safety control improvements

- After the accident, employer added guard to on/off switch to prevent accidental activation
  - Made from electrical junction box
  - Similar to recessed switch design
- Manufacturer provides similar protection for currently produced equipment
  - U-shaped guard over on/off switch



# Recommendations

- Employers should know and comply with child labor laws and establish the type of work that minors can perform
  - Be very clear about job function and hazards if these functions are violated
  - Continually check to make sure rules are being adhered to

# Recommendations

- Employer should ensure that workers are trained to recognize hazards and avoid the hazards of equipment operation and maintenance
  - Include in-depth description of potential hazards if restrictions and procedures are not followed
    - Dangers of working with energized equipment



# Why Safety standards?



# SAFETY

Absolute safety ,in the sense of a degree of safety which satisfies all individuals or groups under all condition, is neither attainable nor affordable.



**SAFETY  
FIRST**

**THE SAFE WAY IS  
THE BEST WAY**

# SPACE ACCIDENTS

Video clip  
55 min

# Reference

- Mr. Ken Roberts, MS, CIH, CSP, Environmental Services Officer
- Professor Feyen
- Other references to be given on the general reference section.

END



# References

This presentation is put together from, course books , other presentations as well as various websites in the forms of text, photos, audio and video clips.

All the references will be given in the general reference section on the web Ct

# Reference

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