Managing Physical Hazards

Lecture 2 : Risk Assessment of Physical Hazards

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Undergraduate Diploma in
Occupational Health and Safety

Lecture Overview

- **Distinction Between Hazard and Risk**

The lesson clarifies the difference between identifying physical hazards and evaluating the actual risk they pose based on likelihood and severity.

- **Hazard-Specific Risk Assessment**

Emphasises that physical hazards require tailored assessment methods rather than generic assumptions.

- **Key Physical Risk Factors**

Focus on evaluating exposure frequency, duration, energy levels (mechanical, electrical, thermal), and degree of human interaction.

- **Use of Risk Matrices**

Introduces structured tools such as risk matrices and scoring systems to prioritise hazards effectively.

- **Protection of Vulnerable Groups**

Highlights increased risks for vulnerable workers and contractors and the need for targeted risk controls.

- **Legal Compliance in Malta**

Covers mandatory risk assessments, documentation standards, and the importance of regular review to maintain compliance and effectiveness.

Learning Objectives

1. Understand the difference between a hazard and a risk
2. Learn how to assess different types of physical hazards
3. Identify key risk factors like exposure time and energy levels
4. Use a risk matrix to calculate and prioritise risks
5. Recognise workers who may be more vulnerable to harm
6. Apply these skills to real workplace situations

Introduction to Physical Hazards

- Physical hazards are workplace hazards that arise from environmental conditions or sources of energy that can cause harm to the body without necessarily involving chemical reactions or biological agents. They are typically linked to the presence of force, motion, temperature, pressure, or radiation. Unlike other hazard types, physical hazards often result from exposure to measurable forms of energy that interact directly with the human body.
- Common examples of physical hazards include excessive noise, mechanical vibration, electricity, moving machinery, extreme heat, extreme cold, and different forms of radiation. These hazards are frequently found in industries such as construction, manufacturing, healthcare, and energy production. Each hazard presents unique risks depending on how it is generated, controlled, and encountered in the workplace environment.
- Physical hazards involve the transfer or release of energy, whether mechanical, electrical, or thermal, which can damage tissues, organs, or body systems. The level of harm depends on factors such as intensity, duration of exposure, and proximity to the source. Environmental conditions, workplace design, and worker interaction with equipment all influence how significantly these hazards affect health and safety

Importance of a Systematic Risk Assessment

- Systematic assessment of physical hazards plays a critical role in preventing workplace injuries and fatalities. By identifying sources of mechanical, electrical, or thermal danger early, employers can implement controls before incidents occur. This proactive approach reduces accidents such as machinery entanglement, electric shocks, or heat-related illnesses, helping protect workers from both immediate harm and long-term health effects.
- A structured hazard assessment also ensures compliance with occupational health and safety regulations. Employers are legally required to evaluate risks and demonstrate that appropriate control measures are in place. Proper assessment and documentation show due diligence and accountability, reducing the likelihood of legal penalties while ensuring that safety standards are consistently applied across all operations and activities.
- Beyond safety and compliance, systematic assessment improves overall workplace efficiency. When hazards are identified and managed effectively, there are fewer disruptions caused by injuries, equipment damage, or emergency responses. A safer work environment supports smoother operations, higher worker confidence, and improved productivity, creating both human and organisational benefits

Why Distinction Matters?

- Understanding the difference between hazard identification and risk evaluation is essential when dealing with physical hazards. Simply recognising a hazard does not reveal how dangerous it truly is. Without proper evaluation, workplaces may misjudge the seriousness of hazards involving machinery, electricity, noise, or temperature extremes, leading to poor safety decisions.
- Overestimating risk can result in unnecessary controls, increased costs, and reduced operational efficiency. For example, treating all physical hazards as high risk may lead to excessive restrictions or overuse of protective equipment. This can create compliance fatigue, where workers become less responsive to genuinely serious physical dangers over time.
- Underestimating risk is even more dangerous, especially with high-energy physical hazards. Assuming low risk without proper assessment may expose workers to severe injuries such as electrical burns, crush injuries, or heat stress. This often happens when hazards are familiar or appear routine, leading to complacency and inadequate control measures.
- Recognising the distinction supports targeted and proportionate safety controls. When risk is accurately evaluated, employers can focus resources on the most serious physical hazards. This leads to more effective prevention strategies, better worker protection, and improved compliance with occupational health and safety standards.

Types of Physical Hazards (1/2)

1. Mechanical Hazards

Risks from moving or sharp objects.
Examples: rotating machinery, moving vehicles, falling objects, cutting tools.

2. Electrical Hazards

Dangers caused by electrical energy.
Examples: electric shock, arc flash, exposed wiring, faulty equipment.

3. Thermal Hazards

Exposure to extreme temperatures (hot-cold-freezing-windy environmental condition)
Examples: hot surfaces, flames, steam, extreme cold, heat stress, burns.

4. Noise Hazards

Harm caused by excessive sound levels.
Examples: loud machinery, construction tools, prolonged industrial noise leading to hearing loss.

Types of Physical Hazards (2/2)

5. Vibration Hazards

Exposure to continuous or repeated vibration.
Examples: power tools, heavy vehicles, hand-arm vibration syndrome (HAVS).

6. Radiation Hazards

Exposure to harmful energy waves or particles.
Examples: UV radiation, X-rays, ionising and non-ionising radiation.

7. Pressure Hazards

Risks from high- or low-pressure environments.
Examples: compressed gas cylinders, boilers, diving operations.

Hazard Specific Risk Assessment Approach(1/2)

- Physical hazards vary widely in how they can cause harm, which makes a one-size-fits-all approach ineffective. For example, mechanical hazards like moving machinery require different evaluation methods than thermal hazards such as hot surfaces. Each hazard has unique characteristics, energy levels, and exposure patterns that influence both the likelihood of injury and the severity of outcomes, making tailored assessments essential.

- Generic risk assumptions may overlook critical details specific to physical hazards. Noise exposure, for instance, depends not only on loudness but also on exposure duration, frequency, and worker proximity. Similarly, electrical hazards require evaluation of voltage, current, insulation quality, and control measures. Using standard assumptions for all hazards can result in underestimating serious risks or overestimating minor ones.

- Hazard-specific assessment allows for precise measurement of risk factors. Thermal hazards may need temperature monitoring and evaluation of contact time, whereas vibration hazards require analysis of frequency, intensity, and duration of tool use. Each type of physical hazard interacts differently with human physiology, so a tailored approach ensures that assessment reflects real-world conditions and potential harm accurately.

Hazard Specific Risk Assessment Approach(2/2)

- Different hazards also demand different control strategies, which can only be determined through specific assessment. Mechanical hazards might require guards and emergency stops, while electrical hazards need insulation and lockout systems. Thermal hazards may be controlled through PPE or engineering solutions such as ventilation or heat shields. Tailoring the assessment ensures appropriate measures are implemented efficiently and effectively.

- Finally, hazard-specific assessments improve prioritisation and resource allocation. By evaluating each physical hazard based on its unique risk factors, workplaces can focus on the most dangerous conditions first. This reduces injuries, improves compliance, and increases overall safety efficiency. Tailored assessments also provide better documentation and evidence for legal and regulatory obligations in occupational health and safety.

Exposure Frequency

Exposure frequency is a key factor when assessing physical hazards because it directly affects the likelihood of harm occurring. Hazards encountered frequently, such as loud machinery in a factory or repeated use of vibrating tools, increase the probability of injury or long-term health effects like hearing loss or hand-arm vibration syndrome. In contrast, hazards encountered only occasionally, like rare access to high-voltage equipment, may present lower overall risk if proper precautions are followed. Assessing exposure frequency helps prioritise control measures, ensuring that hazards with frequent worker interaction receive the most attention. Accurate frequency evaluation is critical for mechanical, electrical, thermal, and other physical hazards to prevent cumulative or repeated harm.

Exposure Duration

Exposure duration refers to the length of time a worker is exposed to a physical hazard during a single incident or over repeated tasks. Longer exposure periods increase the likelihood of injury or the development of chronic health conditions. For example, prolonged contact with vibrating hand tools can lead to hand-arm vibration syndrome, while extended exposure to extreme heat may cause heat stress or heat stroke. Even low-level hazards can become significant risks when exposure is sustained. Evaluating exposure duration is essential for all physical hazards—mechanical, electrical, thermal, noise, or vibration—because cumulative effects often determine the severity of harm and help guide the design of control measures.

Energy Limit Involved (1/3)

Mechanical Energy
•Energy from moving or falling objects, machinery, tools.
•Examples: cuts, crush injuries, fractures, collisions.
•Calculated via kinetic energy: E=12mv2E = \frac{1}{2} m v^2E=21mv2.

Thermal Energy
•Energy from extreme heat or cold.
•Examples: burns, frostbite, heat stroke, hypothermia.
•Measured via temperature and exposure time.

Electrical Energy
•Energy from electrical currents and voltage.
•Examples: electric shock, electrocution, burns.
•Safety threshold depends on current (mA), voltage (V), and duration.

Energy Limit Involved (2/3)

Radiation Energy
- Energy from ionizing (X-rays, gamma rays) and non-ionizing (UV, microwaves) radiation.
- Examples: tissue damage, cancer, eye injuries, burns.
- Measured via dose (Sieverts) or intensity (W/m^2).

Acoustic Energy
- Energy from high-intensity sound or vibrations.
- Examples: hearing loss, stress, fatigue.
- Measured in decibels (dB).

Kinetic Energy (Falls & Slips)
- Energy from sudden motion or impact.
- Examples: fractures, sprains, head injuries.
- Depends on body mass and speed of fall.

Pressure/Explosion Energy
- Energy from sudden pressure changes, blasts, or compressed gases.
- Examples: concussive injuries, ruptured eardrums, structural damage.

Energy Limit Involved (3/3)

Hazard Type	Energy Limit Concept	Typical Thresholds
Mechanical impact	Maximum force or impact energy before injury	E.g., 50 J can fracture a finger bone
Fall from height	Kinetic energy at impact	2–3 m fall can cause serious injury depending on body orientation
Noise	Sound energy level	>85 dB over 8 hours can cause hearing loss
Heat/Cold	Energy transfer rate to tissue	>44°C skin exposure can cause burns; <0°C prolonged exposure causes frostbite
Electric shock	Energy in volts & amps	50 mA through the heart can be fatal (AC, 220 V)
Radiation	Dose absorbed	>1 Sv acute exposure can be fatal (ionizing radiation)

Human Interaction Level

Human interaction with hazards can be **direct or indirect**. Direct contact occurs when a person physically touches or operates machinery, tools, or materials, increasing the likelihood of injury from cuts, burns, or electrical shocks. Indirect exposure occurs when humans are near hazards but not in immediate contact, such as standing near moving machinery or loud equipment. For example, a worker directly operating a lathe is at higher risk of hand injuries than someone observing from a control panel.

Interaction can also be classified as **manual or automated**. Manual processes require human presence and control, making the person more susceptible to physical hazards such as repetitive strain injuries, falls, or crushing accidents. Automated processes reduce direct human involvement, lowering exposure risk, though hazards remain if safety protocols fail. For instance, a conveyor belt operated manually poses a higher risk than one monitored automatically with safety guards in place.

Greater human interaction increases both the probability and severity of injuries. The more a person handles, touches, or manipulates hazardous equipment, the higher the chance of accidents. Training, protective gear, and safety systems are essential to mitigate this risk. For example, a welder working directly with high-temperature arcs and molten metal faces more immediate danger than a technician controlling the welding remotely, highlighting how interaction level directly influences hazard exposure.

Environmental Factors

The **workplace layout** plays a critical role in physical hazards. Poorly organized spaces, cluttered walkways, or obstructed emergency exits increase the risk of slips, trips, and collisions. Machinery placed too close together can also lead to accidental contact or entrapment. For example, a factory with narrow aisles and scattered tools exposes workers to higher chances of falls and injuries compared to a well-structured, open workspace with designated zones.

Weather conditions significantly influence hazard levels, especially in outdoor environments. Extreme heat, cold, rain, or high winds can worsen physical hazards like slips, burns, frostbite, or heatstroke. Wet or icy surfaces increase fall risks, while strong winds can destabilize scaffolding or loose materials. For instance, construction workers on a rainy day face a much higher risk of slipping from scaffolds than on dry, stable surfaces.

Confined spaces pose unique physical hazards due to limited access, poor ventilation, and restricted movement. Workers in tanks, tunnels, or small utility rooms may be more vulnerable to falls, collisions, or exposure to hazardous energy. Emergency evacuation can be difficult in such spaces, amplifying injury severity. For example, a maintenance worker inside a narrow storage tank faces higher risk from slips, machinery, or sudden equipment movement than in an open workspace.

Risk Matrix Overview

A **risk matrix** is a structured tool used to evaluate and prioritise hazards by combining **likelihood (probability)** and **severity (impact)** of an incident. It converts qualitative assessments into a visual format, allowing managers and safety teams to quickly identify high-priority risks. Common formats include **3x3** (low, medium, high) or **5x5** (very low to very high) grids. Each cell represents a combination of how likely an event is and how severe its consequences could be, guiding decision-making for mitigation strategies and resource allocation in workplaces with multiple hazards.

By plotting hazards on a matrix, organisations gain a **clear visual of risk prioritisation**. High-likelihood, high-severity hazards are flagged as critical and require immediate intervention, while low-likelihood, low-severity risks can be monitored or accepted. This approach enhances communication across teams, as everyone can see which hazards demand urgent attention. Risk matrices also support **preventive planning**, helping teams implement controls before incidents occur. For example, machinery prone to frequent failure and causing serious injury would appear in the “high-high” zone, signaling urgent corrective action.

Risk Matrix Overview

RISK MATRIX 5X5

Consequence
How severe could outcomes be if the risk event occurred?

Likelihood
What's the chance of the risk occurring?

	Insignificant 1	Minor 2	Significant 3	Major 4	Severe 5
5 Almost certain	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
4 Likely	Medium 4	Medium 8	High 12	Very high 16	Extreme 20
3 Moderate	Low 3	Medium 6	Medium 9	High 12	Very high 15
2 Unlikely	Very low 2	Low 4	Medium 6	Medium 8	High 10
1 Rare	Very low 1	Very low 2	Low 3	Medium 4	Medium 5

Risk Matrix Overview (Scenario 1)

Scenario 1 – Construction Site Fall Hazard:

A construction site reports frequent worker falls from scaffolding. Using a **5x5 risk matrix**, the likelihood is “high” due to repetitive tasks at height, and severity is “very high” because falls can result in fractures or fatalities. The hazard appears in the top-right zone, prioritising it for immediate mitigation. Controls implemented include safety harnesses, guardrails, scaffolding inspections, and worker training. The matrix allows management to track whether interventions reduce the risk level over time, ensuring safety standards are met and regulatory compliance is maintained.

Score 5x4 =20 (Extreme- Red)

Risk Matrix Overview (Scenario 2)

Scenario 2- Warehouse stuck by falling object

In a warehouse, a worker is stacking boxes on a high shelf. One box becomes unstable and falls, hitting the worker on the shoulder. The likelihood is moderate because stacking is routine but not always perfectly stable. The impact is medium, causing bruising or minor fractures rather than serious injury. Preventive measures include proper stacking procedures, using safety helmets, training workers, and securing heavier boxes at lower levels. This scenario represents a **medium-risk physical hazard** where moderate severity and occasional likelihood require proactive controls.

Score 3x3= 9 (Medium – Yellow)

Risk Matrix Overview (Scenario 3)

Scenario – Office Slip on a Small Spill:

In an office, a worker accidentally spills a small amount of water near a printer. The likelihood of someone slipping is low because the spill is quickly noticed, and the area is not heavily trafficked. The potential impact is also low, as the worker may only experience a minor slip or stumble without injury. Basic controls, such as placing a warning sign, promptly cleaning the spill, and maintaining good housekeeping, are sufficient to reduce risk and prevent accidents. This represents a low-impact, low-severity physical hazard.

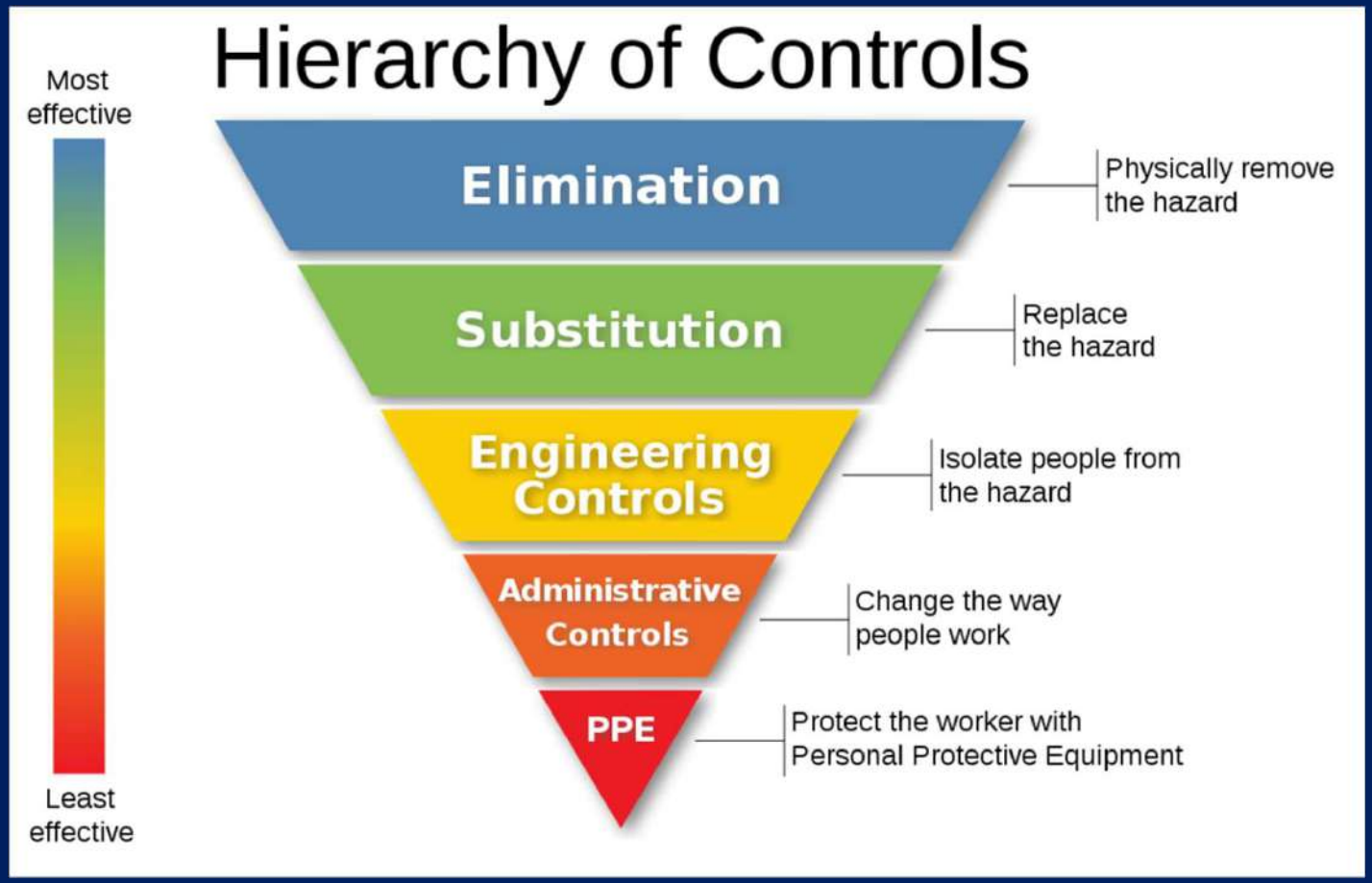
Score 1x3=3 (Low – Green)

Prioritising Physical Hazards

Prioritising physical hazards involves addressing the **highest risk hazards first**, based on their likelihood and severity. Structured methods like risk matrices help identify which hazards could cause the most harm if left uncontrolled. By focusing on critical risks, organisations can prevent severe injuries, fatalities, or major operational disruptions. For example, hazards involving heavy machinery, electrical exposure, or work at height are usually prioritised due to their potential for serious consequences compared to minor physical risks.

Effective prioritisation also supports **smart resource allocation strategies**. Time, funding, and safety personnel should be directed toward hazards that pose the greatest threat. This ensures safety investments deliver maximum impact rather than being spread thinly across low-risk issues. A structured prioritisation approach improves planning, enhances compliance, and supports continuous risk reduction. By systematically ranking hazards, organisations create safer environments while making informed decisions about training, equipment upgrades, and engineering controls that reduce physical hazard exposure.

Control Measures (Hierarchy of Control)



Vulnerable Workers (Physical Hazards RA)

Young workers are often more vulnerable to physical hazards due to limited experience, incomplete training, and a lower awareness of workplace risks. During risk assessments, their unfamiliarity with machinery, tools, or hazardous environments can increase the likelihood of accidents. They may also underestimate danger or hesitate to speak up about unsafe conditions. As a result, organisations must account for their vulnerability by implementing enhanced supervision, tailored training, and simplified safety procedures to reduce exposure to physical hazards.

Pregnant workers face increased risk from certain physical hazards because of physiological changes that can affect balance, fatigue levels, and tolerance to strain or environmental conditions. Risk assessments must consider hazards such as heavy lifting, prolonged standing, vibrations, or exposure to extreme temperatures. These factors can increase both the likelihood of injury and the severity of consequences for both the worker and the unborn child. Adjusted duties, flexible work arrangements, and environmental modifications help reduce these risks.

Workers with disabilities may encounter heightened exposure to physical hazards depending on mobility, sensory, or cognitive limitations. Risk assessments must evaluate how workplace layouts, emergency procedures, or equipment usability affect their safety. For example, reduced mobility may increase the risk of falls or delay evacuation during emergencies. By identifying these factors, organisations can introduce reasonable adjustments such as assistive equipment, accessible layouts, and personalised safety plans to minimise physical hazard risks and ensure inclusive protection for all workers.

Contractors and Third Parties(Physical Hazards RA)

Contractors and third-party workers are often at greater risk from physical hazards because they are less familiar with site-specific risks, layouts, and safety procedures. During risk assessments, this lack of familiarity can increase the likelihood of accidents involving machinery, traffic routes, or hazardous environments. Without proper awareness, contractors may unknowingly enter restricted zones or misuse equipment. Including them in hazard identification ensures that physical risks are clearly communicated and integrated into the overall workplace safety plan.

Communication gaps between organisations and contractors can further increase exposure to physical hazards. Differences in procedures, language barriers, or unclear responsibilities may lead to unsafe practices or misunderstandings about controls. Risk assessments must emphasise structured inductions, clear safety briefings, and active supervision to bridge these gaps. By ensuring contractors receive the same level of hazard information and oversight as employees, organisations can reduce incidents and maintain consistent physical hazard control across all workers on site.

Legal Framework

Under Maltese law, employers have a strong **duty of care** to protect workers from physical hazards and ensure a safe working environment. The Health & Safety at Work (**HSAWA)** Act XXXIII - Chpt 646 of 2024 reinforces this obligation by requiring employers to identify, assess, and control risks that could harm employees or others on site. Guided by the Occupational Health and Safety Authority in Malta, the law emphasises prevention through proactive safety management, ensuring workplaces systematically address hazards before incidents occur.

Mandatory risk assessments are a core legal requirement under **Legal Notice 36/2023 – General Provisions of Prevention**. Employers must evaluate physical hazards, implement preventive measures, and regularly review controls to maintain compliance. These regulations require structured documentation, worker consultation, and continuous monitoring of workplace risks. By enforcing formal risk assessment processes, Maltese legislation ensures organisations actively manage physical hazards, allocate resources effectively, and demonstrate accountability in protecting employees, contractors, and third parties from harm.

Documentation Requirements

Proper documentation is essential for managing physical hazards because it ensures traceability, consistency, and accountability in the risk management process. Written risk assessments provide a structured record of identified hazards, their likelihood and severity, and the control measures implemented. Hazard registers act as living documents that track ongoing risks, helping organisations monitor changes in equipment, processes, or environments. Control records, such as maintenance logs, inspection reports, and training documentation, demonstrate that preventive actions are actively maintained. Together, these documents create a clear audit trail that supports legal compliance, internal reviews, and incident investigations. They also improve communication between managers, workers, and regulators by providing transparent evidence of hazard management. In the context of physical hazards, strong documentation ensures that risks are not only identified but consistently controlled, reviewed, and improved over time.

Review and Updating Assessments

Risk assessments for physical hazards must be treated as living documents that evolve with workplace conditions. Regular review cycles ensure that existing controls remain effective and that new risks are not overlooked over time. Reviews should be scheduled periodically, but also triggered by key events such as workplace incidents, introduction of new equipment, process changes, or layout modifications. These trigger events can significantly alter exposure to mechanical, thermal, or electrical hazards. Updating assessments promptly ensures controls remain relevant and aligned with real conditions. Continuous review also supports learning from near misses and adapting preventive strategies. By maintaining dynamic, up-to-date risk assessments, organisations ensure ongoing protection against physical hazards and demonstrate a proactive, rather than reactive, approach to workplace safety management.

Common RA Mistakes

Copy-paste risk assessments: A common mistake in assessing physical hazards is relying on copy-paste risk assessments that are not tailored to real conditions. Generic templates may overlook site-specific risks such as machinery layout, uneven flooring, or working at height. For example, using an old assessment from a warehouse in a construction site could miss excavation or plant movement hazards. Risk assessments must reflect actual environments, tasks, and equipment to remain accurate and effective.

Ignoring real exposure data: Another mistake is ignoring real exposure data and relying on assumptions instead of evidence. Physical hazards like noise, vibration, heat, or mechanical failure should be measured and monitored. For instance, assuming noise is safe without decibel readings may expose workers to hearing loss. Similarly, skipping inspections can hide faulty guards or worn tools. Accurate assessments depend on observations, testing, and incident data to properly evaluate real hazard levels.

Lack of worker consultation: A lack of worker consultation can weaken physical hazard assessments significantly. Workers often understand daily risks better because they interact directly with tools, machinery, and environments. Ignoring their input may overlook hazards like slippery areas, unstable loads, or unsafe shortcuts. Involving workers encourages practical insights and stronger safety ownership. Effective assessments combine management planning with frontline experience to identify realistic hazards and implement controls that truly reduce risk.

Case Study 1

Case Study 1 – Manufacturing Plant Machinery Risk Assessment:

A manufacturing company conducted a risk assessment after several near misses involving rotating machinery. The safety team observed workers interacting with conveyor belts and cutting machines during maintenance tasks. Hazards identified included entanglement, sharp edges, and unexpected start-ups. The assessment involved walkthrough inspections, worker interviews, and review of incident records. Likelihood was rated high due to frequent exposure, and severity was severe due to amputation risks. Control measures included installing fixed guards, implementing lockout/tagout procedures, and providing refresher training. Visual warning signage and supervision were added to reinforce safe behaviour. After implementation, follow-up reviews showed reduced near misses and improved compliance.

Case Study 2

Case Study 2 – Construction Site Fall Hazard Assessment:

A construction contractor carried out a risk assessment before starting roofing work on a multi-storey building. The team evaluated hazards such as working at height, unstable ladders, and falling objects. Site inspections revealed unprotected edges and inconsistent ladder use. Weather conditions, including strong winds, were also considered. Likelihood was assessed as medium to high due to task frequency, while severity was critical because falls could be fatal. The company introduced guardrails, safety harness systems, and secured access ladders. Workers received a toolbox talk on fall prevention, and daily inspections were scheduled. The assessment was documented and reviewed weekly as work progressed. This scenario highlights how proactive planning and environmental considerations help manage physical hazards before high-risk activities begin.

Case Study 3

Case Study 3 – Warehouse Manual Handling and Impact Hazards:

A logistics company conducted a risk assessment after an increase in minor injuries in its warehouse. Observations showed workers manually lifting heavy boxes and stacking goods at height. Hazards included musculoskeletal strain, falling objects, and collisions with moving pallet trucks. The team gathered data from injury logs, conducted ergonomic assessments, and consulted workers about daily challenges. Risks were rated medium, with potential for serious injury if loads fell. Controls introduced included mechanical lifting aids, weight limits, improved shelving stability, and marked traffic routes. Training on safe lifting techniques and pedestrian segregation was also implemented. Post-assessment monitoring showed reduced injury rates and improved workflow. This case demonstrates how combining data analysis, worker feedback, and engineering controls strengthens physical hazard management.

Summary of Key Points

1. Hazard vs Risk distinction
2. Hazard-specific assessment factors
3. Use of matrices for prioritisation
4. Legal compliance importance

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