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MINISTRY OF LAND MANAGEMENT, URBAN PLANNING AND CONSTRUCTION

គោលការណ៍ណែនាំ

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Construction Workplace Health & Safety Guidelines

ផ្នែកទី ១- Volume 1

ឆ្នាំ២០២២ - Year 2022

CONSTRUCTION WORKPLACE HEALTH & SAFETY GUIDELINES

VOLUME 1

Ministry of Land Management, Urban Planning and Construction

Preface

The Royal Government of Cambodia has considered the construction sector as an engine of economic growth and it has become a pillar along with three other pillars, such as agriculture, garment and footwear industry, and tourism. The Ministry of Land Management, Urban Planning and Construction has been effectively implementing the Law on Construction.

With the growth of the construction sector, construction site safety and health require great attention in order to assure the safety of and mitigate risks to individuals engaged in construction works, especially workers employees, and staff at construction sites. In this regard, the Ministry of Land Management, Urban Planning and Construction has continually introduced legal measures and regulations to further strengthen and promote well-being and safety of workers, employees, and staff at construction sites.

Addressing these issues the Ministry of Land Management, Urban Planning and Construction cooperate with the Australian Embassy in Cambodia to develop Construction Workplace Health and Safety Guidelines which are a regulation for workers employees ad design companies and construction companies, and individuals involved in construction works so as to avoid accidents at construction sites which affect people's health and lives as well the planning and plans of construction projects.

I requires that investors, workers, employees, and people involved in Cambodia's construction sector pay close attention to their own safety and health while working at construction sites.

Deputy Prime Minister
Minister of Land Management, Urban Planning and Construction

CHEA SOPHARA

Preface of

His Excellency the Australian Ambassador to the Kingdom of Cambodia

Cambodia's dynamic and growing construction sector is a key driver of economic growth. It also supports the livelihoods of 150,000 construction sector workers and their families. While the construction sector has supported Cambodia's rapid development, it also presents new challenges including the need to improve workplace safety on Cambodia's construction sites.

Following several serious incidents at construction sites, Australia responded quickly and effectively to the Royal Government of Cambodia's request for support to improve the safety of Cambodia's construction workers, their families and the public.

In September 2021, I had the pleasure of participating in the signing ceremony for the Memorandum of Subsidiary Agreement (MSA) between Australia's Department of Foreign Affairs and Trade and the Ministry Land Management Urban Planning and Construction (MLMUPC) to enhance construction safety in Cambodia.

Since the signing, a technical adviser funded by the Government of Australia and a team of experts from the MLMUPC has developed the Construction Workplace Health and Safety (WHS) Guidelines. These Guidelines are an important step to improving the health and safety of Cambodians engaged in the Kingdom's dynamic building construction sector.

I commend these Guidelines to all the designers, engineers, project managers, contractors and workers involved in Cambodia's construction sector. By diligently managing safety risks, we will see the necessary improvements in an industry that is vital to Cambodia's future.

The Australian Ambassador to the Kingdom of Cambodia

Pablo Kang

Introduction

Throughout the country, in all facets of construction and demolition activities, measures to guarantee the health and safety of workers and employees need to be considered and put into practice. In doing so, construction workers and employees will be protected from the hazards and dangers that are present on construction sites. To meet this goal, before implementing any measures, it is necessary for those controlling and managing construction sites to consult with and inform workers and employees, or their representatives, in all aspects of construction work, to prevent accidents and incidents and the potential impacts on health and safety.

There are many professionals, technical experts and skilled and unskilled workers involved in Cambodia's construction sector. On any given day, between 150,000 to 180,000 individuals are engaged in construction work. Some workers do receive training in health and safety and are offered at least a basic guarantee of a safe workplace. However, through careful implementation of safety measures, all workers and employees can return safely to their homes and families at the end of each workday

The Construction Workplace Health and Safety Guidelines focus on key areas of construction safety risk. They aim to protect and promote the health and safety of workers and employees. Also, by reducing injury and time lost to accidents, the Guidelines will assist in enhancing the productivity of the construction sector.

The Guidelines do not in any way substitute for the provisions set forth in the Law on Construction promulgated by Royal Kram NS/RKM/1119/019 on 2 November 2019. Nor do they substitute for other legal documents prepared by the General Department of Construction of the Ministry of Land Management Urban Planning and Construction or other government entities. The Guidelines act as a supplementary to existing legal measures and regulations, and serve to inform and guide the workers, employees, design companies, construction companies and individuals involved in construction work.

The production of the Construction Health and Safety Guidelines represents a further example of the effective cooperation between the Ministry of Land Management, Urban Planning and Construction and the Australian Embassy in the Kingdom of Cambodia. They offer a roadmap for construction site workers, employers, professionals, businesspeople in the field of construction and officials at all levels of government for advancing workplace health and safety on Cambodia's construction sites.

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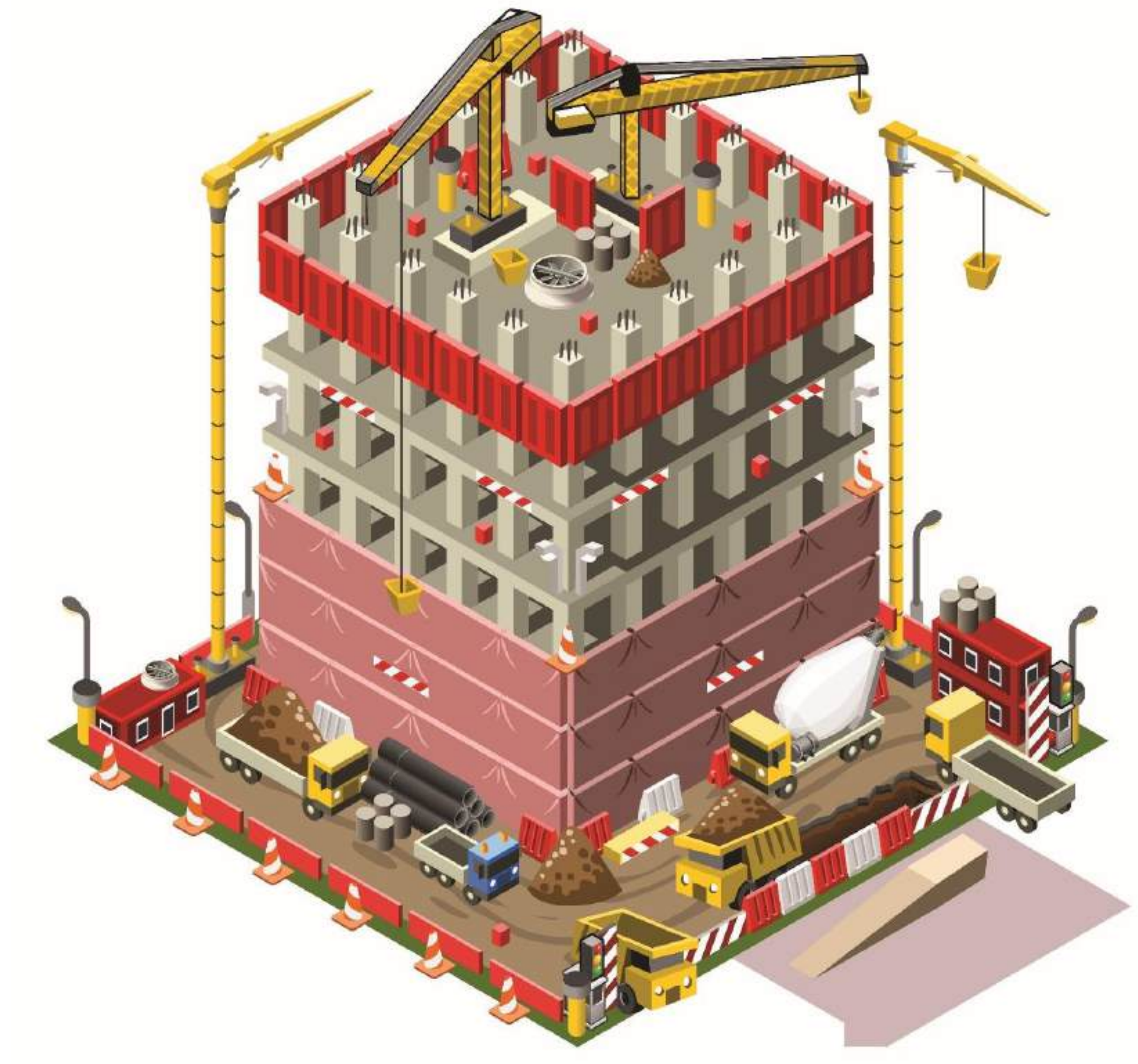
TABLE OF CONTENTS

CHAPTER 1

THE NORMATIVE FRAMEWORK



At the core of work, health and safety are laws and regulations that have been designed to provide a broad framework for improving standards of construction site, health and safety. The laws and regulations are designed to assist construction site owners in:

- Securing the health, safety and welfare of workers and other people at a construction site.
- Protecting the public from the health and safety risks of construction activities.
- Eliminating construction site risks at the source; and
- Involving everyone connected to a construction site to comply with work, health, safety standards.

A normative framework is like a set of guidelines used by everyone involved with a construction site, with the aim of assisting them in providing safer construction sites for workers, visitors and the public.

The WHS Normative Framework establishes a range of obligations and duties for construction site owners, Principal Contractors, workers and other parties connected to a construction site and ensures that there is consistent compliance with legal requirements set by the Government. The following laws and regulations are a summary source of legal compliance obligations relating to construction sites in Cambodia, however, it is advised to refer to all sources of Cambodia law and legislation to ensure a full understanding of all regulations and laws applicable to construction sites in Cambodia.

<u>Prakas on Construction Management</u>

Article 2. Only enterprises, companies, or construction contractors with building permits issued by the Ministry of Land Management, Urban Planning and Construction or the municipal/provincial department of land management, urban planning, construction, and cadastre shall be permitted to open a construction site.

Article 3. Each construction site may only be processed if it has received authorisation to open a construction site. The authorisation to open a construction site shall be applied for from the Ministry of Land Management, Urban Planning and Construction or the municipal/provincial department of land management, urban planning, construction, and cadastre, and shall be permitted to open the construction site within no more than one month after receiving the building permit.

The documents to be used in the application for authorisation to open the construction site are:

- Application of the Construction Site Owner.
- Building permit.
- Contract between the Construction Site Owner and a construction enterprise, company or contractor.
- Construction business authorisation of the construction enterprise, company or contractor contracting the construction.

Article 4. Each construction site shall:

- For the construction agent to monitor, regularly file the authorisation to open the construction site, the planned drawings for each specialised construction, the work plan for each stage of the construction and the relevant documents.
- Have construction technicians responsible for the construction with the obligation to give explanations and information to the competent authorities.
- Display a construction board with the name of the construction of the building to be constructed, the construction company, the Construction Site Owner, the architect, the engineer, the construction area, the contact number, and the location of the construction.
- Shall equip the area with lights and fire extinguishers at all times.
- Shall minimise the noise, smoke, dust, and other impacts in a scope and at a time acceptable to the neighbours.

Article 5. Each construction site shall be surrounded by a fence with a height of at least 2.8 metres, and it shall not be constructed on the sidewalk. If the construction is narrow, the temporary fence on the public sidewalk shall retain a walking space on the sidewalk, and the protective screen shall be constructed to a size permitted or determined by the competent authorities. Any construction with a height of five meters or over shall be surrounded by plastic sheeting or safety screening.

Article 6. The construction site shall be kept in good order and clean at all times from the start until the completion of the construction. The Construction Site Owner shall be responsible for managing the order and cleanliness related to the storage of materials or waste affecting the public road or flowing into the culvert of the drainage and canals.

Article 7. The building office, material storage, worker accommodation, machinery and construction activities shall be arranged and processed inside the surrounding site or satellite site or at a place where the order and security is ensured.

Article 8. For the construction that requires the use of lifting equipment and may affect the public road, the Construction Site Owner shall:

- Request authorization from the local authorities to close the road to install the construction assembly and construct a detour.
- Equip signal lights on the closed road to ensure safety and public order at night.

Article 9. In the event that the construction requires piling, the Construction Site Owner and Principal Contractor shall:

- Permit the competent technical officials to enter and inspect the construction site.
- Avoid impacting underground assemblies.
- Ensure the safety around the construction site.
- Arrange the work order in accordance with the technical standard requirements.

Article 10. The Construction Site Owner and Principal Contractor shall provide safety protection tools, including but not limited to helmets, gloves, boots, safety belts for high-rise work, and other protective equipment for workers, workers, and visitors on the construction site at all times.

Article 11. Upon completion of the construction, the Construction Site Owner shall submit a report on its construction process and apply for authorisation to close the construction site from the Ministry of Land Management, Urban Planning and Construction or the municipal/provincial department of land management, urban planning, construction, and cadastre.

The documents to be used in the application for authorisation to close the construction site include:

- Application of the Construction Site Owner.
- Authorization to open the construction site.
- Report on the construction process.

Article 12. Upon the receipt of the authorisation to close down the construction site, the Construction Site Owner shall apply for the certificate of construction compliance from the Ministry of Land Management, Urban Planning and Construction or the municipal/provincial department of land management, urban planning, construction, and cadastre before starting to utilise the construction.

Article 13. Upon completion of the construction, the Construction Site Owner shall remove the fence surrounding the construction site and remove the construction waste to ensure cleanliness.

Article 14. Any construction site breaching the regulations stated in Article 3 shall be temporarily suspended by the competent authorities. In the event that the Construction Site Owner refuses to obey these regulations, the competent authorities shall take action to seize the equipment and materials and file a complaint with the court.

In the event that any construction site breaches regulations detailed in Articles 4, 7, 9, 10, 11, and 12, the competent authorities shall advise the Construction Site Owner to remedy those shortcomings or give a written notice to adjust any points deviating from the approved plans or in violation of the urban planning regulations. Within 15 days after receiving the notice, if nothing has been corrected, the competent authorities shall temporarily suspend the construction site. If the Construction Site Owner refuses to obey the instruction, the competent authorities shall remove and seize the equipment and materials and file a complaint with the court.

In the event that any construction site breaches Articles, 5, 6, and 8, the competent authorities shall impose a penalty and force the Construction Site Owner to comply with the instruction to ensure public order and safety. In the event that the Construction Site Owner refuses to obey the instruction, the competent authorities shall seize the construction materials.

Article 15. A construction site that is temporarily suspended as stated in Paragraph 1 and Paragraph 2 in Article 14 shall be legally reopened only if it meets the requirements of the competent authorities.

The application for the reopening of the construction site is composed of the following:

- Application of the Construction Site Owner.
- Old authorization to open the construction site.
- Construction site suspension letter.
- Certification of the correction of the shortcomings.

Article 16. The Construction Site Owner and Principal Contractor shall comply with the Law on Labour of the Kingdom of Cambodia.

The Law on Construction

Article 1. This law is intended to ensure:

- Construction quality, security, and safety; the protection of property and well-being of construction owners, construction users and the public.
- Aesthetics and good environment for sustainable living in order to promote public well-being.
- Accountability for and efficiency in working and practicing professions in the construction sector.
- An increase in investors' confidence in the construction sector and the promotion of the economically and socially efficient real estate market.

Article7. All construction work shall comply with the building technical regulations.

Compliance with the building technical regulations shall be certified by a certifier who has a licence, or a permit granted by the Ministry of Land Management, Urban Planning and Construction. The conditions and procedure for the construction certification shall be determined by a sub-decree.

Article 8. Every construction shall have a structure that can safely carry all load, according to the function of the construction, as determined in the building technical regulations.

The classifications, types, and sizes of construction that requires structural safety certification shall be determined by a Prakas of the Minister of Land Management, Urban Planning and Construction.

Article 9. Every construction shall comply with the fire safety regulations, as determined in the building technical regulations and provisions of fire prevention and extinguishment.

The classifications, types, and sizes of construction that requires fire safety certification shall be determined by an inter-ministerial Prakas by the Minister of Land Management, Urban Planning and Construction and the Minister of Interior.

Article 22. Construction material, equipment, and product required to assure construction quality and construction users' safety shall be accredited or certified for compliance with the building technical regulations by the Ministry of Land Management, Urban Planning and Construction or with Cambodian Standard by the National Standards Council by having the Cambodian Standard Mark affixed or printed on them and by having a license to use the Cambodian Standard Mark.

The formality and procedure for compliance certification and the types of construction material, equipment, and products required to assure construction quality and construction users' safety shall be determined by a Prakas of the Minister of Land Management, Urban Planning and Construction.

Article 23. The production, distribution, import, sale, supply, and use of any construction material, equipment or product without Cambodian Standard Mark affixed on them, or without accreditation or compliance certification with the building technical regulations shall be prohibited in the case where the construction material, equipment or product is required to have the Cambodia Standard

Mark affixed, or to have accreditation or compliance certification with the building technical regulations.

The use of construction material, equipment, and product that does not comply with building technical regulations shall be prohibited.

The formality and procedure for checking compliance of the use of construction material, equipment, and product with the building technical regulations shall be determined by a Prakas of the Minister of Land Management, Urban Planning and Construction.

Article 26. All building or demolition work shall have prior permission by the competent authority.

Article 27. Building or demolition work in an emergency or in disaster situations in order to save or protect lives or to prevent serious impact or damage to health or property in emergency situations shall not require a prior permit.

Within a period of 30 (thirty) days, at the latest, after the emergency situation ends, the owner of the construction built in the emergency situation shall apply for a certificate of occupancy according to the existing conditions and procedures.

Within a period of 30 (thirty) days, at the latest, after the emergency situation ends, the owner of the construction demolished in the emergency situation shall notify in writing the competent authority.

Article 29. Repair, modification, or installation of construction equipment does not require permission if the work does not affect its load support structure, exterior aesthetics, or the function of the whole building or any part of the building and does not affect public security, safety, and order. In this case, the construction owner shall give the competent authority prior notice.

The types and sizes of repair, modification/alteration or installation of construction equipment that do not require permission shall be determined by a sub-decree.

The formality and procedure for prior notices concerning repairs, modifications or installations of construction equipment which do not require permission shall be determined by a Prakas of the Minister of Land Management, Urban Planning and Construction.

Article 31. A building, repair, or demolition permit does not absolve the individual who is granted the permit from any obligation and responsibility according to the building technical regulations and other existing regulations.

The carrying out of building or demolition work for the construction that does not require a permit does not absolve the construction owner from any obligation and responsibility according to other existing laws and regulations.

Technical Guidelines on Physical Accessibility for Persons with Disabilities

Article 2. The Technical Guidelines on the Physical Accessibility for Persons with Disabilities shall apply to projects on construction and modification of public physical infrastructures, structures, public service buildings, and public spaces such as road networks, walking routes, sidewalks, parks, parking lots, train stations, airports, schools' administrative buildings, education institutions, hospitals and health facilities, and projects on constructions of infrastructures, borey structures, houses, hotels, restaurants, markets, factories and other private buildings for persons with disabilities in the Kingdom of Cambodia to provide accessibility for persons with all types of disabilities to move, enter/exit, move up/down and access easily, safely and without barriers.

Article 3. Entities or units with the authority to issue construction permits shall require construction owners to design physical infrastructures which are accessible by persons with all types of disabilities including entry/exit, moving up/down and access to connection paths, gratings, tactile paving surfaces, ramps, paths, safety handrails, stairs, doors and door handles, lifts and lift buttons, escalators, travelators, alarms, internal passages, resting rooms, signs, signal lights, service counters, urban-style and rural-style toilets, urinals, hand washing sinks, water sources, hand pumps, bathrooms, classroom or meeting hall furniture, and other safety equipment in accordance with the technical standards as in the Annex of this Prakas.

The Cambodia Labour Law 1997

Article 3. "Workers", in the sense of this law, are every person of all sex and nationality, who has signed an employment contract in return for remuneration, under the direction and management of another person, whether that person is a natural person or legal entity, public or private. To clearly determine the characteristics of a worker, one shall not take into account of neither the jurisdictional status of the Principal Contractor nor that of the worker, as well as the amount of remuneration.

Article 6. "Laborers" are those workers who are not household servants or workers, namely those who perform mostly manual labour in return for remuneration, under the direction of the Principal Contractor or his representative. The status of labourer is independent of the method of remuneration; it is determined exclusively by the nature of the work.

Article 7. "Artisans" are persons, who practice a manual trade personally on their own account, working at home or outside, whether or not they use the motive force of automatic machines, whether or not they have a shop with a signboard, who primarily sell the products of their own work carried out either alone or with the help of their spouse or family members who work without pay, or with the help of workers or apprentices, but the entire workshop is solely under the direction of their own. The number of non-family workers, who regularly work for an artisan, cannot exceed seven; if this number is exceeded, the Principal Contractor loses the status of artisan.

Article 8. "Apprentices" are those who have entered into an apprenticeship contract with a Principal Contractor or artisan who has contracted to teach or use someone to teach the apprentice his occupation; and in return, the apprentice has to work for the Principal Contractor according to the conditions and term of the contract.

Article 9. In accordance with the stability of employment, it is distinguished:

- Regular workers.
- Casual workers, who are engaged to perform an unstable job. Regular workers are those who regularly perform a job on a permanent basis. Casual workers are those who are contracted to.
- Perform a specific work that shall normally be completed within a short period of time.
- Perform a work temporarily, intermittently and seasonally.

Article 10. Casual workers are subject to the same rules and obligations and enjoy the same rights as regular workers, except for the clauses stipulated separately.

Article 32. Every person of Cambodian nationality working as a worker for any Principal Contractor is required to possess an employment card. No one can keep a worker in his service who does not comply with the provision of the above paragraph.

Article 45. The labour contractor is a sub-contractor who contracts with an entrepreneur and who himself recruits the necessary work force or workmen for the execution of certain work or the provision of certain services for an all- inclusive price. Such a contract must be in writing.

Article 229. All establishments and worksites must always be kept clean and must maintain standards of hygiene and sanitation or generally must maintain the working conditions necessary for the health of the workers.

The Ministry in Charge of Labour and other relevant ministries shall prepare a Prakas (ministerial order) to monitor the measures for enforcing this article in all establishments subject to the provisions of this Chapter, particularly regarding:

- The quality of the premises.
- Cleaning.
- Hygienic arrangements for the needs of personnel.
- Beverages and meals.
- Lodging of the personnel, if applicable.
- Workstations and the seating arrangements.
- Ventilation and sanitation.
- Individual protective instruments and work clothes.
- Lighting and noise levels in the worksites.

Article 230. All establishments and worksites must be set up to guarantee the safety of workers. Machinery, mechanisms, transmission apparatus, tools, equipment and machines must be installed and maintained in the best possible safety conditions. Management of technical work utilizing tools, equipment, machines, or products used must be organized properly for guaranteeing the safety of workers.

The Prakas covered in Article 229, shall also determine the measures for enforcing this article, particularly regarding:

- Risks of falling.
- Moving heavy objects.
- Protection from dangerous machines and apparatus.
- Preventive measures to be taken for work in confined areas or for work done in an isolated environment.
- Risks of liquids spilling.
- Fire prevention.

Article 233. Visits to establishments and inspections of the enforcement of the legislative provisions and regulations regarding health, working conditions and safety shall be made by Labour Inspectors and Labour Controllers. Labour Medical Inspectors and experts in work safety shall collaborate to achieve these inspection missions.

After inspection, if infractions are found, the Labour Inspector shall serve notice on the manager of the establishment by indicating all points that do not conform to the provisions of Chapter VIII of this labour law and the Prakas for its implementation.

Article 242. All enterprises and establishments covered by Article 238 of this law and employing at least fifty workers shall have a permanent infirmary on the premises of the establishment, workshop, or work site.

This infirmary shall be run by a physician assisted by one or more male or female nurses, based on the number of workers.

During working hours, both day and night, there shall always be at least one male or female nurse present.

The infirmary shall be supplied with adequate materials, bandages and medicines to provide emergency care to workers in the event of accidents or occupational illness or sickness during work.

Expenses incurred in organizing and operating this infirmary are the responsibility of the Principal Contractor.

Article 244. When there are more than 200 workers, the infirmary must include, in addition to medicines and bandages, areas for hospitalizing the injured and sick before they are transferred to a hospital or isolated if necessary. These areas must be able to handle two per cent of the personnel employed at the site.

Care, treatment, and food for the injured and sick persons hospitalized in the infirmary are the responsibility of the Principal Contractor.

Article 248. An accident is considered to be work related, regardless of the cause, if it happens to a worker working or during the working hours, whether or not the worker was at fault; it is the accident inflicted on the body of the worker or on an apprentice with or without wage, who is working in whatever capacity or whatever place for a Principal Contractor or a manager of an enterprise.

Equally, accidents happening to the worker during the direct commute from his/her residence to the worksite and home are also considered to be work-related accidents as long as the trip was not interrupted, nor a detour made for a personal or non-work-related reason.

All occupational illness, as defined by law, shall be considered a work-related accident and shall be remedied in the same manner.

Article 249. Managers of enterprise are liable for all work-related accidents stipulated in the Article above regardless of the personal status of each worker. Any person who engages the services of a worker for a specific, occasional work is required to make reparation for accidents that victimized the worker during the work.

Article 250. Every manager of enterprise shall manage or have someone take all appropriate measures to prevent work related accidents.

Article 252. The victim or his beneficiaries are entitled to compensation from the manager of enterprise or the Principal Contractor in the event of work-related accidents inflicting on him and resulting in temporary incapacitation. However, this compensation can be paid on the condition that the accidents cause incapacitation for longer than four days. If the work-related accidents lead to a temporary incapacitation of four days or less, the victim is entitled to his regular wage.

The victim who intentionally causes an accident shall receive no compensation. The competent tribunal can:

- Reduce the compensation if it is proved that the accident was the result of an inexcusable mistake of the victim.
- Increase the compensation if it is proved that the accident was the result of an inexcusable mistake of the Principal Contractor or persons acting for him in management of work.

Article 253. Compensation for fatal accidents or for accidents causing permanent disability is paid to the victim or his beneficiaries as an annuity.

Supplementary compensation is granted to a victim who requires constant care from another person. In the event of incapacitation, compensation shall be paid no later than the fifth day after the accident.

Article 254. Victims of work-related accidents shall be entitled to medical assistance (benefits in kind, medical treatment and medicament as well as hospitalization) and to all surgical assistance and prostheses deemed necessary after the accident.

CHAPTER 2

WORK, HEALTH AND SAFETY CHAIN OF RESPONSIBILITY

Chain of Responsibility (COR) is a simple process of ensuring that everyone has a responsibility to look after the health and safety of themself, other workers, visitors, and any other person who may interact with a construction site.

Understanding the Chain of Responsibility is essential to ensuring your construction site is safe and the risk to injury is minimised for everyone. It helps increase accountability, effective communication, and ensures every person understands their role when entering a construction site.

Although it may be argued that the owner of a construction site has an overall responsibility to ensure that the construction site operates safely, it is up to each and every person to take responsibility for ensuring that they act in a safe manner whilst on a construction site and do not cause a danger to others around them.

A chain of responsibility will ensure your construction site operates in a safe manner

<u>Chain of responsibility - who is liable for worksite injuries?</u>

Chain of Responsibility laws dictate that Principal Contractors are responsible for the health and safety of their workers, as well as anyone else who may be affected by their business or work operations, such as customers and visitors.

<u>How does chain of responsibility work?</u>

Chain of Responsibility can be established by assigning specific responsibilities to particular individuals at a construction site. Every individual with responsibility can then be held responsible through a series of procedural, policy and legal requirements.

This does not mean that every worker at a construction site is given a responsibility to ensure the safety of others at a site; but does put responsibility on some people to ensure that a construction site complies with safety procedures, policy and laws implemented to keep people safe.

The Chain of Responsibility results in an understanding of who had ultimate responsibility for outcomes and consequences. In this way, each individual has some level of influence within that Chain of Responsibility.

Allocating safety duties to competent workers is an important part of chain of responsibility

Why is a chain of responsibility important?

The Chain of Responsibility is an important aspect of WHS management. It is a method of ensuring that the people who have the authority and power to take charge of a situation do so, and that everyone else abides by the policies and procedures governing their respective roles. This can help identify areas of the construction site in need of improvement, as well as areas that are doing well. The benefits of Chain of Responsibility include:

Determining negligence and liability

This legality is often crucial in determining negligence and liability. It ensures that the person who is ultimately responsible for the actions of a worker can be held accountable for those actions.

Workplace health and safety

The Chain of Responsibility is one of the cornerstones of workplace health and safety. Each individual at a construction site has a specific role in identifying risks in their area, and then ensuring that they are managed appropriately. It is effective because it places responsibility on every person involved on a construction site, from owners through to visitors.

Effective disciplinary reporting system

Chain of Responsibility is a disciplinary reporting system used in many organisations. It is widely used to ensure that everyone follows the rules and regulations. When a worker violates a rule, he/she is reported to their superior. The superior will then decide the punishment for the violation. The process continues until the highest-ranking official is reached, who is then the person authorised to impose the punishment.

Protects business reputation
Every construction site is built on the responsibility of its workers. This is a crucial aspect of a construction site. If the worker fails to work properly then it affects the reputation of the construction site.

Safety management system (SMS)

The best way to comply with the responsibilities and duties required by Cambodia Law is to have a Safety Management System (SMS) in place. This includes training, procedures and business practices to identify risk, manage compliance & reporting and document actions taken to manage safety. The biggest benefit of having a SMS is that a construction site can provide a safer work environment for its workers, visitors and the public.

Chain of responsibility – what is your role?

Understanding the Chain of Responsibility will help you understand how to manage health and safety at your construction site. If you are a construction site owner, the last thing you want to worry about is whether or not your construction site is compliant with laws and legislation or if you are risking fines and punishment for non-compliance.

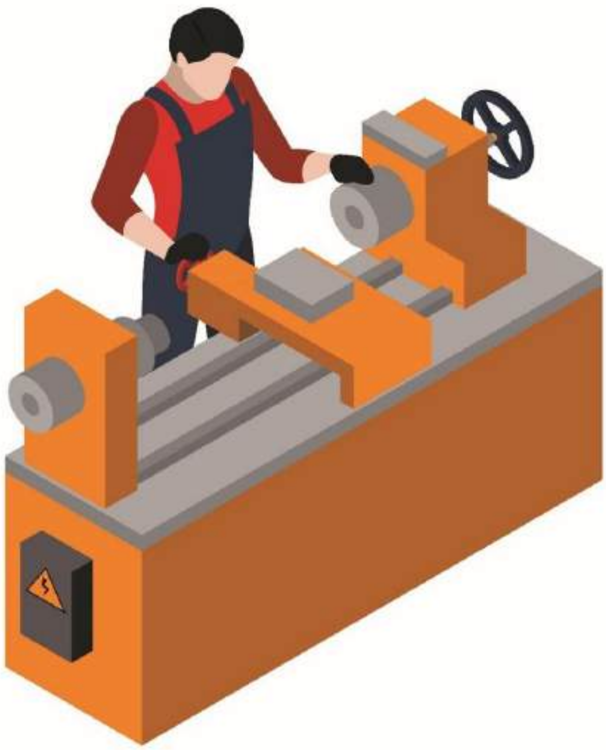
What role do you play in improving safety on a construction site?

Below are some examples of chain of responsibility roles that may be related to your construction site.

Manufacturers

Manufacturers need to ensure that they know the requirements of compliance and conformance of their products and materials and the evidence required to demonstrate compliance. This involves being aware of a range of related requirements such as testing, assurance, and certification.

It also requires manufacturers to understand how a construction site should and should not use their products.



Manufacturers of products used on a construction site have a responsibility to make safe products

Importers, wholesalers, distributors and retailers

Importers, wholesalers, distributors and retailers need to ensure that the products being supplied to a construction site do not breach trade or consumer laws or industry-specific requirements for safety or performance. Some products or materials have specific requirements to demonstrate safety and suitability before they can be lawfully sold and may require independent testing and certification before being supplied.

Architects, designers, engineers and other specialists

Architects, Designers, Engineers and other specialists involved in the planning and design of building and construction must ensure that they understand and specify the performance requirements of building elements and materials. Design consultants must design buildings to comply with the relevant National requirements. This includes the specification of building products which meet the performance requirements of all safety related laws and regulations.

Procurement

Procurement plays a key role in ensuring the right products and materials are used on a job. If you are involved in sourcing and buying materials and products used in construction you need to understand the requirements of compliance and conformance and obtain the evidence required to demonstrate suitability. It also requires procurers to understand how customers should and should not use products and materials.

It is crucial that products, materials and training are not sourced based on the cheapest price but comply with national safety standards and regulations.

Procurement officers have a responsibility to purchase quality, safety rated products

Approval authorities

Approval authorities (such as building certifiers/surveyors) of developments and construction have responsibilities for ensuring that plans, specifications and critical aspects of construction comply with codes, standards and laws. They can also have a role in inspecting buildings and construction and need to be aware of the signs of a product that potentially may not conform to the requirements it purports to meet, and of products and materials being applied incorrectly.

As a government authority, it is your responsibility to adhere to the highest standards of safety and compliance

Developers, specialist tradespersons and workers

Developers, specialist tradespersons and workers do the work of installing and building with products and materials. They are not the only people responsible for ensuring that conforming and complying products and materials are used, but much of the risk and responsibility falls to them because they are the ones that ultimately do the building work.

Developers are responsible for ensuring that cost management does not compromise the performance of the selected building materials, the operation of machinery and overall safety of a construction site. They should also ensure that certificates demonstrating the compliance of purchased and installed materials or training given to workers, comply with the certification documents/building approvals allocated for the construction site. This documentation should be kept with the contract documentation and provided to the building owner on completion of the building work.

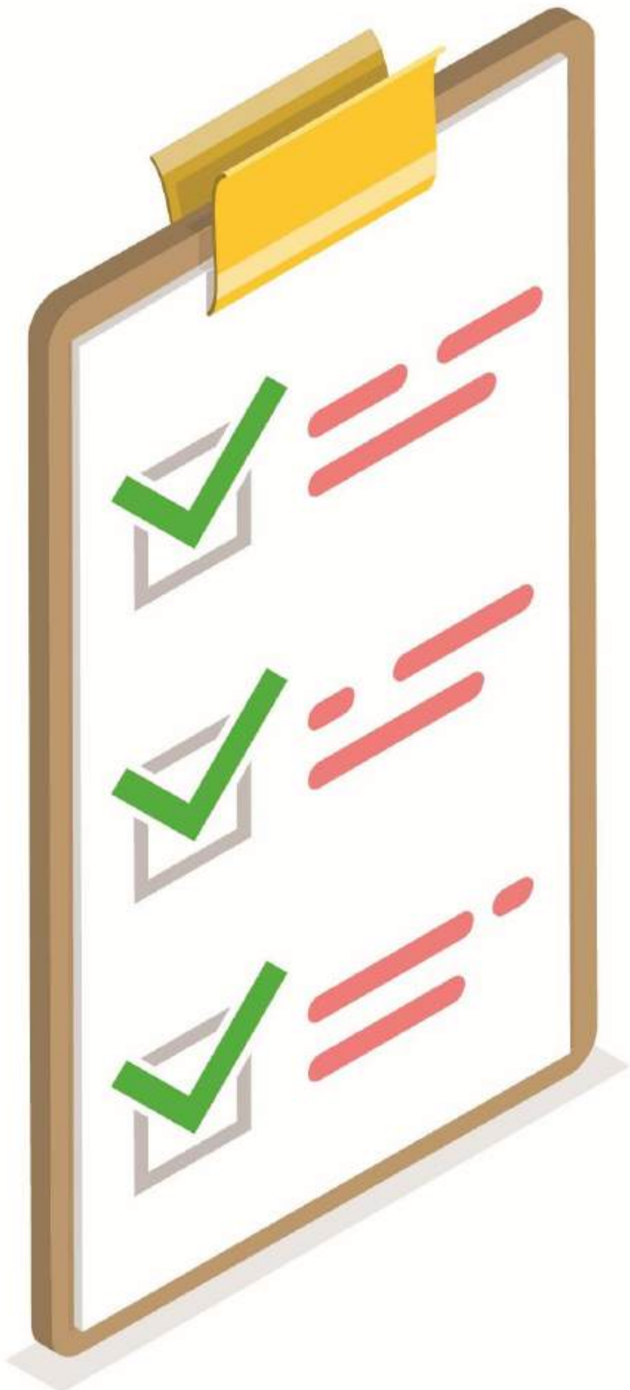
Visitors

Construction sites can be very busy with people visiting frequently. Whether you are a salesperson, trainer, food seller or other related party required to enter a construction site, it is your responsibility to adhere to all of the rules, regulations and safety processes implemented at a construction site. Your safety and the safety of others on a construction site is dependent on you following what is asked of you when you enter a construction site.

As a visitor to a construction site, you have an important role to play in the safety chain of responsibility

CHAPTER 3

SITE SAFETY INDUCTION



Most construction site accidents where a worker was injured or even killed, could have been avoided if the worker had undertaken a construction site safety induction prior to the commencement of their employment and entering a construction site.

While some construction sites may not be very big, a construction site owner must still ensure that any person who works on or enters a construction site, undertakes a site safety induction that includes Work, Health & Safety (WHS) training relating to the particular construction site, before the person works on or enters the site.

The aim of a site safety induction is to make sure that workers and visitors are familiar with the safety rules and procedures of the site including the emergency procedures, the arrangements for supervision of work, who the health & safety representatives are and any specific safety issues on the construction site.

To assist people in meeting their safety obligations whilst on a construction site, a construction site owner must give information about relevant site-specific safety rules, regulations and procedures, and ensure that all workers and visitors to a site are aware of any unusual hazards that may exist on a construction site.

There should be an opportunity for workers to ask questions about their responsibilities whilst on a construction site and to have any issues they may have, clarified by the construction site owner. If a worker is inexperienced, the Principal Contractor must provide any additional safety information and supervision that is needed to make sure that the worker can do the job safely.

The detail required in the site safety induction will vary depending on the complexity of the construction site and factors such as the size of the site, the number and variety of trades working on the site, and how much the site is expected to change as work progresses.

Where there are a number of workers on a construction site, the construction site owner who has overall management and control of the construction site must provide sufficient information to enable those workers to fulfil their site safety induction obligations.

Construction site owner checklist for site safety induction

All workers must be advised of all work, health and safety risks before they start a job or enter a new construction site. Creating a simple site safety induction checklist is a good way to ensure that workers undertake the same site safety induction. A site safety induction checklist will not only provide workers with site safety information, but it will help workers identify:

- if a worker has the skills, training and qualifications needed for their role.
- if a worker is familiar with the work, health and safety rules, safe work methods and specialised equipment used on the construction site.
- what personal protective equipment a worker has and may need.
- if a worker understands the security and emergency procedures for the construction site and who they can report work, health and safety concerns and incidents to.

No	Items covered	Yes No N/A
1	Have you established the competencies and qualifications (including trade qualifications) of the worker?	
2	Have you established proof of the person's construction induction training?	
3	Have you ensured that the person has been taken through relevant safe work method statements (SWMS) for any high-risk tasks to be performed?	
4	Does the person have the correct personal protective equipment (PPE) available? • Hard hat • Safety glasses • Safety footwear • Long sleeved shirt • High visibility vest • Other	
5	Have you shown the person what to do in an emergency and identified the location of the, • assembly point and evacuation route? • closest medical facility? • contact details of emergency services? • provisions for emergency communications?	
6	Have you shown the person, • the location of the first aid facilities / kits? • who the first aiders are and how to obtain treatment?	
7	Have you shown the person where all relevant fire-fighting equipment is located? For example, fire extinguishers, hose reels.	
8	Have you introduced the person to their site health and safety representatives (HSRs)?	
9	Have you shown the person where the worksite facilities (including toilets and drinking water) are located?	
10	Have you explained the procedures for reporting incidents, injuries and hazards?	
11	Has the person been trained to set up and use any specialised equipment that is required?	
12	Have you explained the site security procedures?	
13	Have you explained the site health and safety rules?	
14	Have you given the person an opportunity to ask questions about their responsibilities and to have any issues clarified?	

Table 1: Sample Site Safety Induction Checklist for a construction site owner

<u>Visitors to a construction site</u>

Visitors should be accompanied and supervised by site safety inducted personnel at all times while at a construction site. All visitors must undertake a site safety induction prior to entering a construction site.

Visitor induction checklist

This checklist provides examples of what could be covered in a site safety induction for visitors who enter a construction site.

No	Items covered	Yes	No	N/A
1.	Has the visitor signed in at the site office or a record made of their presence at the worksite?			
2.	Have you shown the visitor what to do in an emergency including, • how to contact help at the worksite and • how an emergency is raised?			
3.	Have you shown the visitor the location of the emergency assembly point and evacuation routes?			
4.	Have you shown the visitor the location of the first aid facilities/kits and how to obtain treatment or assistance?			
5.	Have you explained to the visitor what to do if you become separated?			
6.	Does the visitor have the correct PPE e.g.: • hard hat • safety glasses • safety boots • long sleeve shirt, and • high-visibility vest?			
7.	Does the visitor know how to wear the PPE correctly?			
8.	Have you identified the major hazards and no-go zones at the worksite?			
9.	Do they have any further questions or need clarification on any point?			

Table 2: Sample Site Safety Induction Checklist for a visitor

Information to be provided on a site safety induction

The recommended information to be provided to workers during a site safety induction includes:

- hazards and risks specific to the construction site.
- control measures for hazards and risks such as no-go zones.
- site specific rules that must be complied with such as personal protective equipment like hard hats that workers must wear and use.
- safety documents, policies and plans specific to the construction site such as traffic management plans.
- whom to report accidents, incidents and hazards to and how to submit a report.
- accident, emergency and evacuation procedures and associated equipment at the construction site.
- the layout of the construction site including entries and exists, loading and unloading areas, location of facilities, first aid and security requirements.

You should also update people when there are changes to the construction site that may affect health and safety.

Carrying out site safety inductions

The way a site safety induction can be delivered will depend on various factors, for example the number of people being inducted, the size of the construction site and the complexity of the work, health and safety matters to be discussed.

Some ways site safety induction training can be delivered are through:

- on the job training.
- toolbox talks.
- an induction video or booklet.
- email or a phone conversation.
- web-based 'online' interactive programs.
- a one-off session in a classroom type setting.

Where there are unusual risks associated with the construction site, for example restricted construction site access or machinery hazards, a person who is familiar with the construction site and its risks should be involved in delivering the training.

The induction training should be adapted to address potential cultural or language barriers.

Site safety induction records

A record should be kept of the names of people who have received a site safety induction for your construction site, including information about the training content, who conducted the training, and the date training was provided. Acknowledgement of the training should be obtained from participants, for example the worker's signature on a training register.

Site safety induction cards

Apart from keeping records of people who have participated in your site safety induction, it is important to also provide each attendee with a site safety induction card that is carried upon the person whilst they are on site and easily produced when requested by a construction site owner, construction site representative, safety officer or government authority representative investigating any safety compliance matters.

The site safety induction card may differ in design based on the construction site and need to reflect the specific site requirements of where the worker is going to be performing their job task or activity. But the minimum information required on all site safety induction cards is:

- Name of Induction. (e.g., Site Safety Induction or Site Working at Heights Induction).
- Photo of the inductee.
- Full name of the inductee.
- Company the inductee works for.
- Date of Induction.

In order to ensure workers are given refresher site safety training, construction sites should set a time frame for the renewal of the site safety induction. This may vary between construction sites and job specifics however general time frames can range from between one time every 3 months to one time every year.

Figure 1: A sample site safety induction card for a worker

Figure 2: A sample site safety induction card for a visitor

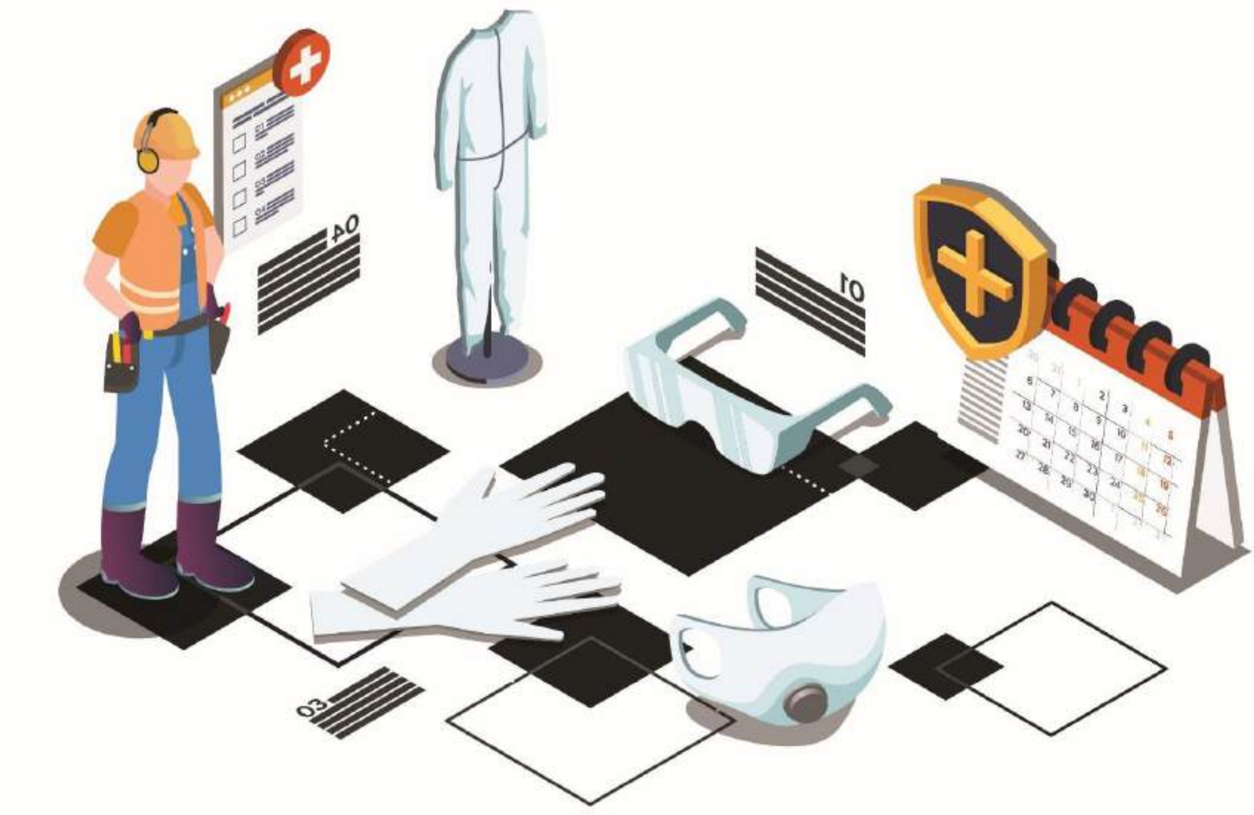
Gender based violence and harassment (GBVH)

Construction site owners and Principal Contractors must ensure that workers undertake Gender Based Violence and Harassment (GBVH) training as part of the required WHS induction and in ongoing guidance and instruction. The aim of the GBVH training is to ensure that all workers are familiar with the GBVH policies and procedures of the construction site, including behaviour which is unacceptable and what reporting mechanisms are available. Advice and instructions relating to GBVH should be available in both Khmer and English to all workers.

Construction site owners and Principal Contractors will monitor GBVH risks and incidents and seek external support from recognised bodies or organisations if monitoring reports suggest that GBVH risks have increased or raise concerns about mitigation measures and response mechanisms.

CHAPTER 4

USE OF PPE



There are times when working on a construction site that workers and visitors to the site will be required to use personal protective equipment (PPE) to protect them from being affected by certain hazards.

This section outlines safety guidelines regarding PPE for those working on a construction site and describes the responsibilities of all people with regards to supplying and using the appropriate PPE.

Personal protection equipment (PPE)

PPE refers to anything used or worn to minimise risk to workers' health and safety. This may include, but is not limited to:

- hearing protective devices, such as earmuffs and ear plugs.
- respiratory protective equipment.
- eye and face protection, such as safety glasses and face shields.
- safety helmets.
- fall arrest harnesses for working at heights.
- skin protection, such as gloves, hats and sunscreen.
- clothing, such as high visibility vests, life jackets and coveralls.
- footwear, such as safety boots and rubber boots.

Construction sites have the potential to be quite hazardous places and it is important to prevent any accidents or injuries from occurring whilst on the job.

The PPE required can vary from construction site to construction site depending on the hazards that may be present. However, the minimum PPE that workers on a construction site should wear include a hard hat, a high visibility vest, and steel cap work boots.

All workers should always wear appropriate PPE when on a construction site

PPE and the risk management process

In most circumstances, you should not rely on PPE as a control measure against hazards. The use of PPE is lowest on the list of control priorities. These controls should not be relied on as the primary means of risk control until the options higher in the list of control priorities have been exhausted.

PPE should only be used:

- as a last resort when you have used all other reasonably practicable control measures and the risk has still not been eliminated.
- as interim protection until higher level controls are in place.
- as a backup measure supplementing other higher-level controls (for example, in high-risk activities such as spray-painting, abrasive blasting and some emergency response actions.

PPE should only be used as a backup to safety control measures

Selecting PPE

Where PPE is to be used it must be:

- selected to minimise risk to health and safety, including by ensuring equipment is:
  - suitable for the nature of the work or hazard.

  - a suitable size and fit for the individual who is required to use it and that it is reasonably comfortable.

- maintained, repaired or replaced, which includes ensuring the equipment is:
  - clean and hygienic.
  - in good working order.

- used or worn by the worker, so far as is reasonably practical.

When choosing PPE consider these factors:

For the worker

- Check the PPE is a suitable size and fit for each worker. Respiratory protective equipment, for example, requires a good facial seal.
- If PPE is comfortable to wear and workers are involved in choosing it, they will be more likely to use it.
- Individual circumstances of workers may affect choice. For example, wearing of prescription glasses, allergies such as latex allergy and some medical conditions.
- Consider workers' medical conditions, which can influence whether they can use certain items of equipment.

For the work task

- Match the PPE to the hazard, remembering that a work task may expose workers to more than one hazard. For example, welders may need protection from harmful welding gases and fumes, as well as ultraviolet radiation, hot metal and sparks.
- How the work is carried out and the level of risk to the worker. For example, a more protective respirator may need to be worn where the level of air contamination is very high.
- How long PPE will need to be worn.
- Work demands of the work activity. For example, the level of physical activity or dexterity required.
- Make sure PPE that is to be worn at the same time can be used together.

For the work environment

- Understand the impacts of a hot and humid work environment.

If you are protecting against exposure to a substance such as a hazardous chemical or a biological substance, consider how the substance can enter the body. For example, where a chemical can be absorbed through the lungs and skin, skin protection as well as respiratory protection may be required.

Choose PPE that meets ‘Safety Standards’. For example, do not reuse single use PPE like disposable gloves or disposable masks.

<u>Protecting your eyes on a construction site</u>

Eye protection

There are many work tasks on a construction site that can present a risk to a worker's eyes. The danger is greatest where various particles are caused to become airborne at speed and particularly near personnel.

Construction sites where chemicals are handled or where high levels of radiation are generated in the work process, for example, most forms of welding, must be carefully assessed to prevent eye injuries, since in these work situations there is an inherent risk of injury to the eye.

Agents of eye damage may be broadly classified into the following four categories:

- Impact or blunt force.
- Foreign bodies.
- Chemicals injurious to the eye; and
- Radiation.

Impact or blunt force

Normally the eyelids close as a reflex action before being struck by any object approaching them. A blow to the eye can therefore cause internal damage without any apparent injury to the surface of the eyeball. Haemorrhage into the aqueous humour may occur. If any doubts exist, seek medical advice. Symptoms would include impaired, especially blurred or double, vision.

Always wear internationally rated eye protection

Foreign bodies

Small foreign bodies may settle on, or become embedded in, the eye. These include dust, flying particles and molten metal splashes. Some foreign bodies have physical effects while some have biological effects, and these may interfere with the normal processes of the eye. If not removed, foreign bodies may cause serious damage.

Foreign bodies with high impact force can penetrate the surface of the eye. Penetration by a small particle may not always be obvious if it leaves only a minute mark on the conjunctiva or cornea. This is often difficult to see. Examples of work activities where foreign bodies with high impact force may be present include:

- grinding.
- polishing.
- chipping.
- drilling.
- machine tooling.
- cutting.
- impact of steel on steel.
- impact of steel on other materials.
- welding, brazing and soldering.
- sandblasting.
- saw milling.
- use of rotary mowers.
- spraying paint or molten metal; and
- use of any high-speed rotating device that may break or disintegrate.

Use eye protection when material is being sent into unpredictable directions

Chemical injuries to the eye

Many chemicals can cause eye damage. The severity of the damage will increase with the concentration of the offending chemical and with the duration of contact with the eye.

Strong alkalis are exceedingly dangerous. Strong acids are more likely to cause damage than solvents, thinners and degreasers.

Commonly used chemical substances causing eye irritation/damage include:

- Acids:
    - Sulphuric.
    - Hydrochloric.
    - Nitric.
    - Hydrofluoric.
    - Glacial acetic, and
    - Chromic.

- Alkalis:
  - Sodium hydroxide (caustic soda).
  - Potassium hydroxide.
  - Calcium oxide.
  - Calcium hydroxide, and
  - Lime and cement mix.

- Corrosive chemicals:
  - Phenols.
  - Ferric chloride. and
  - Aluminium chloride.

- Organic solvents (mode of action could be splashes or exposure to vapours over a long period):
  - Thinners.
  - Paint solvents.
  - Dry-cleaning solvents.
  - Degreasers.
  - Petrol. and
  - Kerosene.

- Surface active agents:
  - Liquid or powder detergents.
  - Cutting oils. and
  - Paint removers.

- Allergens; and

- Others:
  - Ammonia.
  - Phosphorus. and
  - Household bleach (sodium hypochlorite).

Radiation

Exposure to various sources of radiation can cause serious eye damage, particularly to the cornea, lens and retina. Generally, both eyes are affected. Types of radiation that may cause damage include:

- ultraviolet.
- infra-red.
- laser.
- microwave. and
- ionising.

Ultraviolet radiation may damage the cornea, the window of the eye. Infra-red radiation can cause cataracts, or opacity of the lens, on prolonged, heavy exposure. Exposure to light from lasers may result in damage to the retina.

Ultraviolet light generated during electric welding can result in painful burns to the eyes known as 'welder's flash' or 'arc eye'. A 'flash' should not be considered until the eye has been examined for the presence of a foreign body and this has been eliminated. Glass workers' cataracts are an example of eye damage caused by exposure to high doses of infra-red radiation.

Intense visible light or glare can result in dazzle or light stroke. The momentary disorientation may lead to further accidents in the worksite.

Wearing the correct PPE for the task is very important to staying safe on the construction site

Optical glasses

Workers requiring corrective optical lenses should wear protective goggles over the corrective spectacles or wear goggles that incorporate the corrective properties of the prescribed lenses. When goggles are worn over spectacles, clarity of vision must not be impaired. It is preferable for workers who wear prescription glasses to be provided with glasses/lenses and frames with prescription lenses which meet recognised safety standards when working in designated eye protection areas.

Contact lenses

The wearing of contact lenses in the worksite is satisfactory, provided that the appropriate eye protection is used in addition to the contact lenses. Contact lenses should not be regarded as a form of eye protection. Eye protection of welders with contact lenses is the same as that recommended for welders generally.

It is in the interest of the person who wears contact lenses to inform the appropriate people, for example, the safety officer or supervisor, because in case of an eye injury, the first aid procedure will have to make provision for the medically safe removal of the contact lenses.

Protecting your eyes

Hazards

- Chemical or metal splash, dust, projectiles, gas and vapour, radiation.

Options

- Safety spectacles, goggles, face screens, face shields, visors.

Note

- Make sure the eye protection chosen has the right combination of impact/dust/splash/molten metal eye protection for the task and fits the user properly.

Appropriate eye protection signage should be erected in a clearly visible place

Head protection

Head injuries are one of the most common causes of fatality. It is important to choose the correct head gear and use it correctly. A common example of head protection is a hard hat.

Head protection is an item of personal protective equipment (PPE), which is generally designed to protect the scalp area and sometimes the jaw as well. Head protection is any equipment that protects these areas from impact trauma and burns.

Wearing head protection that not only has recognised safety rating, but fits the worker correctly is very important. Safety specifications include optimization for horizontal impact or impact from the top and electrical protection insulation, as well as heat protection. Head protection must have supporting straps to keep them in place.

Wearing safety rated head protection can save you from serious head injuries

Protecting your head and neck

Hazards

- Impact from falling or flying objects, risk of head bumping, hair getting tangled in machinery, chemical drips or splash, climate or temperature.

Options

- Industrial safety helmets, bump caps, hairnets and firefighters' helmets.

Note

- Some safety helmets incorporate or can be fitted with specially designed eye or hearing protection.
- Don't forget neck protection e.g., scarves for use during welding.
- Replace head protection if it is damaged.

Appropriate head protection signage should be erected in a clearly visible place

Hard hats for humid and hot conditions.

One of the issues construction sites have with ensuring workers wear PPE, is when workers have to work in humid and hot conditions. Not only can PPE cause workers to overheat, but injuries can occur, if poor quality PPE affects a worker’s ability to work safely.

It is recommended that hard hats with air vents built into the top and sides of the hat are used in hot and humid conditions, to allow more air to circulate through the hard hat, keeping a worker’s head cooler.

Many safety-rated hard hats also have the ability to add accessories to the hat, like sweat bands, which are useful in stopping sweat dripping from a worker’s head into their eyes and/or onto water sensitive equipment. Alternatively, wide brimmed hard hats are helpful in easing sun exposure.

It's important to provide airflow in your safety helmet when working in hot and humid conditions.

Hearing protection

When establishing requirements related to hearing protection, there is a measurement of noise levels in an environment. Hearing protection devices are rated based on Noise Reduction Rating (NRR), which is a calculation that shows how much of a noise reduction a particular device offers.

NRR is measured in decibels. Decibels are the standard way that sound levels are measured. Common examples of decibels start at 40dB, which is the noise level of a quiet office or library. 65-95dB is the amount of noise one would hear from a power lawn mower. 100dB is the level that typical factory machinery will produce. 120dB is a jet plane, ambulance siren, or chainsaw. On the high end are things like handgun fire, fireworks, and even a rocket launching from pad, which come in between 150 and 180dB.

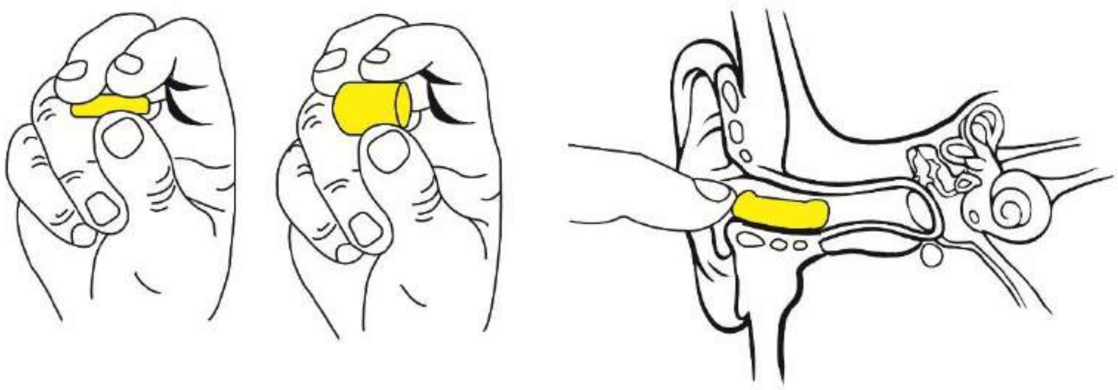
For construction sites where the noise is right at 85dB, simple earplugs may be sufficient. When an area gets significantly louder, it will become necessary to get the earmuff style devices, which are proven to block out much more noise. When the level gets above 85dB, workers must wear hearing protection or risk permanent hearing loss. Even at lower levels it is highly recommended that workers use hearing protection, especially if they will be in a loud environment for extended periods of time.

Without the correct ear protection, your hearing can be permanently damaged.

Noise levels on the construction site

Workers can suffer hearing loss whilst using common equipment found on a construction site. Some of these are:

- air compressors from 3 feet away register 92 decibels, which would take less than 2 hours to cause hearing loss.
- powered drills register 98 decibels, which would cause damage after 30 minutes.
- angle grinders often register at 100 decibels - that's 15 minutes of exposure.
- powered saws can reach 110 decibels from 3 feet away, which could cause permanent hearing loss in under 2 minutes.



Inserting ear plugs correctly is very important in protecting your hearing

Protecting your ears

Hazards

- Noise - a combination of sound level and duration of exposure, very high-level sounds are a hazard even with short duration.

Options

- Earplugs, earmuffs, semi-insert/canal caps.

Note

- Provide the right hearing protectors for the type of work, and make sure workers know how to fit them.
- Choose protectors that reduce noise to an acceptable level, while allowing for safety and communication.

Appropriate ear protection signage must be erected in a clearly visible place

Hand protection

Construction activities expose workers' hands to a multitude of risks at any one time, making choosing the most appropriate construction gloves very important. Principal Contractor's and workers should evaluate the conditions and hazards at hand and appropriately select safety gloves relative to the task performed and the present risk.

Hands can be exposed to harmful substances through skin absorption, severe cuts or lacerations, abrasions, chemical burns, thermal burns, and harmful temperature extremes. Using dangerous machinery or working with hazardous tools also pose a risk to a worker's hands.

It will be important to note the risks that can affect hands on a construction site during the hazard risk assessment.

Industrial safety gloves

Some factors that should influence the choice of safety gloves include:

- the types of chemicals being handled.
- nature of content - total immersion of the hand, splashes, etc.
- thermal protection.
- grip requirements.
- glove material - leather, canvas, metal mesh, etc.
- temperature the gloves will be used in.

In some worksites, like healthcare facilities, disposable gloves will do the trick, while in professions like welding, a worker will need a pair heavy duty, fire resistant gloves.

It is important for a Principal Contractor to understand the hazards on a construction site and the correct level of protection needed.

10 steps to choosing the correct hand protection.

1. <u>Be clear about the task to be done and identify the risks.</u>

The first, and most obvious step, is to identify the risks: Will hazardous chemicals need to be handled? Will cutting tools and welding equipment be used? These should be considered in the context of other hazards in the working area.

2. <u>Assess how workers will come into contact with hazardous chemicals & dangerous substances (i.e., through splashing or immersion) and for how long.</u>

Hazardous chemicals and dangerous substances are common on construction sites. Wet cement, for example, can cause caustic burns and dermatitis, as the powder becomes highly alkaline when mixed with water. Will workers' hands be immersed in chemical mixtures or is the risk purely from splashing or from cuts and abrasions?

3. <u>Choose the minimum level of chemical protection required.</u>

Gloves are rated according to the type of chemicals being handled, their penetration resistance (i.e., if there are any holes), the permeation rate (the time it takes for a chemical to break through the material) and material degradation.

Gloves are tested against 18 substances and are grouped into three categories: Type A gloves (offering the highest levels of protection) have a breakthrough time of 30 minutes for at least six chemicals on the list; Type B offer 30 minutes against at least three chemicals and Type C 10 minutes against at least one.

4. <u>Consider dexterity when assessing the risks from cutting and abrasive work.</u>

Cutting wood or metal with a chop saw, cutting concrete, stone, brick and paving with a power saw or chasing out a wall for new electrical cabling can all lead to lacerations, cuts and punctures, loss of fingers, broken bones and long-term nerve damage.

All gloves reduce dexterity to a degree, however advanced the materials used to make them, so it is important gloves give the wearer enough dexterity (allowing small and delicate components to be picked up and handled, for example), while being thick enough to protect against cuts and abrasions.

This can prevent workers removing gloves to do something and not putting them back on - which is when 70% of injuries occur.

5. <u>Choose the minimum level of cut protection required.</u>

EN 388:2016 is the European Standard for cut protection in gloves. The 'Coup blade cut test' is used to rate the performance of glove material, with a circular blade moving back and forth until it breaks through. Abrasion, cut, tear and puncture resistance are given a value between one and five, with five being the highest.

High-performance materials in gloves, such as steel and fibreglass, give greater levels of protection but can blunt the blade in the EN 388 test. If this happens, the gloves must also be tested to EN ISO 13997, with a blade being dragged across the material and the force needed to cut through measured. This gives a cut protection level, from A to F, with F being the highest.

6. Thermal protection.

Aside from chemical burns, construction workers are also at risk of burns from flames, steam, hot surfaces and liquids, from activities as simple as stripping paint and wallpaper on a small domestic project, to more specialist tasks such as cutting and welding steel reinforcement cages on major construction schemes.

If work is being carried out with flammable materials or in a hot environment, gloves need to be tested to EN 407:2004. There are four levels of protection (one to four, with four being the highest) in six categories, relating to the type of injury: flammability (A), contact heat (B), convective heat (C), radiant heat (D), small splashes of molten metal (E) and large splashes of molten metal (F).

7. Size and comfort.

Hand protection, as with all PPE, needs to be comfortable, safe, appropriate for the season and working conditions. If gloves fit well, workers will be happy to wear them. For example, some people are allergic to rubber latex, so ensure non-latex gloves are chosen, whenever possible. However comfortable gloves are, hands can become hot, sweaty and uncomfortable. As many injuries occur when gloves are removed, it is important to ensure staff have breaks when they can remove gloves safely.

8. Involve workers in choosing hand protection.

A construction site can be a stressful environment and working with staff is essential to ensure they are safe, comfortable and happy. Actively involving workers in choosing PPE, including gloves, is a good strategy, as it has been shown that people are more likely to wear PPE if they take part in its selection.

9. Check suppliers' and manufacturers' certification.

Check suppliers' product certification and ask for details on manufacturing processes and quality assurance systems. This is particularly important for gloves offering the highest levels of protection.

10. Get expert advice from a PPE supplier.

Finally, and most importantly, speak to a PPE supplier. There is no one-size-fits-all solution to hand protection, but reputable suppliers will provide independent and expert advice on the most appropriate gloves for activities and working conditions. This should be backed by evidence showing gloves have been tested in similar environments.

Hands are one of the most vulnerable parts of a construction worker's body, so providing staff with the best protection is vital, not only to minimise working days lost through injury and illness but also to make them feel safe and valued, making them more confident in their roles, and more productive as a result.

Wearing hand protection not only protects your hands, but it can make the task more efficient.

Protecting your hands and arms

Hazards

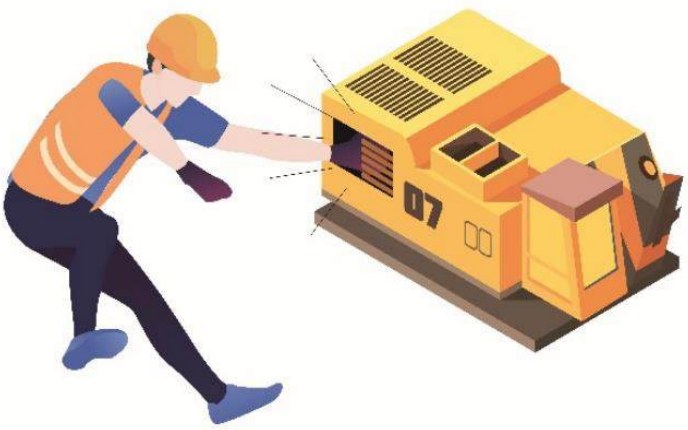
- Abrasion, temperature extremes, cuts and punctures, impact, chemicals, electric shock, radiation, biological agents and prolonged immersion in water.

Options

- Gloves, gloves with a cuff, gauntlets and sleeving that covers part or all of the arm.

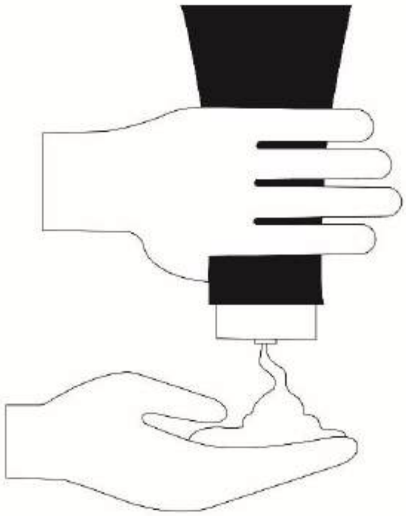
Note

- Avoid gloves when operating machines such as bench drills where the gloves might get caught.



Wearing gloves is not recommended when using machines like bench drills

- Some materials are quickly penetrated by chemicals - take care in selection.
- Barrier creams are unreliable and are no substitute for proper PPE.



Do not use barrier creams for hand protection

- Wearing gloves for long periods can make the skin hot and sweaty, leading to skin problems. Using separate cotton inner gloves can help prevent this.

Appropriate hand protection signage must be erected in a clearly visible place

Foot protection

Foot protection is any piece of personal protective equipment protecting one's foot from any injury while at work or during movement. The foot is a vital part of our body and since we are on our feet constantly from day to day, they are more susceptible to injury. If a foot is injured, our movement may be temporarily or permanently restricted.

Most common types of foot injuries include the following:

- Traumatic injury occurs when feet and toes are cut, pinched or crushed under falling objects, wheels, rollers or gear machinery, contact sharp edges, or get tangled in ropes and chains.

Foot protection provides protection from a wide range of injuries

- The feet can be damaged when the skin, muscles, tendons, blood vessels and nerves get cut, punctured, pricked, or are irritated.

Foot injuries can prevent workers from working for extended periods

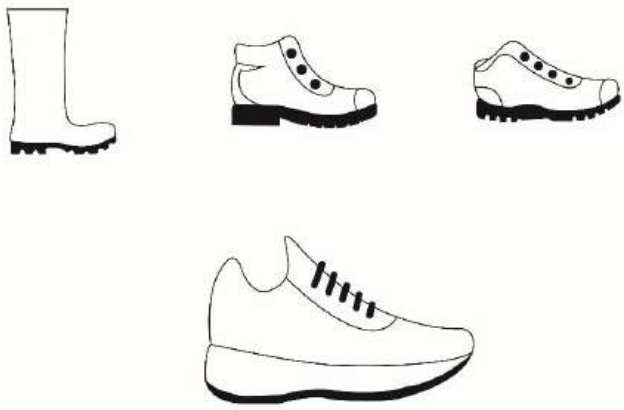
- Bones are fractured or sprained.
- Permeation injury occurs when bare feet contact corrosive liquids, harmful chemicals and other substances. It causes chemical burns, skin irritations or injures to tissues etc.

- Repetitive motion injury occurs when jobs require repeated, rapid foot movements for long periods of time such as machine controlling, sports or driving.
- Burns in feet occur due to contact with high temperature objects. On the other end, frostbite is a risk in the cold environment.

Ensure all slippery surfaces are clearly signed

We can protect our feet from above injuries by the following actions:

- Carryout diligent risk assessments.
- Always wear appropriate shoes (Non skidding, anti-static-electricity, metal-toed safety shoes, etc.)
- Keep floors and walkways clear of sharp objects, ropes and oily substances.
- Indicate slippery floors by using signage.
- Always move carefully.



Choose the appropriate type of safety shoe for the task you are undertaking

Protecting your feet and legs

Hazards

- Wet, hot and cold conditions, electrostatic build-up, slipping, cuts and punctures, falling objects, heavy loads, metal and chemical splash, vehicles.

Be aware of the many feet hazards on a construction site

Options

- Safety boots and shoes with protective toecaps and penetration-resistant, mid-sole wellington boots and specific footwear, e.g., foundry boots and chainsaw boots.

A cross section view of a safety boot with a toe cap

Note

- Footwear can have a variety of sole patterns and materials to help prevent slips in different conditions, including oil - or chemical-resistant soles. It can also be anti-static, electrically conductive or thermally insulating.
- Appropriate footwear should be selected for the risks identified.

Appropriate foot protection signage must be erected in a clearly visible place

Breathing protection

Clean air is essential for the body to stay healthy. However, we mostly realise its importance only when we no longer have enough of it or it is contaminated and polluted with hazardous substances. These hazardous substances can arise during various work processes on a construction site. These are very fine particles, gases or vapours. If they get into the mucous membranes or the lungs, they can damage the body and, in the worst cases, even lead to fatality.

Hazardous substances are split into categories:

Particles: Particles include dry dusts such as fibres, fine dust or smoke on the one hand, and hygroscopic dusts such as crystals, salts, spores, germs or aerosols on the other.

Aerosol spray and sanding dust are examples of Particles

Gases: The gases and vapours group include free-floating molecules such as ozone and water-soluble, fat-soluble, acidic and alkaline gases and vapours.

Gases can be very harmful to your health

With suitable breathing protection, many of these substances can simply be filtered out of the air. Only then can safe working be ensured.

Protection against particles

Dust protection masks provide protection against particles. They are available as disposable masks in the following versions:

Foldable: Practical for taking with you due to flat foldable mask body.

Example of a flat-fold disposable mask

Pre-formed: Easy to use due to pre-formed mask body. These protective masks are used during the grinding of brickwork, iron or paint as well as during the processing of glass and mineral fibres or asbestos, for example.

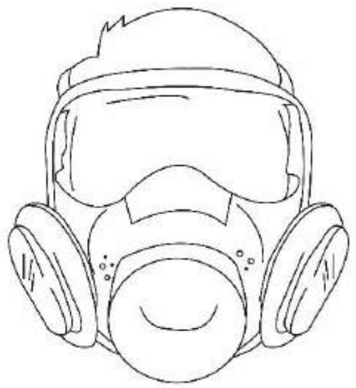
An example of a pre-formed disposable mask and how to put it on correctly

Protection against gases/vapours and particles

Re-usable masks

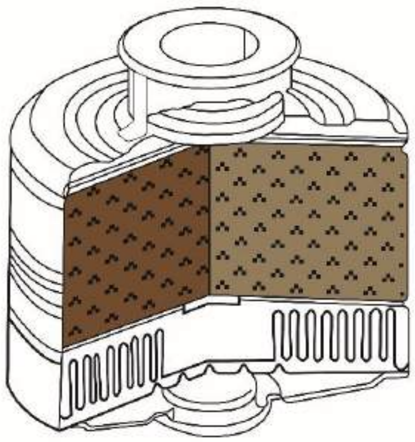
In order to be able to protect your workers against gases and vapours, you require special gas masks. These re-usable masks are used in the event of frequent use and when worn for long periods and are available in two versions:

Half-face masks: stable mask body which covers the mouth and nose.



Full-face masks: respirator with additional face protection covers the mouth, nose, and eyes.

If masks should also protect against particles, **combination filters** are the right choice. Here, particle and gas filters are integrated into a filter housing whereby the particle filter is always spatially arranged in front of the gas filter.



The particle filter (white) is in front of the gas filter (brown)

Breathing support systems

When worn for long periods and in tough work environments, breathing support systems are available. They are split into two categories**:**

Respirator systems with blower units: filtration of ambient air without hindering breathing (O2 content > 17%)

Compressed air systems: supply of clean air in the event of oxygen deficiency (O2 content ≤ 17%). Often used to supply whole rooms.

Breathing support systems are also available with a combination filter.

Protecting your Lungs

Hazards

- Oxygen-deficient atmospheres, dusts, gases and vapours.

Options – respiratory protective equipment (RPE)

- Some respirators rely on filtering contaminants from worksite air. These include simple filtering facepieces and respirators and power-assisted respirators.
- Make sure it fits properly, e.g., for tight-fitting respirators (filtering facepieces, half and full masks).
- There are also types of breathing apparatus which give an independent supply of breathable air, e.g., fresh-air hose, compressed airline and self-contained breathing apparatus.

Note

- The right type of respirator filter must be used as each is effective for only a limited range of substances.
- Filters have only a limited life. Where there is a shortage of oxygen or any danger of losing consciousness due to exposure to high levels of harmful fumes, only use breathing apparatus Note: never use a filtering cartridge.
- You will need to use breathing apparatus in a confined space or if there is a chance of an oxygen deficiency in the work area.

Appropriate breathing protection signage must be erected in a clearly visible place

Respiratory protective equipment (RPE)

Careful selection, maintenance and regular and realistic operator training is needed for respiratory equipment, particularly for use in emergencies, like compressed-air escape breathing apparatus, respirators and safety ropes or harnesses.

The below section provides guidance on the selection and use of adequate and suitable respiratory protective equipment (RPE) in the worksite.

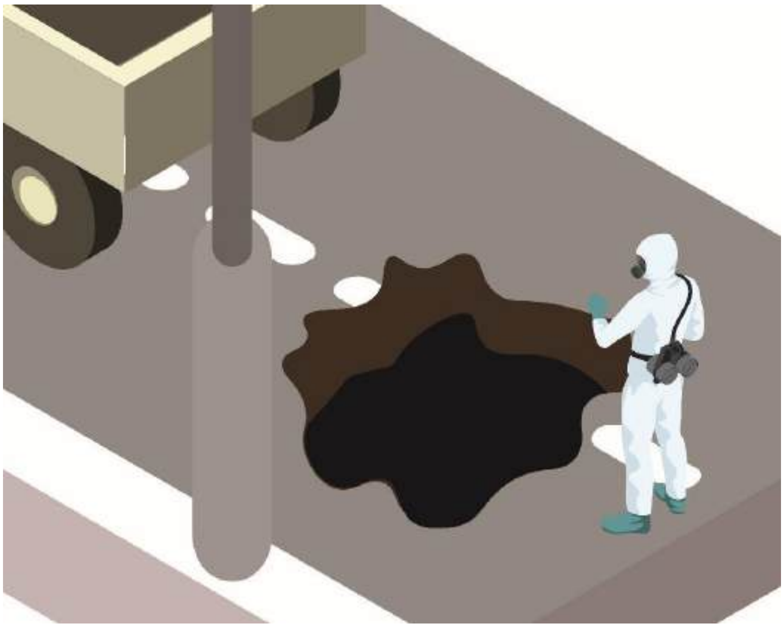
It tells you when you can use RPE, using a simple step-by-step approach. It helps you to decide the adequate level of protection for a given hazardous substance and how to select RPE that is suitable for the particular wearer, task and work environment. It also contains advice on how to make sure that the selected RPE keeps working effectively.

Many workers wear respirators or breathing apparatus to protect their health in the worksite. These devices are collectively known as respiratory protective equipment (RPE). Respirators filter the air to remove harmful substances and breathing apparatus (BA) provides clean air for the worker to breathe.

Some construction work activities may result in harmful substances contaminating the air in the form of dust, mist, vapour, gas or fume. For example, when:

- cutting a material such as stone or wood.
- using a product containing volatile solvents.
- handling a dusty powder.
- welding stainless steel.

Workers may also need to work in areas where oxygen levels are or may become low, for example, confined spaces, such as a trench, silo or tank.



Some confined spaces may be oxygen deficient and contain harmful atmospheres.

RPE is a particular type of personal protective equipment (PPE) designed to protect the wearer from breathing in harmful substances or from oxygen-deficient atmospheres when other controls are either not possible or insufficient on their own.

The two main types of RPE are respirators and breathing apparatus:

- **Respirators (filtering devices)** use filters to remove contaminants from the air being breathed in. They can be either:
    - non-powered respirators - relying on the wearer's breathing to draw air through the filter; or

A non-powered respirator

    - powered respirators - using a motor to pass air through the filter to give a supply of clean air.

A powered respirator uses a motor to provide clean air

- **Breathing apparatus (BA)** needs a supply of breathing-quality air from an independent source.

A BA uses oxygen from a tank to provide you air

Respirators and BA are available in arrange of styles, dividing into two main groups:

- **Tight-fitting face-pieces (often referred to as masks)** rely on having a good seal with the wearer's face. These are available as both non-powered and powered respirators and BA. A face fit test should be carried out to ensure the RPE can protect the wearer.

A tight-fitting face-piece

- **Loose-fitting face-pieces** rely on enough clean air being provided to the wearer to prevent contaminant leaking in (only available as powered respirators or BA). Examples are hoods, helmets, visors, blouses and suits.

A loose-fitting face-piece

RPE filters

A key component of any respirator is the filter. Filters are available for solid or liquid particles, vapours and gases. They can be an intrinsic part of the device or come separately so they can be changed on a reusable respirator. It is vital that you choose the correct filter, which will be effective against the hazard.

Breathing apparatus

There are different types but all:

- will supply air from an independent source such as a compressed air cylinder or air compressor (note; only Air Compressors manufactured specifically for re-fill and supply of compressed air should be used with BA).
- can be used against a range of airborne hazards and in different atmospheres. (note: any workers using BA should be properly trained by qualified trainers).

Appropriate breathing protection signage must be erected in a clearly visible place

You should only select and use RPE:

- where an inhalation exposure risk remains after you have put in place other reasonable controls (residual risk).
- while you are putting in place other control measures (interim measures).
- for emergency work or temporary failure of controls where other means of control are not reasonably practicable.
- for short-term or infrequent exposure, such as during maintenance work, where you decide that other controls at the source of the exposure are not reasonably practicable.

There are situations where specialist advice may be needed to select the right RPE. These include:

- emergency escape - where you need to provide RPE for safe exit from an area where hazardous substances may be released suddenly after control systems fail.
- emergency rescue.

Remember, RPE can protect **only** the wearer and if it is used incorrectly, or is poorly maintained, it is unlikely to provide the required protection. Note also that RPE can be uncomfortable to wear and may interfere with work, which can lead to incorrect use.

Specific requirements for RPE use

RPE at work should:

- adequately control inhalation exposure to provide the wearer with effective protection.
- be suitable for the intended use.
- be CE-marked or of an approved type/standard approved by HSE.
- be used by properly trained people who are supervised.
- be properly stored, cleaned and checked regularly to ensure it remains effective.

Adequate RPE is right for the hazard and reduces exposure to the level required to protect the wearer's health.

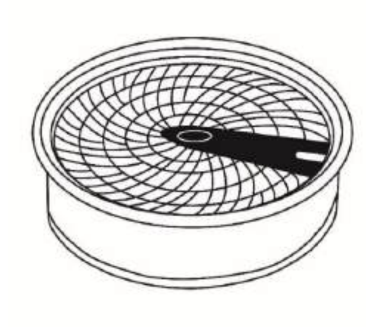
Suitable RPE is right for the wearer, task and environment, such that the wearer can work freely and without additional risks due to the RPE.

You must ensure that reusable RPE undergoes thorough examination and, where appropriate, testing at suitable intervals. This should be monthly, or every three months if used less frequently. This will not only make sure the RPE protects the wearer but will also extend the life of the equipment and so maximise your investment.

You should record RPE examinations and tests – and, where appropriate, any repairs made – and retain them for at least five years. The records will help to keep track of the equipment's maintenance.

You should test the quality of air supplied to BA at least once every three months. For RPE to be effective, you should integrate its use into normal worksite activities. You should also ensure that

RPE is used according to the manufacturer's instructions, as poor working practices or improper use can significantly reduce its effectiveness.



Ensure all PPE meets or exceeds industry safety standards

Dos and don'ts

General dos and don'ts are given in the following tables, to highlight key considerations for using RPE. These are reminders for the wearer but, as the Principal Contractor, you should ensure that your workers follow good practice.

Non-powered respirators

Dos

- Always ensure the respirator is in good working order before putting it on, even when new.
- Always use all the straps provided, making sure they are correctly positioned and adjusted. Follow the manufacturer's instructions.
- Always fit two identical filters to a twin-filter respirator.
- Always clean and store the RPE properly, paying special attention to the valves on reusable RPE.
- Change filters as instructed by the manufacturer.
- Ensure the other PPE you need to wear is compatible with the respirator.

Always use PPE according to the manufacturer's instructions.

Don’ts

- Never use in oxygen-deficient atmospheres.
- Never use a particle filter to protect against gases/vapours or gas/vapour-only filters against particulates.
- Never use if dirty, damaged or incomplete.

Always inspect your PPE for defects before wearing it.

Powered respirators

Dos

- Always ensure the respirator is in good working order before putting it on, even when new.
- Always use **all the straps** provided, making sure they are correctly positioned and adjusted. Follow the manufacturer’s instructions.
- Always check the fan is providing enough airflow before you use the device.
- Always fit identical filters to a multi-filter unit.
- Always change all the filters on a multi-filter unit together.
- Always clean and store the RPE properly, paying special attention to the valves.
- Change filters as instructed by the manufacturer.
- Ensure the other PPE you need to wear is compatible with the respirator.

Don’ts

- Never use in oxygen-deficient atmospheres.
- Never use particle-only filters against gas/vapour, or gas/vapour-only filters against particulates.
- Never use if dirty, damaged or incomplete, or if not providing enough air.
- Never keep working if the fan stops or the flow rate falls. Leave the work area immediately.

Breathing apparatus

Dos

- Always ensure the breathing apparatus is in good working order before putting it on, even when new.
- Always look after your supply hose during use - your life may depend on it.
- Always use all the straps provided, making sure they are correctly positioned and adjusted. Follow the manufacturer's instructions.
- Ensure that an adequate clean air supply is available for all users.
- Ensure that the compressed air quality meets the minimum requirements of BS EN 12021.
- Always plan your exit from the contaminated area so you don't run out of air.
- Ensure the other PPE you need to wear is compatible with the BA.

Don'ts

- Never place the hose inlet near to potential sources of contamination, e.g., vehicle exhausts.
- Never use the equipment without the waist belt.
- Never use a light-duty airline hose where there is any potential for crushing by vehicles or passers-by etc.
- Never keep working if the airflow rate drops or any warning devices are activated. Leave the work area immediately.

Ensure the intake of the compressor or hose is not blocked or within range of exhaust fumes

<u>Filters</u>

Filters are classified in relation to the form of the hazardous substance(s) they can be used against - either particles, gas/vapour, multi-gas or combined (particle and gas/vapour).

If the filter is also usable with powered respirators then they will also be marked 'TH' (turbo hood) for hood devices or 'TM' (turbo mask) for mask devices.

Particle filters do not trap gases or vapours or give any protection against oxygen-deficient atmospheres.

Gas/vapour filters do **not** protect against particles or give any protection against oxygen-deficient atmospheres.

Note that particle filters are not effective against mist or spray of organic solvents. Seek advice from the manufacturer.

Particle filters

Particle filters trap and hold particles (dust, mist, fume, smoke, micro-organisms) from the air flowing through them. Large particles are easier to trap than small ones. These filters can be used against both solid particles and liquid particles (mists, fine sprays and aerosols).

Particle filters are classified according to their efficiency. The filter (or the face-piece it is built into) will be marked with the letter P (for particle) and a number to indicate efficiency, or the level of protection provided:

- P1 = Low efficiency. *
- P2 = Medium efficiency. *
- P3 = High efficiency.

* Do not use against fumes unless specified by manufacturer.

Filters are additionally marked:

- NR = Not reusable - designed for a single work shift (eight hours) and must be disposed of safely at the end.
- R = Reusable

Gas/vapour filters

These filters are designed to remove gases or vapours as specified by the manufacturer. Gas/vapour filters are classified according to their capacity and the type of substance they can be used against.

Their capacity refers to how much of the specified contaminant they can hold (as measured in a laboratory test at set conditions):

- Class 1 = Low capacity.
- Class 2 = Medium capacity.
- Class 3 = High capacity.

The filter (or the mask it is built into) will be marked with a number to indicate this capacity rating, and a letter to indicate the type of substance they are suitable for. Gas/vapour filters also have a standard colour coding. For example, a mask or filter marked as ‘B2 - Grey’ would protect against inorganic gases and vapours and have a medium capacity.

Multi-gas filters

A multi-gas filter is one that is suitable for more than one type of gas or vapour. They will be marked for the types of gases/vapours for which they are suitable (e.g., A1B2 = Organic vapour filter with capacity class 1 and inorganic gases filter with capacity class 2).

Multi-gas filters are an option for Principal Contractors who have different gases and vapours at their sites. Multi-gas filters are more expensive to buy than single type filters and tend to be heavier.

Warning: If you use multi-gas filters, you should take extreme care - be certain that the use of this filter against mixtures of gases/vapours (either at the same time or one after the other) will not result in exposure. Always seek clear instructions from the manufacturer on how this filter may be used safely in your worksite and on replacement intervals. If performance against mixtures of gases is needed, it may be safer to consider BA.

When to change filters

Particle filters

Particle filters will become clogged and make breathing difficult, possibly resulting in face seal leaks.

The following is recommended:

- For TH and TM type filters for fan-assisted respirators, change as instructed by the manufacturer.
- For replaceable filters, it would be good practice to mark the filter visibly with the date it was taken out of the packaging and fitted to the RPE; an in-house replacement date can be added to this marking.

Changing particle filters - hints and tips:

- Do not use if the shelf-life expiry date on the filters has passed.
- Change when filters are damaged or visibly contaminated.
- Change when they become harder to breathe through. This can happen quickly if the wearer is exposed to very high dust concentrations.

Gas/vapour filters

Gas/vapour filters have a limited capacity for removing gases/vapours, so after a time the gas or vapour will pass straight through. This is known as breakthrough. When breakthrough occurs, the RPE offers no protection.

Filter life is very difficult to predict because it depends on a large number of factors. They don't last forever.

The following is recommended:

Filter capacity 1 - Change at least every two days or as instructed by the manufacturer; but if the filter is used for protection against a:

- Carcinogen.
- Respiratory sensitiser.
- Potential carcinogen.
- Substance that may cause allergy or asthma symptoms or breathing difficulties if inhaled.

Change every day, or as instructed by the manufacturer.

Filter capacity 2 - Change at least once a week or as instructed by the manufacturer.

- Capacity 3 and TM/TH type filters, you should change as instructed by the manufacturer.
- For replaceable filters, it is good practice to mark the filter visibly with the date it was taken out of the packaging and fitted to the RPE; an in-house replacement date can be added to this marking.

Changing gas/vapour filters - hints and tips:

- Change filters as instructed by the manufacturer; for example, AX filters are single use only and mercury (Hg) filters have a maximum use time of 50 hours.
- Change before any expiry date marked on the filter.
- Do not use if the expiry date on the filters has passed.
- Change when damaged or visibly contaminated.
- Change before the contaminant can be smelled or tasted.
- Change before the filter life indicated in your risk assessment.

Quality of air for breathing apparatus

Air quality

Air supplied to breathing apparatus (BA) should be clean and safe to breathe, whether it is supplied via a fresh air hose or a source of compressed air.

Fresh air hose

You should securely anchor the inlet for fresh air hose BA in an area that is free of contaminant. This can usually be achieved by siting the inlet well away from the work area (e.g., in free air outside the building), and upwind of any local sources of airborne contamination (e.g., vehicle exhaust).

Compressed air

Compressed air for BA normally originates from a compressor system. The maintenance, examination and testing of compressors should be carried out according to the manufacturer's instructions. The siting of air inlets to compressors should follow the same principles as for fresh air hose. However, because compressors themselves can generate and concentrate a wide range of contaminants, you should take extra care in assuring air quality. Standard Air Compressors can be fitted with oil filtering devices; however, it is strongly recommended to use a specialized BA Air Compressor.

As the BA wearer's life and health depend on the air supplied by the compressor, you should ensure that the air supplied meets the quality requirements.

Compressors which are moved from site to site, such as those used by the emergency services or on construction sites, will require a higher standard of maintenance and should be sited so that the quality of air they provide is not compromised by nearby contaminants.

Periodic testing of air quality

The purpose of periodically testing air quality is to make sure that the control measures you have put in place are delivering the air quality required. You should base the frequency of such tests on a risk assessment, but they should take place at least every three months, and more often when the quality of air cannot be assured to these levels.

As part of the risk assessment, if a mobile compressor is being used, consideration should be given as to how often the air supply should be checked when the compressor is moved. Testing for these components may be carried out using any appropriate method, e.g.:

- simple colour change tubes.
- on-line gas testers.
- sample collection for laboratory analysis elsewhere.

The supplier of your compressor or BA should be able to advise you on the best method for you. You should keep records of air quality tests for five years.

Clothing protection

Protective clothing is any clothing specifically designed, treated, or made to help minimise risk to a worker's health and safety while working. Examples of protective clothing include:

- work pants & shirts.
- flame retardant clothing.
- high visibility clothing.
- overalls and protective aprons.

Ensure the correct PPE is worn according to the relevant work you are undertaking

<u>The difference between protective clothing and regular work clothes</u>

Protective clothing is worn specifically to help minimise risk to a worker's health and safety while working. It can be used to protect against a specific or general construction site hazard (after all other reasonably practicable control measures have been put in place to eliminate or minimise the risk).

Regular clothing is not protective clothing. For example, a worker's everyday clothing such as pants or jeans worn at work are not generally considered protective clothing.

Jeans and a t-shirt are not considered protective clothing

Uniforms or other clothing worn solely to identify a person as a worker, are not normally considered protective clothing.

Uniforms are not always considered protective clothing

Fit and comfort

Protective clothing must fit the worker properly for both comfort and safety.

- Clothing should be easy to put on and take off.
- It should not interfere with normal movement required for the job. For example, walking, climbing stairs or ladders, sitting, standing, and operating plant or machinery.
- It should not be too loose or baggy. Loose or baggy clothing could get snagged on objects or cause tripping.
- Pants and sleeves should not hang down over hands or feet. Rolled up sleeves and trousers could get caught in machinery.
- Protective clothing should cover an entire area, even when a worker is moving. For example, if a person raises their arms or leans over, clothing should not leave parts exposed.
- Clothing should not be so tight that it restricts blood flow.
- Clothing should not have sharp edges or rough surfaces that could harm the worker or others near them.
- Where possible, protective clothing should be made of breathable materials to avoid thermal discomfort (workers becoming too hot or sweaty while working).

Not wearing properly fitted protective clothing can increase your risk to injury

Compatibility with other clothing and PPE

Protective clothing must be compatible with other PPE workers may need to wear or use at the same time. For example:

- gloves should fit with sleeves.
- trousers should fit over or inside boots (whichever is best practice in your industry).

Sometimes protective clothing itself may create a new risk. For example:

- heavy or layered protective clothing may increase the risk of a worker over-heating and suffering a heat-related illness or injury.
- bulky protective clothing may restrict a worker’s mobility.

Any new risks identified as a result of PPE requirements must also be managed.

Consider the individual needs of your workers

Never assume that one type of protective clothing will suit all workers. When selecting protective clothing you need to consider the individual requirements of your workers, as well as considering what will provide the best protection.

- Does the supplier offer a good enough range of sizes to fit your workforce?
- Does your supplier provide protective clothing for both men and women?
- Is the clothing suitable for any religious or cultural requirements of your workers?
- Will any of the protective clothing aggravate any medical conditions or allergies of your workers, such as a latex allergy?

Protective clothing designed specifically for women

Protective clothing designed for men generally does not fit women in the same way. This can increase health and safety risks for women. ‘Unisex’ protective clothing is often just clothing designed for men but offered in smaller sizes.

Female workers should have access to protective clothing designed specifically for women’s bodies. For example:

- clothes designed to fit female body proportions.
- smaller sized and narrower fitting work boots. Wearing thicker socks to accommodate work boots designed for men is not acceptable.
- smaller sized and narrower fitting safety gloves.

You should engage with your female workers on what the best protective clothing options are for them. Many PPE suppliers provide PPE specifically for women. Ask your supplier what they can offer that meets the PPE needs of women. They may be able to add to their range.

Ensure both men and women have correctly fitted protective clothing.

How to look after protective clothing

Give workers information and training on correct storage and maintenance of their protective clothing. Proper care and maintenance are essential to make sure protective clothing continues to provide protection.

STORAGE	CLEANING	DECONTAMINATION	INSPECTION	MAINTENANCE AND LIFESPAN
Workers must have access to storage facilities where: ○ it can be kept dry ○ it is safe from damage or interference ○ it is easily accessible to workers.	Principal Contractors must provide protective clothing that is clean and hygienic. Cleaning should be carried out according to manufacturer instructions.	Protective clothing that has been exposed to harmful substances (such as fuel, grease or paint) will need to be decontaminated after use. Decontamination should be carried out by someone with the right training and	Principal Contractors must make sure protective clothing is kept in good working order. Protective clothing should be regularly inspected. It should be checked for:	Protective clothing with an expiry date, or a required maintenance schedule, should be logged and monitored to make sure it is maintained or disposed of at the right time.

	Some protective clothing may need re-treating or re-coating after being cleaned (e.g., re-waterproofing).	knowledge to do it properly and thoroughly. Note: Clothing contaminated with asbestos requires special treatment. See Chapter 9 Environmental Control and Protection for more information.	○ signs of soiling ○ signs of contamination ○ damage (rips, tears etc) ○ functioning closures (buttons, zips etc) ○ missing accessories (reflective trims, clips etc) ○ fabric working as it should (still be waterproof or heat-proof).	Damaged or defective protective clothing needs to be fixed or replaced as needed. Protective clothing should never be used after it has expired or reached the end of its usable lifespan.

Sharing protective clothing

Usually, protective clothing is provided for the use of an individual. But if protective clothing is only needed for a short time, it may not be cost effective to issue every worker with their own protective clothing.

Shared protective clothing must be properly cleaned and disinfected before it is used again to make sure there are no health risks to the next person. Shared items still need to fit each user properly to provide full protection.

Always wash and decontaminate shared clothing after each use.

Single use protective clothing

Any protective clothing that is designed for single use (such as disposable coveralls or disposable gloves) should not be reused.

Do not reuse disposable clothing.

Protecting your whole body

Hazards

- Heat, chemical or metal splash, spray from pressure leaks or spray guns, contaminated dust, impact or penetration, excessive wear or entanglement of own clothing

Options

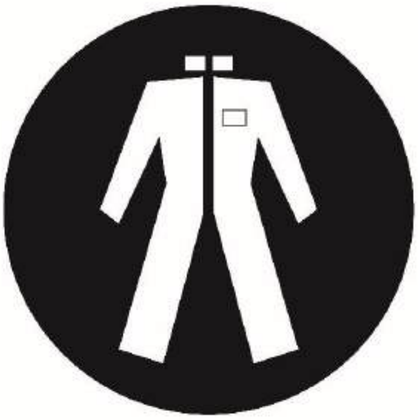
- Conventional or disposable overalls, boiler suits, aprons, chemical suits

Ensure the right protective clothing is worn according to the appropriate task.

Note

- The choice of materials includes flame-retardant, anti-static, chain mail, chemically impermeable, and high visibility.

- Don't forget other protection, like safety harnesses or life jackets (Insert relevant types of clothing).



Appropriate workwear signage must be erected in a clearly visible place

Is PPE effective?

The effectiveness of PPE relies heavily on:

- workers following instructions and procedures for wearing/using the PPE correctly.
- the PPE fitting correctly.
- the PPE being properly maintained.

Workers might avoid using PPE if it:

- must be used for long periods.
- interferes with clear vision needed for the task.
- makes it difficult to perform fine work.
- is hot or uncomfortable to wear.
- if they have not been properly trained on how to fit and use it correctly.

The best way to know if this is happening is to watch your workers performing their tasks. If they discard the PPE or do not use it, this may indicate that it doesn't fit, is uncomfortable, or interferes with their work. You should also watch workers after the task is complete to make sure they clean, maintain and store the PPE correctly.

Maintenance of PPE

Proper care and maintenance are essential to ensure PPE continues to provide the necessary level of protection.

- Look for broken or damaged components before using PPE and repair or replace it as needed.
- Replace PPE that has expired or reached its usable lifespan.

- Clean reusable PPE after use and store in a clean area such as a cupboard, drawer or resealable container.
- Report broken, damaged or contaminated PPE.

Always check for damage before using any PPE

Sharing PPE

Most PPE is provided for the personal use of a worker. However, PPE may be shared in some circumstances, for example where PPE is only required for limited periods.

Shared PPE must be properly cleaned and disinfected before it is used again to ensure there are no health risks to the next person. Refer to the manufacturer's instructions for appropriate methods.

Information, training and instruction

Workers must be provided with enough information, training and instruction on when to use PPE and how to:

- use, fit and wear it including any adjustments that may be needed.
- carry out repair or replace parts.
- clean and store it correctly.

When wearing more than one item of PPE to protect against substances, such as hazardous chemicals or biological substances, it is important to put on and remove each item correctly. If hands could become contaminated when removing PPE, it is important to wash them thoroughly to prevent accidental contamination.

Construction site owner and principal contractor responsibilities

If PPE is required by a construction site, the Construction Site Owner or Principal Contractor must provide it to workers free of charge.

In deciding who should provide PPE consider:

- the availability of equipment.
- whether the equipment can generally be used outside work, such as sunglasses or boots.
- the need for a personal fit.
- the requirements in the relevant industrial award or enterprise agreement regarding provision of PPE.

Worker responsibilities

If you're a worker, contractor or other person at a construction site you must, so far as you are reasonably able to:

- use or wear the PPE provided to you according to any information, training or instruction given.
- not intentionally misuse or damage the equipment.
- report any loss or damage to the site manager.

If your PPE is uncomfortable, doesn't fit properly or causes an adverse reaction when using it, tell the site manager. Visitors must also wear PPE as instructed by the site manager while on site.

Disposing of PPE

Unless contaminated, disposable PPE can be disposed of with the general waste, preferably a closed bin. A closed bin is a bin with a fitted lid.

Where the PPE is contaminated it should be disposed of in a closed bin, preferably one that does not need to be touched to place contaminated PPE inside. A bin with a foot pedal or other hands-free mechanism to open the lid would be appropriate.

It is recommended to dispose of contaminated PPE in a dedicated bin with a hands-free opening and closing mechanisms.

The bin for contaminated PPE should contain two bin liners to ensure the waste is double bagged. Double bagging minimises any exposure to the person disposing of the waste.

PPE would be considered contaminated if:

- it has been worn by a symptomatic worker or visitor to the construction site.
- it has been worn by a close contact of a confirmed COVID case.
- the PPE has been in contact with a potentially contaminated surface, or
- it is visibly soiled or damp (e.g., face masks).

Where a closed bin is not available, the contaminated PPE should be placed in a sealed bag before disposal into the bin. The sealed bag and a single bin liner are considered equivalent to double bagging.

It is important to follow good hand hygiene after removing and disposing of your PPE. Hands should be cleaned thoroughly with soap and water (for a minimum of 20 seconds) or hand sanitiser.

Protection against electrocution

An important part of completing a hazard assessment of a facility is to understand the electrical risks. Electrical hazards pose the risk of arc flash causing electrocution, severe burns, permanent eyesight, and hearing damage, and can even be fatal in some cases.

Things to look for during the assessment include outlets too close to conductors, torn or frayed wires, improper use of lockout devices, overloading circuits, and more. Electrocution can also be a result from arc flash, along with severe burns, permanent auditory damage, and permanent eyesight damage.

There is PPE that is specifically designed to protect the wearer from electrocution and electric shock and will always include hearing protection, leather footwear, and safety goggles. Required personal protective equipment for electrical hazards are broken down into the following four categories, per the NFPA 70E Standards.

- **PPE Category 1:** This category is meant for instances with the lowest level of electrical risk. Required PPE includes leather gloves, a hard hat, and arc-rated pants, long-sleeved shirt, and face shield.
- **PPE Category 2:** The next level of protection requires all PPE be arc-rated, save for the leather gloves. This includes a balaclava or helmet, a face shield, long-sleeved shirt, pants, and a jacket.
- **PPE Category 3:** One step up, PPE for this category also must be arc-rated, save for the leather gloves, and includes a balaclava, a flash suit hood, a long-sleeved shirt, pants, flash suit paints, and a flash suit jacket.
- **PPE Category 4:** This category is for instances with the highest level of electrical risk and could possibly result in death. It is required to wear a balaclava, a flash suit hood, gloves, a long-sleeved shirt, paints, flash suit paints, and a flash suit jacket, all arc rated.

PPE CATEGORY 1	PPE CATEGORY 2	PPE CATEGORY 3	PPE CATEGORY 4
Minimum Arc Rating of **4 cal/cm^2**	Minimum Arc Rating of **4 cal/cm^2**	Minimum Arc Rating of **4 cal/cm^2**	Minimum Arc Rating of **4 cal/cm^2**
Arc Rated Clothing: • AR long sleeve shirt and pants, or AR coverall • AR face shield, or AR flash suit hood • AR jacket, parka, rainwear, or hard hat liner (as needed) 	**Arc Rated Clothing:** • AR long sleeve shirt and pants, or AR coverall • AR face shield, or AR flash suit hood, and AR balaclava • AR jacket, parka, rainwear, or hard hat liner (as needed) 	**Arc Rated Clothing:** • As required: AR long sleeve shirt and pants, AR coverall, AR Flash suit jacket, and/or AR flash suit pants • AR flash suit hood • AR gloves • AR jacket, parka, rainwear, or hard hat liner (as needed) 	**Arc Rated Clothing:** • As required: AR long sleeve shirt and pants, AR coverall, AR Flash suit jacket, and/or AR flash suit pants • AR flash suit hood • AR gloves • AR jacket, parka, rainwear, or hard hat liner (as needed) 
Protective Equipment • hard hat • safety glasses or safety goggles • hearing protection (with inserts) • Heavy-duty leather gloves • leather footwear (as needed)	**Protective Equipment** • hard hat • safety glasses or safety goggles • hearing protection (with inserts) • Heavy-duty leather gloves • leather footwear	**Protective Equipment** • hard hat • safety glasses or safety goggles • hearing protection (with inserts) • leather footwear	**Protective Equipment** • hard hat • safety glasses or safety goggles • hearing protection (with inserts) • leather footwear

Ensure when working with electricity that a risk assessment is conducted before choosing the PPE category.

CHAPTER 5

DEVELOP AND IMPLEMENT A SITE SAFETY PLAN

On a construction site, accidents can happen. A number of workers may be working on a building site at the same time, where there can also be multiple unknown hazards, so a site safety plan can be invaluable in providing a cohesive safety strategy and minimizing the potential for accidents.

Developing a Site Safety Plan is vital to ensuring safety on a work site

The goal is to minimize accidents (ideally to zero) and increase safety at a construction site. Because each construction site is structured differently, with different projects, objectives, and construction equipment, it's important to have a specific plan for each location: a site-specific safety plan (SSSP). A site-specific safety plan is a risk management document written and maintained by a construction site owner to manage the health and safety of the construction site and those working there.

A living document

Every site safety plan should be a living document that can be easily adapted to the specific safety and contractual needs of each project. The larger and more complex the project, the larger and more complex the site safety plan. Each task in a project should be reviewed to identify known hazards, and your site safety plan should provide general guidance for those hazards that are unexpected or unpredictable, what to do about them, who does what during an emergency, how they do it, and when they do it.

Your plan objective should state that your company intends to take any steps necessary to protect its Workers, and others, from accidents and hazardous conditions in the construction site.

Plan and consult with experts

Site safety plans should be completed before work starts but should also be updated on a regular basis as conditions on the construction site change. This should include a step-by-step analysis of each workers responsibilities from when people enter the site, to material being unloaded and until the project is complete.

Site safety plans should be written to cover all workers at the site. Proof that workers are adequately trained should be provided, and systems should be in place to make sure they're in compliance with work, health and safety policies. A disciplinary policy should be in place to address situations in which safety procedures are not followed.

A competent person responsible for the SSSP should be identified, along with a backup contact in the event that person is unavailable.

Consult with safety experts to ensure you have an up-to-date site safety plan

An effective site safety plan should ensure that workers and visitors to a construction site are aware of:

- the types of hazards that may be associated with work being done on the site.
- procedures and measures needed to avoid or control exposure to hazards.
- how to contact the Construction Site Owner and Principal Contractor with safety concerns or to report an injury or illness.
- previous work done at the site and hazards that may already be present.

The plan should include guidelines for when and where personal protective equipment (PPE) - such as hard hats, respiratory protection, hearing protection, gloves, chemical splash goggles, and face shields - should be worn on the job site.

The goal should be zero accidents, and substantial reductions in accident frequency can be expected when safety programs and safety requirements are adopted on a project site.

Owners and project designers should be included in the process of formulating any plan. Their direction and planning are crucial in laying out the steps that will be necessary to complete the project.

If these stakeholders decide to alter the parameters and scope of work, project managers will need their input at that stage, as well.

Construction workers should be consulted ahead of time and invited to provide input on safety procedures they believe would benefit the project. Many workers will have had experience with previous accidents and near-misses on construction sites and will be able to provide valuable insights on procedures and best practices.

Include site-specific information

A good site-specific safety plan will contain the following:

- Project name.
- Project location.
- Description and visual diagram of the project.
- List and description of site conditions and exposures.
- Routes of travel and delivery to and within the site.
- Building entries and stairwells.
- Presence and location of any hazardous materials (such as asbestos) and protocols for dealing with such materials.
- Safety standards and location of any potential hot work on the job site.
- Hazard communication and response plan in case of accident.
- Material safety data sheet (MSDS) for any chemicals or other potentially hazardous materials, and their locations on-site.
- First aid protocols and where first aid can be obtained.
- Clearly defined roles and responsibilities for each workers and subcontractor.
- Contact information for safety representatives and emergency contacts.
- List of construction site safety rules, such as designated smoking areas or restrictions on operating certain equipment in defined areas.

Site safety plans should take into account including the below information:

- Types of Hazards on the site.
- Procedures and measures to avoid control exposure to hazards.
- Contact information for emergencies and for contractors, subcontractors, and the staffing agency.
- Guidelines for when personal protective equipment should be worn on site.
- Information about why wearable personal protective equipment improves safety.
- Previous work done on the site and hazards that may still be present.

<u>What should a site-specific safety plan include?</u>

Site-specific safety plans should include a variety of information designed to protect not just workers, but subcontractors, visitors, and members of the public from potential safety risks presented on-site.

The safety representative

Clearly state that the primary safety responsibility for each worker falls on the supervisor in charge of that particular construction site, that he has completed mandatory safety and first aid training, and he has the authority to stop work should a hazardous situation occur.

State that these same supervisors have the authority to spend money to eliminate imminent danger to workers, others, and property. Also identify the company's safety representative, who is responsible for safety related training and the verification of worker compliance with safety regulations.

Site safety supervisors must not be scared to report safety breaches

Medical treatment

Outline the specifics of who provides medical services, when and where these services will be provided, and how and when emergency personnel shall be summoned.

Safety inspections

Clearly state that the supervisor of each construction site shall conduct continuous safety inspections of the work area and that any problems will be immediately noted and corrected.

Safety indoctrination

Outline how new workers are briefed on safety issues prior to going to the construction site. Clearly state how all workers have been issued personal protective equipment (PPE), trained in proper use of PPE, and familiarized with those situations that require its use.

Continuous safety training

Detail how and when your company conducts safety training, toolbox talks, etc., including who gives them and when. Also state that every worker is empowered to bring any safety related concern to the attention of management and indicate how and when management reviews those problems.

Housekeeping

Construction site neatness is a prime indicator of your attitude toward safety. Indicate in your safety plan who is responsible for clean-up and when these activities should occur.

Protective equipment

Detail what PPE is issued to each worker. State that each worker is responsible to have their PPE when needed, who is responsible for ensuring proper PPE use, and how to replace worn, damaged, or lost PPE.

Accident reports

Each accident, no matter how slight, should be reported to the site supervisor. It should have its own file that should contain all information about the accident, and what steps were taken to eliminate the hazard. Identify who will conduct the accident investigation, how he can be called, and where the records will be kept.

Work zone warning devices

Detail work zone warning devices used by your company and when they should be utilized. List any Worker training, such as flagger training, in the use of work zone safety equipment.

Fire protection

Identify fire protection equipment provided on site, who is responsible for summoning fire emergency personnel, and that your workers are not expected to fight fires unless they are trained to do so. Include precautions to take when fuelling/storing flammable liquids.

Equipment inspections

List procedures and schedules for regular inspection, testing, and reconditioning according to manufacturer, or local, state, and federal standards. Detail how deficient equipment is handled. Also indicate who is responsible for inspections, repairs, and where the records of these activities are kept.

Control of lockout/tag-out

Discuss your lockout/tag-out procedures, how and when they will be used, and who has the authority to remove a lockout tag. It is important to note that this section does not replace a formal lockout/tag-out policy or program.

Hazard communications
Indicate where MSDS forms are filed and who to call with MSDS questions. Identify who provides workers with hazard communications. Refer to your hazard communications plan for specific information and notification procedures when dealing with hazardous or harmful materials.

Subcontractors

State that any subcontractors hired or responsible to your company will be required to follow your safety regulations and abide by your safety plan and safety program.

Periodic plan review

Identify who reviews this plan, when it's reviewed (at least annually), and who can approve and/or make changes to this plan. A comprehensive review prior to each project is most desirable.

Regular reviews of your safety plan are important to maintaining a safe construction site

Identify construction site hazards

In considering potential issues that may arise, a plan should be developed that takes into account - and seeks to avoid - hazards such as:

- equipment failure.
- operator failure of heavy equipment such as forklifts, cranes, etc.
- fire hazards, through the careful storage of flammable material.
- chemical exposure through touch or fumes.
- poor air quality.
- improperly stacked or handled material that's likely to fall.

- excessive noise that could damage hearing.
- lack of cleanliness.
- electrical hazards.
- hazards that can lead to tripping, slipping, or falling.

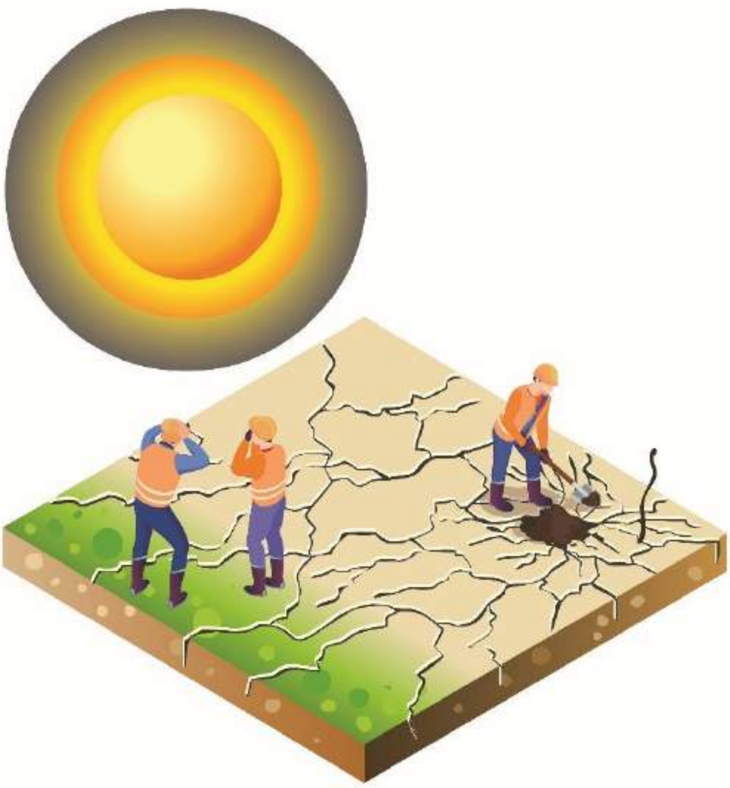
A checklist detailing how such incidents are most likely to occur, and a site map detailing potential problem areas such as blind spots, can help workers prepare and take the proper precautions. Of course, where possible, such situations should be avoided and locations where they might occur adjusted to improve safety.

Establish weather protocols

Establish clear protocols for work procedures and/or suspension during inclement weather. Construction sites are particularly prone to damage and unsafe conditions during severe weather, simply because not everything is "nailed down."

High winds can wreak havoc with material that isn't properly secured, in extreme cases sending it flying with the potential to injure workers. So, it's a good idea to monitor weather reports and have contingency plans in place for securely storing loose materials and equipment in the case of bad weather.

Make sure workers know how to recognize dangerous weather. Know when to delay work in case of severe heat or cold, lightning storms, and other extreme weather conditions that can pose a threat to workers on the site.



Ensure workers know the signs of dangerous weather

Why some site-specific safety plans fail

Many site-specific safety plans fail because they're not specific enough.

It's easy for construction site owners and managers to simply follow a standard template that's passed along to workers for routine "sign and return" approval, but this will not address particular issues specific to a given site. It's also not enough to just pass along local regulations and industry standards without stating how they apply specifically to the work at hand.

Safety plan templates fail to take into account project specifics, such as the site layout (blind spots, trenching, etc.) that can affect things like traffic control and worker and visitor safety. Templates may also leave out important details including any hazardous chemical components specific to the project, an accurate visual diagram of the site, and information about the location of the project in relation to its setting - all of which may inform workers of potential dangers and thereby improve overall safety.

While a template SSSP may be better than no SSSP at all, neither a template nor a simple restating of Industry guidelines without consideration of the unique elements of a given project is the best option. Templates will often fail to address essential information specific to the project at hand. This failure can leave necessary safety protocols unstated and put worker health and safety at unnecessary risk.

Five step construction site safety plan

Follow these five steps to create a construction site safety plan for your construction site:

1. **Inspect and improve your construction site**
2. **Conduct a job safety analysis**
3. **Put your plan in writing**
4. **Train your workers**
5. **Analyse incidents**

CHAPTER 6

ACCIDENT AND EMERGENCY PROCEDURES

Accidents happen unexpectedly, without design or by chance on construction sites every day. Accidents normally occur because of a combination of incidents that have occurred either over a build-up of time or at that very instant.

Some causes of incidents may include:

- poor choice of risk controls.
- a system of work that involved unnecessary risks (either a system of work designed by management or a 'shortcut' that management knew about but failed to prevent).
- insufficient training for the job.
- insufficient supervision.
- poor maintenance of equipment.
- unguarded machinery.
- unsafe use of machinery, materials and substances.
- unrealistic production schedules.
- safe work procedures not followed.
- poor housekeeping.
- operator error caused by fatigue, boredom, complacency; and
- failure to act after previous incidents.

An accident can result in no injury (near hit), a serious injury, causing a severe disability, death or major property damage.

This section discusses why it is important for construction site owners to develop and implement accident and emergency procedures on construction sites.

Emergencies

An essential component of work health and safety is to be prepared for possible events that may occur in the construction site. This requires construction site owners to develop procedures and document a plan for incidents, accidents and emergencies that may occur.

Workers must be informed of and trained in procedures and Principal Contractor's must also review plans to ensure they are effective and up to date.

An Accident & Emergency Plan should be based on a practical assessment of hazards associated with the work activity or construction site, and the possible consequences of an emergency occurring as a result of those hazards. External hazards should also be considered in preparing an emergency plan.

Emergency plans do not necessarily have to be lengthy or complex. They should be easy to understand and tailored to the specific construction site where they apply.

In preparing an Accident & Emergency Plan, all relevant matters need to be considered including:

- the nature of the work being carried out at the construction site.
- the nature of the hazards at the construction site.

- the size and location of the construction site, for example, remoteness, road access and proximity to health services.
- the number and composition of the workers, for example, workers, contractors, and other persons such as visitors at the construction site.

Emergency plans, or a summary of key elements of emergency plans, should be readily accessible by workers or on display at the construction site.

Emergency Plans are vital to ensuring correct procedures are followed after an incident

Incidents, accidents and emergency planning

A construction site owner must develop and document a plan and procedures for any incidents, accidents and emergencies that may occur at a construction site. Workers must be informed of and trained in procedures that are created. Construction site owners must also review plans to ensure they are effective and up to date.

An emergency plan is a written set of instructions that provides for:

- emergency procedures, including an effective response.
- evacuation procedures.
- notification of emergency services.
- medical treatment and assistance.
- communication procedures.
- testing of procedures; and
- information, training and instruction to relevant workers in relation to implementing the emergency procedures.

What types of emergencies should be covered?

There are many types of accidents and emergencies that can occur on a construction site. Types of emergencies that should be planned for may include:

- chemical spills.
- fire.
- explosions.
- medical emergency.
- electrocution.
- poisoning.
- rescues.
- incidents with hazardous chemicals.
- machinery malfunctions causing injury.
- natural disasters.

Emergency plans can be designed for small incidents up to large scale emergencies.

What should your accident & emergency plan include?

Your accident & emergency plan should include the following information:

- an effective response to an emergency.
- evacuation procedures.
- notifying emergency services organisations.
- medical treatment and assistance.
- effective communication between the authorised person who co-ordinates the emergency response and everyone else at the construction site and any neighbours who may be affected.
- testing your emergency procedures, including how frequently you'll do this.
- information, training and instruction to your workers about implementing the emergency procedures.

Responsible people

Construction Site Owner's should allocate accident & emergency response duties to workers who can manage the emergency situation.

Their responsibilities, authority and accountability should be defined so that the responsible person understands their role during an emergency and other worker understand respect and respond to the responsible person's commands and instructions. Your emergency plan should list these people. Tell your workers who these people are by email, posters, in staff meetings and during safety inductions.

Make sure these responsible people have helmets, hi-vis vests or other items that clearly identify them as accident & emergency controllers.

Ensure only competent personnel are allocated emergency response duties

Informing emergency services

Fire fighters, medical responders and other emergency services personnel may be exposed to the hazards at your construction site when they attend an emergency.

Providing them with all the relevant information will help them reduce the risks to their health and safety and determine the best response to the emergency.

When reporting an emergency-to-emergency services you should tell them about:

- the nature of the emergency that has occurred.
- details of workers injured, and initial response being taken on the construction site.
- the locality of your construction site and any restrictions to access.
- details of any hazardous chemicals or dangerous substances present at your construction site (you should have a register or inventory list at your construction site) and safety data sheets relating to the hazardous chemicals or dangerous substances.
- any dangerous machinery, radiation sources, asbestos, restricted access points, drains, excavations, unstable grounds, or systems that may activate automatically.

Have a map or site plan that shows where your hazards are near your construction site's entry. Any required placarding and signage you have up is also vital for emergency services.

Emergency equipment

If an accident or emergency occurs at your construction site, you and your workers will need appropriate equipment to respond to any emergency scenarios you've identified, and it needs to be located where it's readily accessible by workers in the event of an emergency. Use signage in both Khmer and English language so people can see where the equipment is kept.

You may need to seek advice from competent professionals about the types of equipment available and training you need to operate such equipment; also get competent professionals to regularly check what you put in place is still current and suitable. Check the work health and safety laws to see if there are any requirements specific to the work and hazards at your construction site.

Make sure your emergency equipment, signage, lighting, fire extinguishers, sprinklers, fire hoses, alarm/detection/warning systems and so on are regularly inspected, tested and maintained.

The availability, location and servicing of emergency equipment should be regularly reviewed by the project team at maximum monthly intervals and anyone who is likely to use them in an emergency.

Emergency equipment may consist of the following type of equipment and its quantity should be considered for each credible emergency scenario outlined in the emergency plan or emergency procedures:

- firefighting equipment (e.g., charged risers, hydrants, hose reels, suppression systems, extinguishers, fire blankets).
- crane assisted first aid cage/workbox.
- height rescue kit.
- first aid equipment.
- flashback arrestors fitted to oxy/acetylene equipment.
- stretcher and stretcher access.
- nurse call system.
- emergency warning information system.
- emergency back-up lighting.

- electrical rescue kits - low or high voltage.
- spill containment equipment such as booms, sandbags, vermiculite or sand.
- protective clothing e.g., overalls, chemical splash suits, gloves.
- specialist equipment e.g., weather and environmental monitoring equipment, gas detectors, or emergency power.

Erect clearly visible signage to indicate locations of emergency equipment.

First aid

As covered in the First Aid section of this manual, construction site owners must provide adequate first aid facilities and equipment to allow people to respond to accidents and emergencies.

Not only must you regularly assess your first aid personnel, equipment and kits but your emergency plan needs to document your assessment, records of training, what equipment and kits are provided, and what you have in place for workers in the field.

Train your workers

All workers need to be trained in the relevant accident & emergency procedures that are created for your construction site.

As well as general evacuation drills for the entire construction site, some workers may need specific training and 'rehearsals': for example, workers required to work in confined spaces should know about rescue and first aid procedures relevant to working in that environment.

Workers appointed to manage emergency situations need training, so they have the skills, knowledge and confidence to respond to an emergency immediately and competently. This includes using any emergency equipment and providing first aid.

Ensure your workers receive training on emergency procedures to ensure they react professionally and safely.

Emergency evacuation

Construction site owners must maintain an accurate and up to date emergency evacuation plan.

The plan, including emergency exits must be displayed prominently at the construction site. Workers must be trained in evacuation procedures including:

- the identity of workers responsible for coordinating emergency evacuations.
- any alarm system and emergency warning and intercommunication system used at the construction site.
- actions that workers are required to take in response to alarms.
- the evacuation route(s) to be taken to exit the construction site.
- assembly area or designated alternative areas which provide a safe refuge internally or externally.
- how the end of the evacuation will be signalled.
- what is required at the completion of the evacuation.

Make sure your Evacuation Plan is up to date and visible to all workers.

Reporting an accident or emergency

An obligation to notify

Under the Work, Health and Safety laws in Cambodia, construction site owners must notify authorities after becoming aware an incident has occurred resulting in:

- death of a person on a construction site.
- a person needing medical treatment within 48 hours of being exposed to a substance on a construction site.
- a person needing immediate treatment as an in-patient at a hospital.
- a person needing immediate medical treatment for one of the following injuries: amputation, serious head injury or serious eye injury, removal of skin (example: de-gloving/ scalping) electric shock, spinal injury, loss of a bodily function, serious lacerations (example: requiring stitching or other medical treatment).

You must report the following incidents if they expose a person in the immediate vicinity to an immediate risk to the person's health and safety.

- Registered or licensed machinery collapsing, overturning, falling or malfunctioning.
- Collapse or failure of an excavation, or shoring supporting an excavation.
- Collapse of a building structure (or partial collapse).
- Implosion, explosion, or fire.
- Escape, spillage or leakage of any substance.
- Machinery or objects falling from high places.

Accident & emergency procedures

An emergency is an unplanned event that has the potential to harm the life, health, or safety of a person, or to damage the environment or public property.

Emergency response plan and procedures

Every construction site needs an emergency response plan before work begins so that everyone is prepared in case of an emergency. Because the size and complexity of a construction site differs from site to site, the planning necessary for emergencies will also differ. An effective plan must take into consideration the items listed below.

Assessment/hazard identification

Identify hazards and assess potential risk by answering these questions:

- What can go wrong?
- What are the consequences?

Emergency resources

Determine what resources are available for the hazards identified and assessed. Verify that emergency responders operate in the area. If not, make alternate arrangements.

Maintain on-site resources such as fire extinguishers, spills containment equipment, and first aid kits. Outside help may be so far away that on-site resources are necessary, such as fire protection or ambulance and medical resources in remote areas.

Communication systems

To relay accurate information quickly, use reliable communications equipment, develop procedures, and train personnel. A backup system is a good idea in case the emergency destroys phone lines, for example. Emergency phone numbers and the site address/location should be posted clearly around the construction site.

Ensure there is a reliable method to contact emergency services.

Administration of the plan

The person in charge of administering and organizing the plan must ensure the following:

- Everyone clearly understands their roles and responsibilities within the plan.
- Adequate emergency resources are available for each stage of the project.
- The plan is reviewed regularly and always after an emergency to correct any shortcomings.

Emergency response procedures

Before you begin work on a construction site, make sure you are familiar with the emergency response procedures for that site.

STOP and ASSESS the situation before performing any of the tasks. Stay calm to provide an example to others.

The site supervisor should be able to provide information about:

1. emergency warning alarms and codes.
2. emergency telephone numbers.
3. nearest hospital.
4. rescue procedures.
5. meeting or muster points.
6. names of persons capable of administering first aid.
7. location of emergency equipment such as fire extinguishers.

Communication of the procedures

- Review the procedures with workers, subcontractors, and suppliers to ensure that it covers their activities.
- Review it with owners of operating machinery to ensure that hazards are identified and covered.
- Review it regularly with your health and safety representative to address new hazards or significant changes in site conditions.
- Post the procedures in a conspicuous location at the project.

When developing your plan, make sure it always reflects current conditions on the construction site.

Follow these 6 emergency procedure steps:

1. **Stay calm** do not panic - Your behaviour can influence others, so staying calm will help the emergency response.
2. **Take command** - Call or delegate someone to call emergency services immediately and explain the situation. Assign someone to meet and direct the ambulance to the location.

3. **Assess the situation -** Use extreme caution when approaching the scene to avoid being injured yourself. Try to determine what happened and what the emergency is. Try to eliminate or control the cause of the emergency to prevent further danger to the injured worker, to others, or to the property. Give first aid as soon as possible.
4. **Provide protection -** Safeguard the area to prevent others from being injured and prevent further losses. You may be called upon to help divert traffic, suppress a fire, prevent object from falling, or shut down equipment or utilities.
5. **Preserve the scene -** Do not disturb anything except to save a life, relieve suffering, or prevent immediate or further losses. Barricade, rope off, or post a guard at the scene to make sure nothing is moved until the relevant authorities have completed their investigation.
6. **Follow procedures -** Follow the procedures outlined in your company's emergency response plan. Ensure that senior management is informed. They can contact the proper authorities, notify relatives, and begin the procedures for reporting and investigating the incident.

Critical Incident (death) general response

Incident Occurs:

- Evacuate area (activate emergency alarm if required).
- Make Safe (isolate services, cordon off area, extinguish small fire etc.).
- Ensure first aid is provided.
- Contact emergency services and send a person to flag emergency services to site.
- Preserve scene.

Before Emergency Services Arrive:

- Follow emergency services instructions over the phone.
- Prepare for emergency services arrival (clear access, stretcher access etc.).
- Ensure roll call is conducted (refer to visitors register & attendance board).
- Notify Site Manager.
- Obtain induction form of any seriously injured workers for next of kin details.

Emergency Services Arrive:

- Follow instructions from emergency services.
- Provide copies of induction forms for any injured workers.
- Provide information on missing persons.
- Emergency services will notify next of kin.

All other communications

- Company Owners (HSEQ Manager or Construction Manager to notify).
- Legal Representative notification (Director to notify).
- Injured Workers Principal Contractor notify.

- Injured Workers next of kin (Emergency Services to notify).
- OHS Dept. to investigate (dependent on legal advice).

Emergency response plans

Below are some emergency situations that may be specific to a construction site.

Medical emergency procedure

- Assess situation and make area safe (evacuate if required).
- Provide first aid.
- Injured persons (IP) Principal Contractor to take injured worker to medical facility if required.
- If an ambulance is required, call 119 and appoint someone to direct ambulance to site.
- Prepare any assistance for emergency services (clear pathways, stretcher access etc.).
- Provide next of kin details to emergency services where required (induction form).
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for relevant Construction site Incident Authorities.
- Inform site of the incident.

Gas leak emergency procedure

- Assess situation and make area safe (evacuate if required).
- Isolate supply. Contact plumber if onsite / contact Construction Site Owner. (refer to emergency contacts list on Emergency Information Sign).
- Contact emergency services if required (appoint a person to direct emergency services to the site).
- Isolate any electrical supply in the area. Do not smoke. Do not use radios or mobile phones in the area.
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for Construction site Incident Authorities.
- Inform site of the incident.

Rescuing worker from raised EWP (elevated work platform)

- Assess situation and make area safe (evacuate if required).
- If possible, use the emergency decent device controls to carefully lower the platform (be aware that the ground controls will override the platform controls for emergency purposes).
- Ensure there are no persons underneath the platform, or in the direct drop vicinity of the EWP when using the emergency device.

- If the person in the EWP is in need of emergency treatment and the lowering devices are not working, a second EWP may be used to retrieve the injured worker if available.
- Contact emergency services making it clear that it is a height rescue.
- Contact the EWP supplier/maintenance supplier and ask them to come to site to assist if required.
- Preserve the scene for the relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for Construction site Incident Authorities.
- Inform site of the incident.

Rescuing tower crane operator

- Gain access to the crane cabin and provide immediate first aid assistance.
- Contact relevant emergency services (high angle rescue team) making it clear it is a height rescue.
- Prepare any plant or equipment to assist emergency services (mobile crane, first aid box etc.).
- Take instructions from emergency services.
- Provide next of kin details to emergency services where required (induction form).
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for Construction site Incident Authorities.
- Inform site of the incident.

Smoke/fire/explosion emergency procedure

- Assess situation and make area safe (evacuate if required).
- If safe to do so, attempt to extinguish the fire.
- Contact emergency services if required (appoint a person to direct emergency services to the site).
- Take instructions from emergency services.
- Do not enter site until instructed by emergency services.
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for Construction site Incident Authorities.
- Inform site of the incident.

Structural collapse/trench collapse

- Assess situation and make area safe (evacuate if required).
- Check to see if anyone is trapped (IF SAFE TO DO SO).
- Try and free any trapped workers (IF SAFE TO DO SO).

- Isolate any services that may be damaged or may become damaged.
- Contact emergency services if required (appoint a person to direct emergency services to the site).
- Prepare any tools, plant or equipment onsite that may assist the emergency services.
- Assist emergency services. Re-open unaffected work areas.
- Complete incident report and identify cause and corrective action.
- Maintain scene for relevant Construction site Incident Authorities.
- Inform site of the incident.

Contacting overhead/underground electrical assets

- Assess the situation and prevent access to the immediate area.
- Contact emergency services if required (appoint a person to direct emergency services to the site).
- Contact asset owner (refer to emergency contacts list on Emergency Information Sign.
- If a person is operating mobile plant, instruct driver to stay in the cab and wait until the line is de-energised.
- If there is smoke and a danger of fire instruct the driver to:
    - jump from the cabin without touching the machine.
    - land with both feet together at the same time (DO NOT FALL OVER).
    - shuffle away from the machine always keeping both feet on the ground.
    - clear the machine by 30m.
    - ensure a 30m clear zone is kept in place from machine.
- NEVER touch a person who is in contact with a live electrical service. It must be de-energised first.
- NEVER touch power lines even if you think they are dead until instructed that it is clear to do so by emergency services.
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for Construction site Incident Authorities.
- Inform site of the incident.

Electric shock

- Assess situation and make area safe (evacuate if required).
- Before assisting an injured person, determine cause of electric shock and isolate the supply where safe to do so.
- Provide first aid and arrange for the IP to be taken to a medical facility (mandatory for electric shock).

- Injured persons (IP) Principal Contractor to take injured worker to medical facility if required.
- If an ambulance is required, call 119 and appoint someone to direct ambulance to site.
- Prepare any assistance for emergency services (clear pathways, stretcher access etc.).
- Provide next of kin details to emergency services where required (induction form).
- Preserve the scene for relevant Construction site Incident Authorities.
- Complete incident report and identify cause and corrective action.
- Maintain scene for relevant Construction site Incident Authorities.
- Inform site of the incident.

Mental health incident procedure

Incidents can include Panic attacks / Psychosis / Trauma reaction / Self harm / Drug/Alcohol abuse etc.

- Do not leave the person alone.
- Assess danger to themselves or others - keep them away from potential danger.
- Reassure the person by talking calmly to them.
- Try to get them to control their breathing.
- Maintain eye contact.
- Engage the person by talking. Ask straight forward questions. Do not judge them.
- Don't overcrowd them. Disperse a crowd but ensure assistance is available in case it's required.
- Ask if there is someone you can call to come and be with them.
- If the person is violent or a threat, call the police immediately.
- Ensure the person leaves site safely. Arrange next of kin to collect or call an ambulance if required. (next of kin details are on the induction form).
- Complete incident report and identify cause and corrective action.
- Inform site of the incident.

Major chemical spill

- Cordon off and evacuate the area and contact the emergency services for major spills.
- Identify the chemical and refer to the MSDS sheet.
- Follow advice on MSDS Sheet and don any required PPE specified.
- Prevent further contamination by stopping location of spill and containing spill area with sand, bungs etc.
- Follow advice of emergency services and safely dispose of spilled chemical and contaminated material.
- Investigate the cause of the spill to determine corrective action.
- Complete incident report and identify cause and corrective action.

- Inform site of the incident.

Close contact or confirmed COVID-19 on site

- Isolate the person from site.
- Investigate with who the person had contact.
- Identify the areas where the person is been including amenities.
- Contact HSEQ Manager who will notify Directors, contact the Covid-19 Hotline and arrange construction site cleaning as needed.
- Inform site.

Review your accident & emergency plans

It is very important that construction site owner's review their accident & emergency plans to ensure they remain current and effective. Review your emergency plans regularly or whenever there is a change in your construction site or in the surrounding businesses or environment.

Flooding - preventative measures and post flood procedures

Flooding can wreak havoc on construction sites in the following ways:

- Delaying project timelines.
- Creating harder working conditions for construction workers.
- Causing significant damage to materials.
- Impacting the structural integrity of a building.
- Contamination may also occur where waste-water drainage is located.
- Resulting in defective buildings.

That's why understanding what causes floods and learning some key tips for flood prevention and post flood procedures on construction sites is vital.

Flood preparation for construction sites

Having a plan in place to cope with floods can help reduce the impact on your construction site and help you to recover quickly.

Depending on your construction site's location, you can be impacted by different types of floods such as river or creek flooding, overland flow (when water travels over land during heavy rainfall events) and storm tide flooding when sea levels rise above normal levels flooding coastal areas, or a combination.

It's important to understand the different types of flooding and how your construction site may be impacted. Even if your construction site is not directly flooded, access and supply routes may be cut off during a flood having a significant impact on your work.

To get back to work sooner, use these 4 stages to help your construction site manage a flood:

- Prevent and prepare.
- Respond.
- Recover.
- Communicate.

Prevent and prepare before a flood

Consider what actions you can take to prevent or reduce the likely effects of a flood and prepare steps to plan for, respond to and recover from unavoidable events.

Make a plan

Develop a business continuity plan to help you prevent risks, prepare for potential impacts, respond to and recover from a severe weather event.

Complete a business continuity plan to help you prevent, prepare, respond and recover before a flood or crisis occurs.

Steps to include in your plan:

- Identify key events and risks most likely to impact your construction site.
- Plan how to respond to key risks and incidents (e.g., changes to goods or services delivery).
- Identify worker roles and responsibilities in an emergency and share team contact details.
- Identify and record customer, supplier and emergency contacts.
- Identify and record local emergency alerts, warnings and contacts and update channels.
- Write an emergency evacuation plan and procedures (e.g., identify assembly points, assign roles, shutting down operations procedure).
- Conduct regular emergency drills with workers/visitors/customers/guests and document in your emergency plan.
- Create an event log to record information, decisions, actions, and 'before and after' damage photos for insurance purposes.
- Create a recovery plan to document steps after an incident.

Prepare your business

When planning for a flood, consider alternative ways to operate if power, supplies, buildings, properties, roads and communications are cut off or unavailable.

- Check with your local government to access:
    - flood plans or records to see if your construction site could be affected and what the impact might be.
    - local flood arrangements for your area.

   - local disaster updates.

- Clear gutters and drains to ensure they aren't blocked with rubbish, mud and debris.
- Check exposed electrical equipment including power points and adaptors and elevate from potential water exposure.
- Plan for any workers or visitors remaining on your premises so they are fully informed and have access to first aid and emergency supplies.
- Clear loose equipment and vegetation around your site.
- Identify where to relocate equipment and vehicles.
- Store hazardous materials safely above ground level (or off-site) in case of flooding.
- Sandbag your premises for flooding.

Plan alternatives for loss of power, access, communication and operations

- Plan for extended power outages by getting a generator and fuel.
- Ensure you have enough stock, supplies or spare parts in case your power or access is cut off.
- Identify alternative off-site locations to operate from.
- Plan for flexible worker arrangements.
- Plan how you will manage planned work processes.

Initial response

Usually, if a construction site becomes flooded, supervisors should call a halt to construction work. After all, it's nearly impossible - and definitely unsafe - to work on a site that is engulfed with a large volume of water and mud.

If flooding is a potential threat, a thorough safety plan will spell out evacuation plans and guidelines for determining when it's safe to return.

- Activate your business continuity plan (includes emergency plan)
   - Secure vehicles, equipment and supplies.
   - Unplug electrical equipment, shut down master electrical board and gas supply.
   - Collect your emergency kit.
   - Secure your premises.
   - Evacuate premises if you need to leave.

If workers return to the area before flooding ends, it's important to ensure that they stay out of floodwaters. Besides the danger of drowning, floodwaters may contain dangerous levels of bacteria, and may hide debris and other hazards.

Because almost half of flood-related fatalities involve vehicles, make sure workers know the dangers associated with driving their vehicles into floodwaters. The best advice is very simple: do not drive into a flood.

But the dangers to workers don't end when the water starts to recede. A construction site that has suffered a flood poses a wide variety of hazards long after the flooding itself ends.

Erosion effects

As floodwaters scour the undeveloped land of a construction site, they can dig channels that create trip hazards, and can undermine large areas and small structures. Ground that appears to be solid could be anything but. Before workers (and heavy equipment) begin to move around the site, it should be inspected to ensure that the ground is strong and stable. If driveways, paths, or other areas have been damaged, they should be repaired before work resumes.

Debris dangers

Floodwaters pick up (and create) debris as they race across the ground, so it's possible that the receding waters will leave a variety of debris on your construction site. Some of that debris could be sharp or otherwise dangerous, and much of it will pose a trip hazard.

It's particularly important to be careful around debris that has collected around power poles, transformers, and other equipment that uses high-voltage electricity. A utility worker or an electrician should inspect and test that electrical equipment to ensure that it hasn't been damaged, and that all worker safety measures are still in place.

Debris can present additional hazards for workers who have to move it. Manual lifting of heavy objects creates a risk of injuries to the back, knees, and shoulders, especially because debris items may be odd-shaped, with unusual centres of gravity. Remind workers of the benefits of working in teams and using correct techniques for lifting.

Electrical equipment

If electrical boxes, panels, or other equipment have been exposed to water, do not touch or use them until they have been inspected by an electrician. The best place to turn off power is the main breaker or service panel, and if someone didn't do that before flooding began, it's important to do so before any workers are in the area.

If the flooding or debris has knocked down any power lines, remember that downed lines may still carry current, and the ground within several feet can become energized. Never touch or attempt to move a downed wire, even if you're convinced that it isn't live. Call in the power company or an electrician to verify that the wire is dead and to make any needed repairs.

Entering flooded areas can also expose workers to electrocution if any live circuits are in contact with the water. Even a slightly damp surface such as a concrete floor can conduct electricity and pose a serious risk.

Flooding can also disable emergency equipment such as fire protection systems. Alarms, sprinklers, and other protection devices should be inspected carefully before workers are allowed in the protected areas.

Displaced animals

Humans aren't the only species that find floods to be disruptive. Floodwaters can damage or destroy the habitats of many creatures, forcing them to find shelter elsewhere - often in unexpected places.

Venomous snakes and rodents could be hiding on your construction site, tense and ready to bite a worker who inadvertently reaches into their temporary homes.

If your site is in area where venomous snakes and animals such as rats are common, remind workers to wear gloves and proceed with caution when reaching into areas that could be hiding places. Remember also that rodents can spread many diseases, so proper hygiene is important after coming in contact with them.

Insects may also be a problem after flooding. Besides the sheer annoyance of large swarms of flies and mosquitoes, floodwaters may dislodge colonies of fire ants, wasps, and other biting or stinging insects.

Biohazard possibilities

Floodwaters often overwhelm sewage systems, leading to discharges of raw sewage that's full of dangerous bacteria and other biohazards. Rotting animals and other organic wastes may also turn the water into a toxic cocktail.

Prevention is the key to protection. Wearing proper personal protective equipment (PPE) and avoiding skin contact with floodwaters is important. Paying particular attention to personal hygiene, such as showering immediately after work, can reduce the potential exposure and limit the possibility that a worker may infect family members.

Other types of biohazards and similar dangers include chemical storage tanks that may have been compromised, along with different types of containers. Valves on propane tanks and similar storage may have been damaged and should be inspected before handling.

Carbon monoxide

Much of the equipment used to clean up after flooding, such as generators and gas-powered pressure washers, emits carbon monoxide gas. While workers are rushing to clean things up and get back on schedule, it's easy to forget about that familiar hazard. That's why it's important to remind everyone that gas- and diesel-powered devices of all types must not be used in confined spaces or indoors.

The menace of mould

One of the most dangerous biohazards - and one of the most common after flooding - is the formation of mould. There are many types of mould, and their effects on humans vary greatly depending upon the type, the degree of exposure, and the strength of the individual's immune system.

Many mould spores are small enough to be inhaled and can cause serious respiratory problems. That's why it's important that workers who will be cleaning in areas where mould has formed use proper face masks with the right kinds of filter cartridges. Surfaces upon which mould has appeared should be cleaned thoroughly, and then disinfected with bleach water to prevent future mould growth.

Worker stress

Because of the damage and disruption caused by floodwaters, workers often find themselves working more hours to repair damage and make up for lost time. That increases the possibility that workers will become exhausted, impacting their awareness of proper safety procedures. In addition, depending upon the climate, they may be at greater risk for heat exhaustion or hypothermia.

Supervisors should monitor workers closely to spot any signs of any of these issues, and take immediate action if problems crop up. It's also helpful to use toolbox talks or reminders at the beginning of shifts so workers remember to pace themselves, stay hydrated, and wear proper clothing and PPE.

CHAPTER 7

SAFETY CHECKLIST AND INSPECTION PROCEDURE FOR INSPECTORS AND SUPERVISORS

Construction site inspections help prevent work-related injury and illness on a construction site. They are an important part of an effective workplace health and safety management system and a useful tool to help prevent safety incidents from occurring.

When you carry out a construction site inspection, you are critically examining the construction site to identify and report potential hazards that can be removed or avoided.

Construction site inspections should be supported by other measures to prevent risk. This includes consulting with workers, especially when changes are being proposed to a process, procedure or machinery.

Regular construction site safety inspections will help you identify hazards and reduce the risk of injury to your workers

<u>Construction site supervisors and safety officers</u>

The following information is designed for people who are employed as construction site supervisors and/or have been given responsibility to act as a site safety officer.

When to schedule a site safety inspection

In addition to correcting any hazards that you observe from day to day, set aside time for regular construction site safety inspections. Regular inspections will help you identify hazards so you can assess and control any risks to workers. Inspection is an ongoing task because the construction site is always changing.

It is important to schedule regular construction site inspections. This recognises that construction site hazards come in many forms and need to be managed in a proactive way.

You may also need to carry out an inspection on your construction site:

- in response to a report of an incident or hazard.
- when a new process, procedure or machinery is introduced to the construction site.

How to carry out an inspection

During an inspection, identify unsafe conditions and acts that may cause injury so you can take corrective measures. Use guidelines including:

- use a checklist to ensure that the inspection is thorough and consistent with previous inspections.
- consider what hazards are associated with the job that is being inspected or that would be performed in that work area.
- observe how workers perform tasks and do they follow safe work procedures and use personal protective equipment as required.
- ask workers how they perform their tasks.
- talk to workers about what they're doing and ask them about concerns they may have about health and safety, and
- record any unsafe actions or conditions observed.

An inspection checklist should be tailored to the specific hazards of your construction site and be developed in consultation with work site representatives. This includes Construction Site Owner's and Principal Contractor's, health & safety representatives (HSR's), supervisors, workers and other interested people.

The checklist should consider:

- environmental - including noise, vibration, lighting, temperature and ventilation.
- equipment - including PPE, tools, specialist equipment and machinery.
- work processes - including compliance with existing policies and procedures and how workers act on the construction site while carrying out a task or operation.

Preparing for inspections

Before starting a construction site inspection:

- review the previous site safety inspection report; and
- make sure that any problems identified in that previous report have been corrected.

Things to consider when conducting a construction site inspection

There are different ways to approach site safety inspections, depending on the objectives of your work, health and safety program. For example, you can focus on the most common tasks your workers perform or on a specific issue addressed by your program, such as ergonomics.

- Listen to the concerns of workers.
- Review and analyse construction site hazards and incident reporting data.
- Identify existing and potential hazards and determine their underlying cause.
- Review how effective hazard controls that were previously implemented were.
- Identify areas which need special attention due to the nature of work carried out.
- Identify areas which need attention where data shows signs of stress, wear, impact, vibration, heat, corrosion, chemical reaction or misuse.
- The entire construction site area should be included in the inspection. This includes building access, rest areas, storage areas, amenities and visitor/worker parking areas.

What should you focus on during your inspection.

Your site safety inspection will focus on many variations depending on the type of construction site you are inspecting, however there are 2 key areas that should always be part of your site safety inspection.

- Identifying Hazards.
- Viewing Work Procedures.

If you identify a serious danger

If you identify an immediate danger during a construction site inspection, immediately inform management. Depending on the level of risk, work may need to stop until the risk is eliminated, or adequate controls are implemented.

If you identify an immediate danger as a safety officer or supervisor and take no action, the responsibility falls directly on you if an incident occurs and a person is injured or killed.

It's your responsibility as a supervisor or safety officer to take action when you identify safety hazards.

Construction site inspectors

Construction site inspectors are a key regulator of work, health and safety laws. Their aim should be to reduce construction site accidents, injuries, and death through 'constructive compliance', a prevention strategy that balances positive motivation with strong deterrents.

The primary role of construction site inspectors is to ensure construction sites and their construction site owner's comply with work, health and safety legislation. They do this by:

- providing advice and information.
- inspecting construction sites.
- enforcing the law.

It is not an Inspectors role or responsibility to make a construction site safe, but to instead target unsafe construction site activity, respond to notifiable incidents, provide guidance and advice on how to comply with work, health and safety laws, and enforce those laws if required.

Information and education

Construction site Inspectors must work with Principal Contractors and Construction Site Owner's to improve workplace health and safety for everyone. They have a key role in implementing the Government's construction industry WHS compliance strategy and should:

- openly provide advice on Construction Site Owner, Principal Contractor and worker responsibilities and rights under WHS law.
- openly provide practical and accessible guidance material on hazard identification and risk control.
- openly promote consultation and representation of workers in work, health and safety matters.

The core of an Inspectors responsibilities is to encourage:

- commitment from Construction Site Owner's to implement a planned approach and continuous improvement of work, health and safety.
- effective construction site communication and meaningful worker involvement at all levels.
- control of hazards at their source.
- appropriate provision of training, information, instruction and supervision.
- integration of work, health and safety into broader enterprise systems and practices.

Construction site inspections

An Inspectors construction site inspection and enforcement activities should focus on poor-performing construction sites, specific hazards that pose serious risks, and the causes of common injury. Inspectors generally conduct planned inspections in these areas.

Inspections are conducted after 'reportable' construction site incidents - fatalities, serious injuries, dangerous incidents and emergencies. If necessary, Inspectors should direct that the incident scene at a construction site be left undisturbed prior to an investigation or while seeking assistance from an expert.

Inspectors must attend construction sites in response to reports of unsafe work conditions at a construction site.

As an inspector it is your role to investigate unsafe work practices at a construction site

<u>When to do inspections</u>

An inspector should inspect a construction site to ensure it is complying WHS laws in the following circumstances.

Notifiable incident

Under the WHS law, a Construction Site Owner and Principal Contractor has a duty to inform an Inspector when a 'notifiable incident' occurs at a construction site.

Construction Site Owner’s and Principal Contractor’s must try to preserve the scene as much as possible until an Inspector arrives at the scene or gives further directions. Examples of notifiable incidents include death at a construction site, major chemical spills, explosion, fire, machinery overturning and electric shock.

Depending on the nature and circumstances of the notified incident, Inspectors may be required to attend the scene of the incident.

Programs of inspection

Strategic inspections can occur as part of an Inspectors ongoing inspection programs focusing on poor-performing construction sites, specific hazards that pose serious risks and the causes of common injuries.

Inspector-initiated inspections

Inspectors should initiate inspections of a construction site in response to observations or information. For example, an inspector may investigate after passing a construction site and observing a construction site activity that poses an immediate risk, such as working on a roof without risk controls to prevent a fall from a height or machinery causing a serious danger to the public.

Inspectors should conduct a safety inspection if there has been a serious safety incident

Inspectors' obligations

Inspectors have obligations they must fulfil when performing their duties:

Identification card

Inspectors should carry an official identification card that shows construction site owner's and Principal Contractors who they are and must show their identification:

- If asked to do so by a Construction Site Owner or Principal Contractor.
- When performing a function or exercising a power.
- When the relevant legislation requires them to do so.

Inspectors should show their identification card prior to entering a construction site

Entering a construction site

As soon as Inspectors enter a construction site they must take all reasonable steps to advise of their entry and show their identification card to the construction site owner or Principal Contractor and any HSR who may be affected by the visit. However, Inspectors should not advise of their entry and show identification if doing so would defeat the purpose of their visit, cause unreasonable delay or if either the construction site owner, Principal Contractor or HSR has already received advance notice of the visit.

As they are leaving, or as soon as practicable after leaving the construction site, Inspectors should detail their findings in a written report to the construction site owner and relevant HSRs.

An Inspectors report should include:

- times of entry and departure.
- purpose of the visit.
- description of what the Inspector has done.
- summary of what the inspector has observed.
- powers the Inspector has used.
- whether photographs, sketches or recordings were made and, if so, where these are available.
- the procedures for obtaining further details from the Inspector.
- procedure for internal review of the inspector's decision.

Enforcement action

Before deciding whether to take enforcement action, the Inspector should make enquiries with the construction site owner and Principal Contractor, or their nominated representative, appropriate HSRs and other relevant parties.

The Inspector should also enquire into the construction site owner's and Principal Contractor's overall systems of work and consider whether the identified safety breach happened because of a failure of these systems. The Inspector should take action to address identified faults in the construction site owner's and Principal Contractor's systems of work.

Inspectors should take an escalating approach, both in using corrective tools to make sure construction site owner's and Principal Contractor's comply with the law, and to decide whether to take action for failure to comply. In deciding the most appropriate action, inspectors should pay careful attention to the Governments regulatory model and consider:

- the nature and circumstances of the alleged breach.
- the characteristics of the Construction Site Owner and Principal Contractor.
- other relevant requirements.

Creating your safety checklist

No matter if you are a construction site Inspector, a supervisor or safety officer, you will be required to create your own construction site and hazard specific site safety checklists. Below is an example of how a site safety checklist could look like.

CONSTRUCTION SAFETY CHECKLIST **Find and record common construction hazards**										
Street Address/City:										
Observer:				Date Observed:						
CHECKLIST COMPLETED: (Check ✓ all boxes that apply)								**INSTRUCTIONS**		
☐ From Sidewalk ☐ Off-sire before or after work ☐ On-site								Every section of the audit should have a ✓ **Yes** = Observed and in compliance **No** = Observed and not in compliance **Not Needed** = Not present on job site **DK** = Do not know		
PERSONAL PROTECTIVE EQUIPMENT: **Needed at this construction site?**										**Yes** ☐ **No** ☐ **Do not know** ☐
HARD HATS										Comments
1	Supplied by Construction Site Owner or Principal Contractor	Yes		No		Not Needed		DK		
2	Worn when required	Yes		No		Not Needed		DK		
BOOTS										
1	Supplied by workers	Yes		No		Not Needed		DK		
2	Worn when required	Yes		No		Not Needed		DK		
HEARING PROTECTION										
1	Supplied by Construction Site Owner or Principal Contractor	Yes		No		Not Needed		DK		
2	Worn when required	Yes		No		Not Needed		DK		
EYE PROTECTION										
1	Supplied by workers	Yes		No		Not Needed		DK		
2	Worn when required	Yes		No		Not Needed		DK		
RESPIRATORY PROTECTION										
1	Supplied by Construction Site Owner or Principal Contractor	Yes		No		Not Needed		DK		
2	Training provided	Yes		No		Not Needed		DK		
3	Worn when required	Yes		No		Not Needed		DK		
LADDERS: Are present at this construction site?										**Yes** ☐ **No** ☐ **Do not know** ☐
1	Correct size for the job			Yes		No		DK		
2	Fully opened and spreader bars locked			Yes		No		DK		
3	Firm foundation for ladder feet			Yes		No		DK		
4	Proper climbing procedures			Yes		No		DK		
5	Three-point contact rule followed			Yes		No		DK		
6	Free from obvious defects			Yes		No		DK		

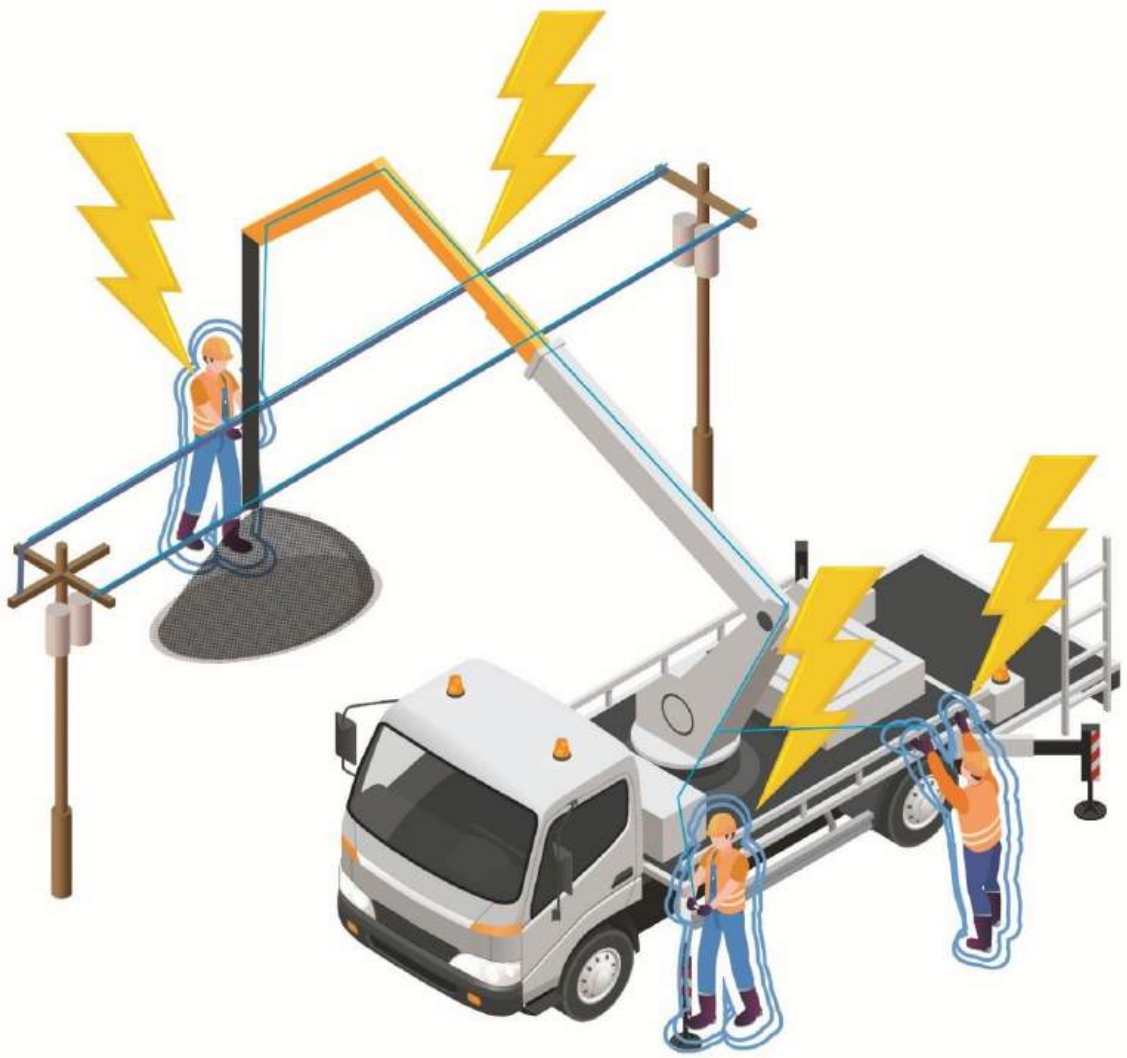
7	Workers stand below top 2 steps	Yes		No		DK		
8	Extend more than 3 feet above support	Yes		No		DK		
	SCAFFOLDS: Are present at this construction site?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Fall protection used if over 1.5 metres	Yes		No		DK		
2	Set up on level stable footing	Yes		No		DK		
3	Platform is appropriate width for type of scaffold	Yes		No		DK		
	FALL PROTECTION: Needed at this construction site?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Fall protection provided for heights 1.5m or over	Yes		No		DK		
2	Harness is worn properly and secured to stable anchorage	Yes		No		DK		
3	Slide guards are installed across full width and all sides	Yes		No		DK		
4	Guardrails are set up for openings 1.5m or above grounds level	Yes		No		DK		
5	Guardrails are constructed sturdily with 2 x 4's	Yes		No		DK		
	MACHINE HAZARDS: Are power tools and machines used at this construction site?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Workers are trained in the use of power tools	Yes		No		DK		
2	Workers have appropriate PPE and keep clothes away safely	Yes		No		DK		
3	Workers are trained prior to using nail guns	Yes		No		DK		
4	Tile and concrete are cut with wet methods	Yes		No		DK		
	HEAT STRESS: Is heat a major concern at this construction site?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Have workers been trained on preventing and recognizing heat related illnesses?	Yes		No		DK		
2	Are workers provided with enough water and appropriate rest breaks?	Yes		No		DK		
	LEAD PAINT HAZARDS: Is the site at risk of lead-contaminated dust?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Have workers been trained on handling lead dust?	Yes		No		DK		
2	Is the work area properly contained?	Yes		No		DK		
	ELECTRICAL HAZARDS: Are present at this construction site?							
1	Work on electrical circuits or energized equipment has begun only after all power sources have been identified, de-energized and locked out, or tagged out	Yes		No		DK		
2	Overhead and underground electrical power lines are located, identified, and avoided	Yes		No		DK		
3	Are ladders, scaffolds, equipment or materials more than 3 metres from any electrical power lines	Yes		No		DK		
	EXVACATIONS: Are present at this construction site?							**Yes** ☐ **No** ☐ **Do not know** ☐
1	Soil and conditions are inspected every day	Yes		No		DK		
2	Safe exits (ladders) for excavations more than 1.5 metres	Yes		No		DK		
3	Shoring shielding and inclination assessed for excavations greater than 1.5 metres	Yes		No		DK		

	ACTIONS OR CHANGES					
1	Talked to your Construction Site Owner or Principal Contractor about health and safety concerns and possible changes/training	Yes		No		
2	Talked to co-workers about health and safety concerns	Yes		No		
3	Talked to Foreman or Contractor about health and safety concerns	Yes		No		
4	Suggested changes in equipment or procedures to co-workers	Yes		No		
5	Asked Foreman or Contractor for changes in equipment or procedures	Yes		No		
6	Asked Foreman or Contractor for training for self and/or co-workers	Yes		No		

COMMENTS

CHAPTER 8

ELECTRICAL SAFETY THROUGHOUT CONSTRUCTION



Electrical hazards are a major cause of death and serious injury on construction sites. This section outlines accepted industry standards for electrical installations and help Principal Contractor's and construction site owner's control electrical risks and protect workers who use electricity.

What is electrical work?

Electrical work means:

- connecting electricity supply wiring to electrical equipment or disconnecting electricity supply wiring from electrical equipment.
- installing, removing, adding, testing, replacing, repairing, altering or maintaining electrical equipment or an electrical installation.

Electrical work does not include:

- work that involves connecting electrical equipment to an electricity supply by means of a flexible cord plug and socket outlet.
- work on a non-electrical component of electrical equipment if the person carrying out the work is not exposed to an electrical risk.
- replacing electrical equipment or a component of electrical equipment if that task can be safely performed by a person who does not have expertise in carrying out electrical work (e.g., replacing domestic fuses or light bulbs).
- assembling, making, modifying or repairing electrical equipment as part of a manufacturing process.
- building or repairing ducts, conduits or troughs where electrical wiring is or will be installed if:
    - the ducts, conduits or troughs are not intended to be earthed.
    - the wiring is not energised, and
    - the work is supervised by a licensed or registered electrical worker,
- locating or mounting electrical equipment, or fixing electrical equipment in place, if this task is not performed in relation to the connection of electrical equipment to an electricity supply.
- assisting a licensed electrician to carry out electrical work if:
    - the assistant is directly supervised by the licensed electrician, and
    - the assistance does not involve physical contact with any energised electrical equipment.
- carrying out electrical work, other than work on energised electrical equipment, in order to meet eligibility requirements in relation to becoming a licensed electrician.
- Electrical work does not include work on electrical equipment that is operated by electricity at extra-low voltage except:
    - electrical equipment that is part of an electrical installation that is located in an area in which the atmosphere presents a risk to health and safety from fire or explosion.

What is an electrical hazard?

An electrical hazard occurs when it is possible to come into contact with electricity. This can happen directly through energised parts of electrical equipment or through indirect pathways such as conductive materials.

The main hazards associated with electrical equipment include:

- contact with exposed live parts, which may cause electric shock and burns (for example, exposed leads or other electrical equipment coming into contact with metal surfaces, such as metal flooring or roofs).
- equipment faults, which may cause fires and cause electric shock injury.
- fire or explosion, where electricity could be the source of ignition in a potentially flammable or explosive atmosphere (for example, in a spray paint booth).

Exposed electrical wire touching water can be fatal

Identifying hazards

Hazards may come from the type of electrical equipment used, how and where it is used, where it is stored, and how it is maintained.

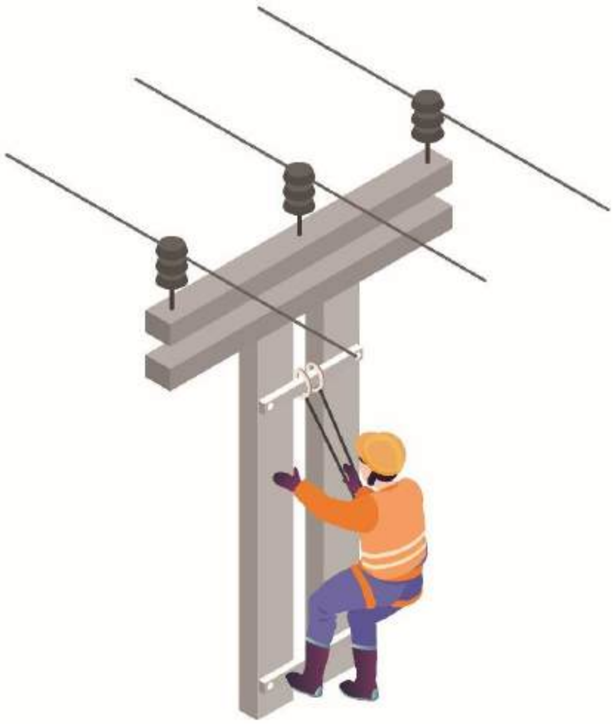
Hazards are more likely to occur when using:

- portable electrical equipment and extension leads, particularly when they are frequently moved, as plugs, sockets, electrical connections and cables are particularly prone to damage.
- equipment in cramped spaces with earthed metalwork, such as inside a tank or bin, where it may be difficult to avoid electric shock if an electrical fault develops.
- equipment outdoors or in wet surroundings, for example commercial kitchens, construction sites and hostile environment.

Water dripping onto a Portable Socket-Outlet Assembly is a dangerous Hazard

<u>**Common electrical hazards in construction sites**</u>

Overhead power lines - overhead powered electrical lines or live wires have high voltages flowing through them. Once in contact, one can suffer from major burns and electrocution. So, remember to maintain a safe distance from them. Label them and put-up warning signs. You can also install safety barriers to keep people off the power lines.



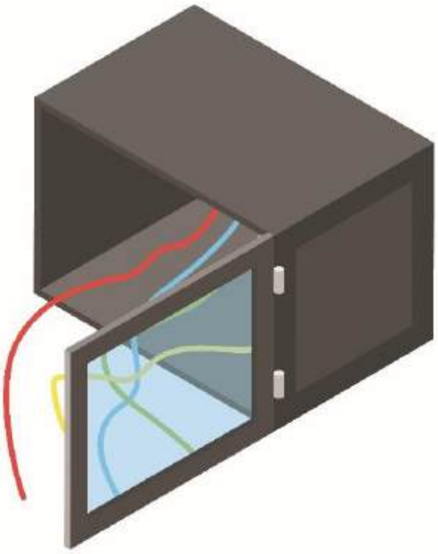
Working too close to power lines can be fatal

Damaged power tools/machine/equipment - Damaged tools, equipment, or machines that are powered by electricity can also cause an electrician or any worker's life. Tell construction workers not to try to fix them. Instead, call electrical subcontractors and industrial electricians will be sent to the site for repairs. If you were able to win bid and are an electrical subcontractor in a construction project, then set schedules for inspection, repair, and maintenance. Observe Out Tag Out (LOTO) procedures at all times before commencing any electrical maintenance and repair works.

Inappropriate wires and overloaded circuits - Inappropriate wire size can cause overheating or overloading circuits that may lead to a fire. So always use the correct wire size to handle electrical load more effectively. Use the correct extension cord designed for heavy-duty use.

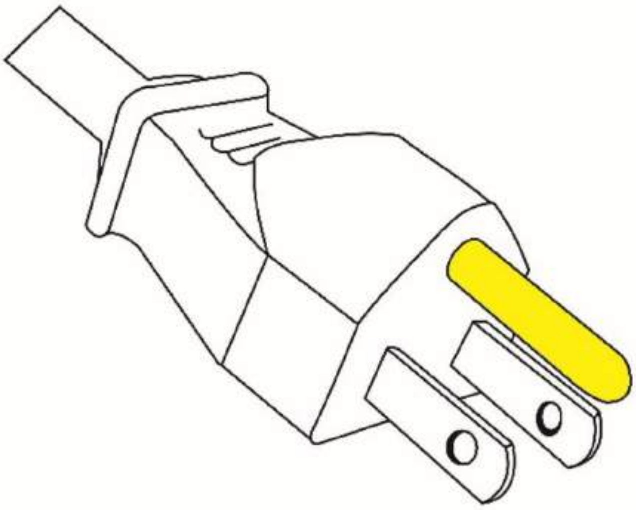
Using a Portable Socket-Outlet Assembly with too many adapters and power cables can lead to electrocution

Exposed electrical parts - When the installation of the electrical system is still ongoing, there will be a lot of exposed wires and open power distribution units or detached insulation parts. These parts can cause potential shocks and burns. Secure them with tags and barriers so those that are not a part of your electrical contracting team won't make a mistake of touching them.



Do not leave exposed wire hanging from the ceiling or walls

Improper grounding - The most common OSHA electrical violation is the improper grounding of equipment. When the ground is properly set, it can reduce the risk of electrocution. The metallic ground pin on equipment should not be removed as it is the one returning unwanted voltage to the ground.



Example of a grounding pin on a power cord plug

Damaged insulation - Insulation on wires keeps voltages contained. When they are damaged, people can get electrocuted. When replacing damaged insulation, be sure to turn off all power sources and never attempt to cover them with just electrical tape.

Example of exposed wiring on an electrical cord

Wet conditions - Electricity travels fast and wide on the water so never operate electrical equipment in wet locations. When it's the rainy season, be sure to schedule your electrical work when the rain stops.

Besides, even when it's the wet season, it won't rain every day for the whole week or month. Only your qualified electrician should inspect electrical equipment that has gotten wet before energizing it. Safety should be the highest priority on construction sites. Now, we look into the best practices for improving your electrical safety practices as well as implementation on the site.

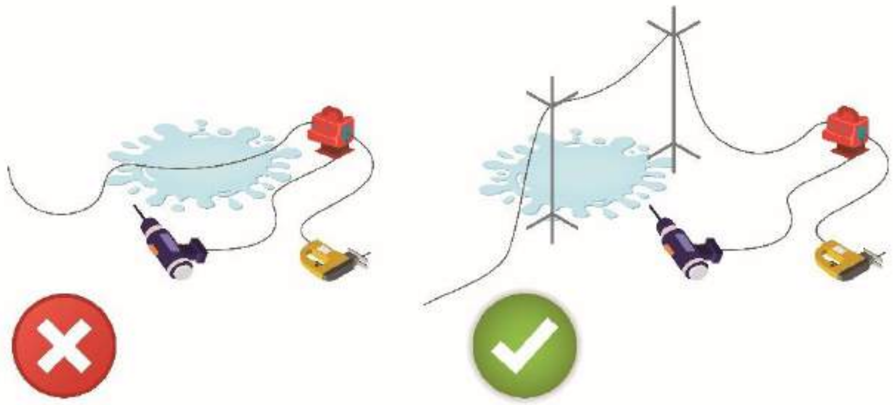
Working with electrical equipment whilst standing in water is a dangerous hazard

<u>Working safely with electricity</u>

Construction site owners have a duty to provide and maintain, so far as is reasonably practicable, a construction site that is safe and without risks to health.

They must also provide and maintain safe systems of work for workers involved in the provision, use, inspection and maintenance of electrical equipment, including all electrical installations, under the construction site owner's and Principal Contractor's management and control.

To meet their obligations and provide a safe system of work, construction site owner's and Principal Contractor's should identify potential electrical hazards in the construction site, assess the risks, implement appropriate risk controls and have procedures in place to review and maintain those controls.



Don't be careless with electricity - always lift electrical leads away from water

Assess the risks

Construction site owner's and Principal Contractor's should evaluate the risks for each identified hazard associated with the electrical equipment used in the construction site. The degree and likelihood of workers being exposed to those hazards should also be assessed.

In assessing risks, construction site owner's and Principal Contractor's should take into account the:

- type of equipment being used.
- environmental conditions.
- likelihood of damage to the equipment.
- risk of workers being exposed to energised parts.
- manufacturers' recommendations, for example whether the equipment is suitable for domestic or commercial use.

Implement risk controls

When the risks have been assessed, consider which risk controls are appropriate in the circumstances. When it is not reasonably practicable to eliminate a risk associated with electrical exposure, construction site owner's and Principal Contractor's must reduce the risk by implementing the highest level of risk control, or combination of risk controls, that are reasonably practicable in the circumstances.

When determining which risk controls are appropriate, consider:

- what are the known risk controls for the identified electrical hazard?
- what risk controls are currently in place?
- is the equipment periodically inspected and tested?
- are leads and equipment being regularly checked for wear, damage and faults through visual inspections before they are used?

- are procedures in place to report damaged and/or faulty equipment and ensure it is promptly taken out of service to be replaced or repaired?
- are residual current devices (RCDs), also known as safety switches, or other measures such as isolation transformers or extra low voltage equipment, in place to ensure that workers are not injured if they come into contact with exposed energised parts?

Common risk control measures

Reduce common hazards and risks with the following control measures:

- Ensure only competent persons, such as appropriately licensed or registered electricians, carry out repairs to electrical installations.
- Provide safe and suitable electrical equipment.
- Provide enough individual socket outlets for equipment.
- Avoid overloading socket outlets or using socket adaptors that can cause fires.
- Ensure power circuits are protected by the appropriate rated fuse or circuit breaker to prevent overloading (if a circuit overloads, do not increase the fuse rating as this creates a fire risk due to overheating).
- Use battery powered equipment instead of mains operated, where possible.

Switch boards

All switchboards installed on construction sites must be designed and constructed to comply with accepted industry safety standards, comply with specified legislation and:

- include a tie bar or other device to prevent strain on termination of cables and flexible cords. The tie bar or other means to prevent strain must be insulated and prevent mechanical damage.
- be securely attached to a pole, post or wall or other stable, free-standing structure designed to withstand external forces that may be exerted on the switchboard (e.g., from flexible cords).
- be protected from the environment by an enclosure meeting IP23 requirements.
- be designed to ensure all main switches and isolating switches are accessible at all times, clearly marked and capable of being locked in an open (off) position.
- have markings at least six mm high identifying all main/isolating switches.
- incorporate insulated stands for supporting cables and flexible extension cords or have a stand fixed near the switchboard.
- be fitted with a lockable door for isolation and security purposes that will not damage the cables when closed.

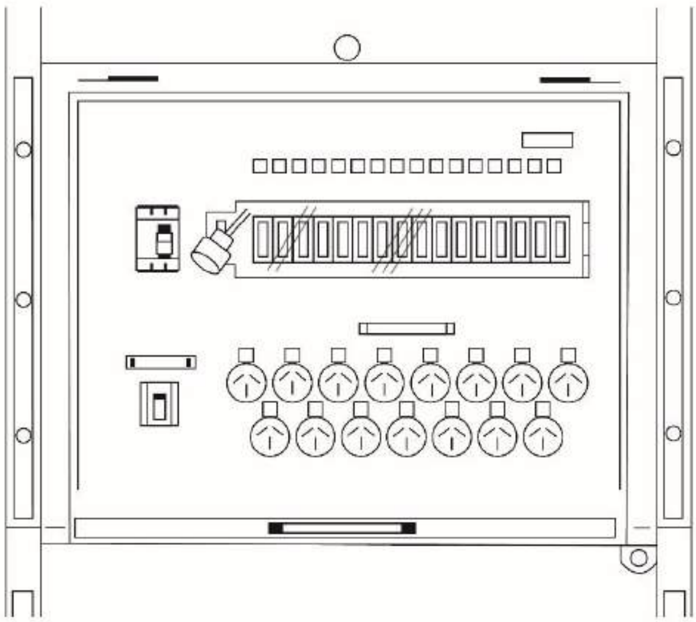
The door must have:

- a device to keep it open when working on the switchboard.
- a sign on the door – ‘KEEP CLOSED – RUN LEADS THROUGH BOTTOM’.

- an opening at the bottom to allow flexible cords to pass through without damage.

See the images below for examples of construction switchboards. In some situations, additional measures should be taken:

- Switchboards with more than one final sub- circuit should have a lockable cover, lock-dog or other security device to prevent unauthorised access to circuit breakers and residual current devices (RCD).
- Where supply is needed for equipment such as welders and floor sanders, a switchboard should be fitted with at least one 15A single phase socket-outlet.
- Where more than one switchboard is installed on site, each switchboard should have a unique identification mark on the exterior of the switchboard enclosure.



Switchboards should have no exposed wiring and be lockable

Location of switchboards

Switchboards should be:

- readily accessible and located where they cannot be damaged during demolition and construction activities.
- located to suit the maximum flexible extension cord lengths.
- positioned so flexible extension cords or cables don't have to run between levels.

On general construction sites, where short duration work is to be undertaken on an additional work level, such as a roof or small mezzanine level, power may be taken from a switchboard on the adjacent level. The extension cord must be mechanically protected. If the total amount of work carried out in the area is likely to exceed one full day, a switchboard should be located on that level.

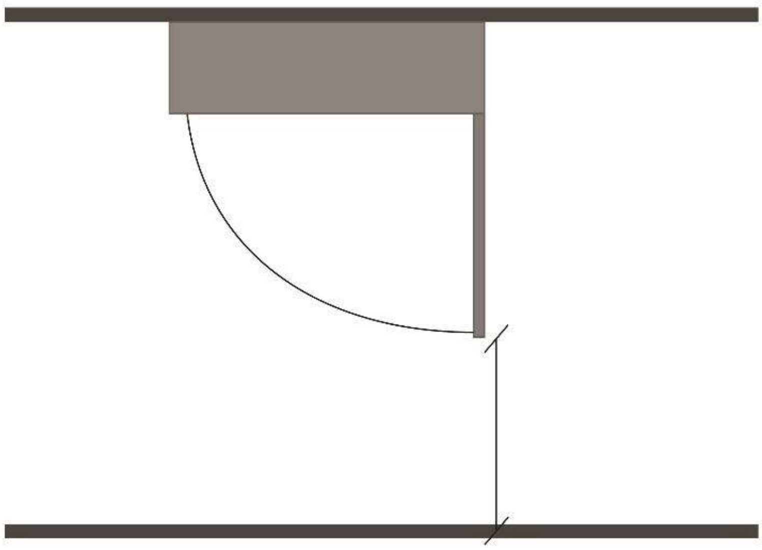
On multi-level construction sites, switchboards may be positioned to allow for the use of extension cords up or down one level from the switchboard. Flexible extension cords must be mechanically protected at the transition between levels and in places where damage is likely to occur.

On sites with multi-level construction, a suitable hard-wired socket-outlet may be installed to supply one floor above or below a switchboard, if:

- the type and location of the socket-outlet protects against exposure to weather.
- the final sub-circuit is protected by an RCD and circuit breaker in the switchboard.
- the socket-outlet is positioned to prevent the risk of mechanical damage.
- the wiring is protected from mechanical damage (e.g., inside conduit or in a protected location).
- the wiring is clearly identified as construction wiring i.e., not permanent wiring.
- there is a means to prevent strain on terminations of cables and flexible cords such as a tie bar, secured insulated lead stand or other means.

Clearance for switchboard doors

Minimum clearance of 600mm must be maintained to allow unimpeded opening of the switchboard door.



Ensure the switchboard door can open unimpeded

Resetting

Where the power supply has been lost, the builder or principal contractor who has overall control and management of the site should ensure a competent person is nominated and available to access and reset any circuit breaker or RCD that has tripped.

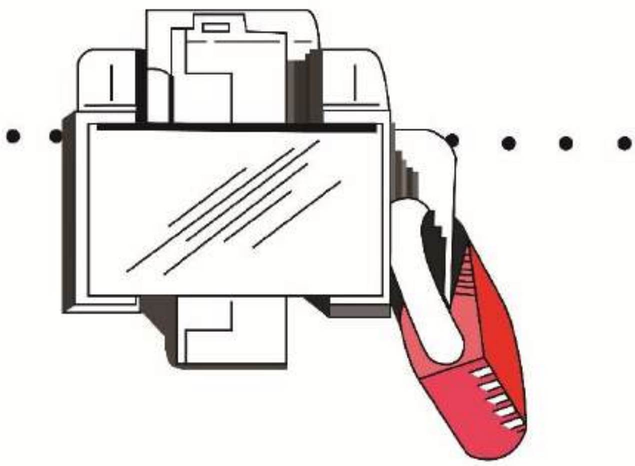
The competent person should:

- through a process of elimination identify any faulty tool or equipment that may have caused the tripping.
- remove faulty equipment that may have caused or been damaged by the tripping.
- check if water has affected any area and the tools and equipment in that area.
- refer the matter to a qualified electrician if the:
    - cause of the tripping cannot be readily identified.
    - tripping may have been caused by the switchboard or construction wiring (including a lighting sub-circuit).
    - circuit breaker or RCD cannot be reset.

Before restoring power, the competent person should sight all persons affected by the tripping and advise them that power is about to be restored.

Use of permanent meter panels

Where the supply is from the permanent meter panel, either a circuit breaker or a service fuse assembly with a locking and/or securing device must be fitted. The requirement does not apply to construction sites where there are permanently occupied domestic or business premises.



An example of a locking device for a circuit breaker

Circuit breakers

Circuit breakers provide protection against circuit overload and fire.

Every final sub-circuit must be protected by a circuit breaker except final sub-circuits exceeding 50A, which may be protected with high rupturing capacity (HRC) fuses.

RCD to final sub circuits

An RCD is a 'safety switch' fitted to an electrical circuit to reduce the risk of electric shock or electrocution.

Every final sub-circuit including lighting and socket-outlets must be protected by an RCD with a rated tripping current not greater than 30mA. This also applies to the final sub-circuits in transportable structures.

This requirement need not apply to final sub-circuits supplying equipment such as cranes or personnel lifts where interruption of supply is a risk to safety.

Security of power circuits

To prevent unauthorised access and the risk of electric shock or fire, the principal contractor or nominated persons should ensure all power circuits are secured at the end of the work shift, and/or when the site is unattended. This is not necessary for security lighting and essential equipment or for locked, transportable structures

Identification of wiring

Construction wiring for consumer mains, sub-mains and final sub-circuits must be readily distinguishable from permanent wiring by using a different coloured cable or by attaching iridescent yellow tape labelled 'construction wiring'. The tape should be spaced at five metre intervals.

Any wiring that has been previously energised must be treated as 'live' until verified otherwise. All live, permanent wiring near construction or demolition work must be clearly identified and labelled.

Construction wiring must not be tied to, bundled or grouped with permanent wiring.

Protection of wiring

Construction sites are dynamic construction sites where permanent wiring or construction wiring may be at risk of mechanical damage from changes to the site.

Existing permanent wiring that is not protected by conduits or metal covers must be protected by an enclosure or barrier.

When a change occurs that may risk damage to construction wiring, a risk assessment should be undertaken. Where the assessment identifies a risk, the wiring must be protected by a suitable enclosure or barrier. If it is not reasonably practicable to protect wiring by the above means, another risk control needs to be determined.

Examples of construction wiring that may be at risk of mechanical damage are where wiring is slung under concrete ceiling slabs or in risers that may have to be accessed for various tasks.

Cables installed within 150mm of a corner of a ceiling and a wall or a beam and a ceiling are unlikely to be at risk of damage and may not require additional protection.

Leads, cords and plugs

Unprotected electrical cords are a hazard to all workers

Leads and cords are easily damaged, particularly those connected to equipment which is often moved. Make sure leads and cords are suitably set up and protected:

- Protect leads and cords from damage. Protection may include drop-over cable protectors, cord covers, non-conductive lead hooks and cable ramps. Damage can be caused by:
  - sharp edges and sharp objects.
  - shoes, boots and other footwear.
  - doors.
  - moving vehicles and mobile plant.
  - other mechanical forces.
  - water, oil and other liquids.
  - grease.
  - heat.
- Arrange leads and cords so that people won't trip on them.
- Avoid running leads across aisles or passages.
- Raise leads up rather than running them across the ground. Raised leads and plugs should be easy for workers to reach without a ladder.
- Remove strain on plugs by using insulated supports.

Flexible extension cords

Extension leads are a temporary solution. You should not use them as a long-term or permanent electrical connection.

Flexible cords on extension leads must be the heavy-duty sheathed type. Store extension leads away when you have finished with them.

Do not use an extension lead:

- if the protection around the cord socket or the insulation is damaged.
- if you will exceed the manufacturer's current rating.
- with a piggy-back plug.
- that is coiled or rolled up - it could overheat.

The maximum length of an extension cord depends on the amperage rating, minimum cross section and resulting conductor resistance.

Where extension cords are joined by Portable Socket-Outlet Assemblies (PSOA) or other means, the maximum length is the total length of all extension cords as well as the length of the supply cord of the final PSOA from which power is supplied.

If the supply cord on a tool is greater than two metres, this length must be included in calculating the maximum length.

Exceeding the maximum length may affect operation of RCD or circuit breakers during a fault and increase the risk of electric shock. It can also cause voltage drop that can damage equipment.

The allowable length of flexible extension cords is restricted on some equipment, such as motors operating trailing cables on suspended scaffolds, swing stages and false cars, to ensure the safety of operators is not affected by voltage drop.

Flexible extension cords must be raised off the floor using insulated hangers or stands to provide a safe route through the work area and clearance for personnel and vehicles. This is not necessary if the distance is four metres or less between the work area and the power supply

Where cords cannot be raised off the floor, another means of protection against mechanical damage, damage by liquids or high temperature must be provided.

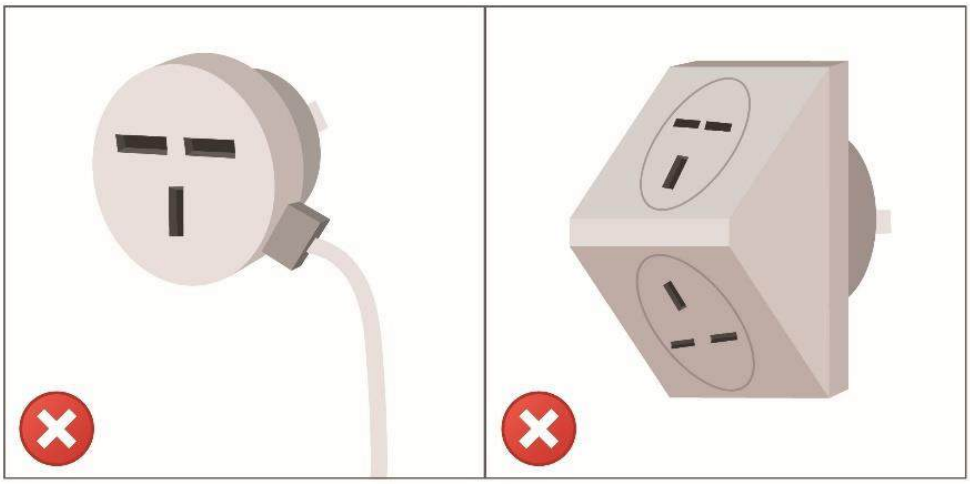
Where flexible extension cords pass through scaffolding or other metal structures, they should be run on insulated hangers to eliminate the risk of mechanical damage.

Where flexible extension cords are used where water may be present, the extension socket and plug shall be protected against the ingress of water. This may be achieved through the use of proprietary manufactured waterproof screw type coupling accessories designed for this purpose.

Orange circular, TPS type cables and other cables normally used as fixed wiring must not be used as flexible extension cords.

Plugs

Hard plastic plugs are easily damaged. Rubber or flexible plastic plugs and sockets are a better option. Double adaptors and piggy-back plugs are not safe. They should never be used on a construction site. It is recommended that ISO standard plugs and converters be used at all times.



Household plugs and adapters should not be used on a construction site

Double pole switches

Double pole switches must be used on every socket-outlet installed on portable equipment designed to be supplied by a flexible extension cord.

All switches, including light switches, on transportable structures must be double poled.

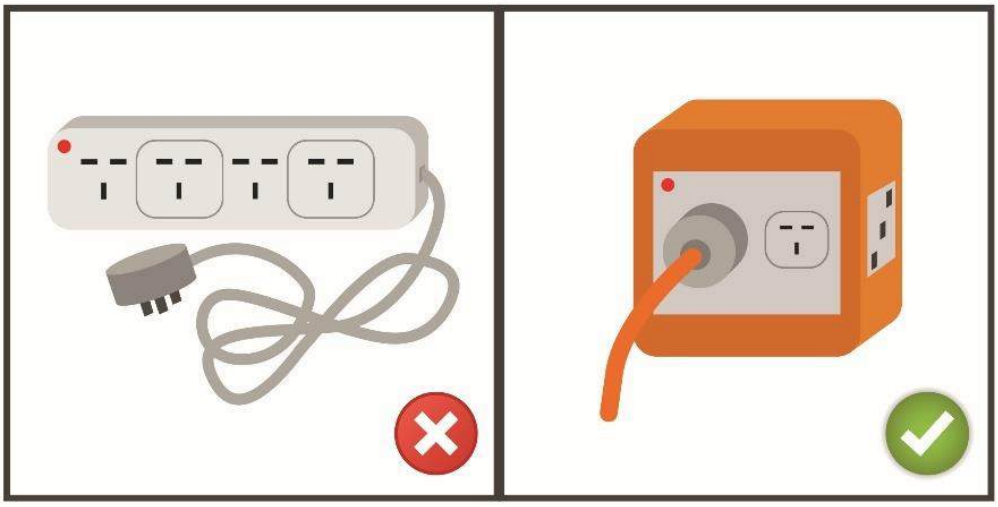
Note: Double pole switches require all live conductors, including active and neutral conductors, to be switched.

Portable socket-outlet assemblies (PSOA)

Multi-plug PSOA must:

- comply with ISO standards.
- incorporate over-current and RCD protection.
- be of robust construction.
- have extended sides or covers over the outlets..
- have a degree of protection appropriate for the environment (IP33 as a minimum).
- incorporate a heavy-duty flexible cord no more than two metres long.

Domestic type power-boards, double adaptors, three pin plugs (piggyback) adaptors and homemade power-boards must not be used on construction or demolition sites.



Unused electrical wiring

Unused permanent and construction wiring must be appropriately terminated by a licensed electrician or removed.

Use of permanent power

Permanent power should only be used for minor or short duration work. When the construction work is more significant in duration, scale or equipment, arrangements should be made to have construction wiring and equipment installed.

Permanent wiring for construction purposes must be protected by an RCD located in the switchboard at the origin of the final sub-circuit. If this is not reasonably practicable, the RCD may be incorporated into the socket-outlet supplying the electrical equipment, or a PSOA plugged directly into the socket-outlet.

Hard-wired generators

When a generator supplies a fixed installation, it must be:

- installed and certified by a licensed electrician and a certificate of electrical safety provided.
- inspected by a licensed electrical inspector before it is used for the first time, and after any alteration to the location or installation of the generator.

Where generators are supplying fixed switchboards, the RCD may be mounted on the switchboard.

Free-standing generators

Manufacturers or suppliers of generators must provide information regarding relevant earth and bonding connections if the generator is used to supply portable tools and equipment. This information should be on a decal or label displayed prominently on the generator.

The information should indicate whether the unit is a bonded generator or an isolated winding generator.

Electrical socket-outlets on generators must be protected by RCD not exceeding 30 mA.

PSOA must not be used in connection with isolated winding generators, as the RCD will not function. Only one item of class 1 electrical equipment must be used with an isolated winding generator.

Lift shafts

Where a permanent lift installation is connected to construction wiring, the following conditions must be met:

- The wiring must comply with industry standards.
- The cables must be fire rated.
- The electrical supply must not be subjected to other main switches.
- All other safety requirements of ISO & industry standards.

Separate final sub-circuit

Construction wiring in lift shafts must be from a separate final sub-circuit protected by a 30mA RCD. Its sole purpose should be to supply power for installing lift shaft equipment.

Circuit breakers and RCD

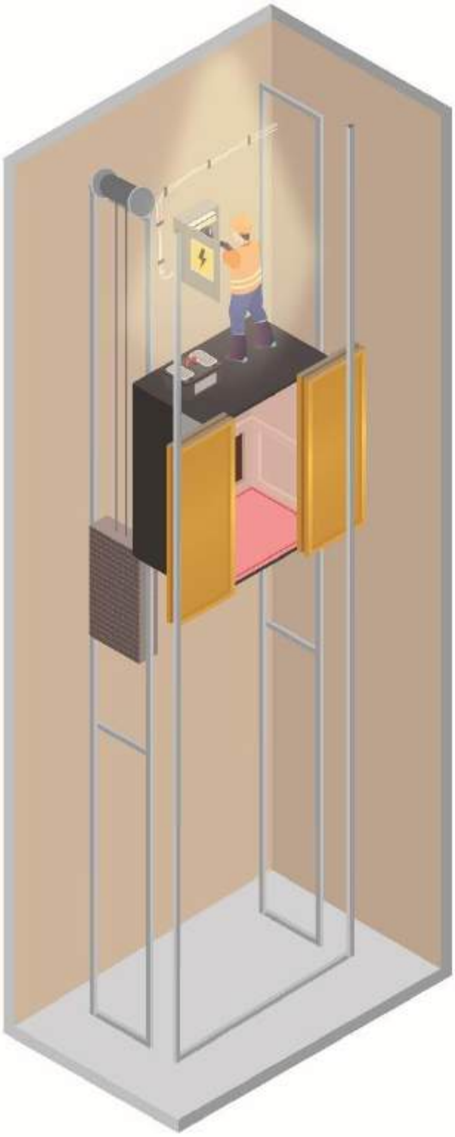
Circuit breakers and RCD should be locked and tagged to prevent accidental isolation of the supply to the lift shaft by other persons on the site.

Lift shaft lighting

Lift shaft lighting may be supplied from temporary or permanent fixed wiring and should conform with the following:

- Fixtures are fluorescent lamps of a minimum 36 watt, or equivalent, and guarded against mechanical damage.
- Fixtures are connected to the wiring by a lighting plug and socket-outlet.
- Fixtures are installed at maximum intervals of six metres with the uppermost fixture within one metre of the top of the lift shaft.
- The lighting is controlled by two-way switches located within easy reach of the lift well access points at the top and bottom floors.

Where more than one lift is being installed in a lift shaft, lighting may be provided from a vertical riser in an adjacent shaft.



Reliable lighting in a lift shaft is vital

Emergency lighting

Emergency lighting must be provided to allow safe egress from the lift well when normal lighting fails. Emergency lighting must provide illumination of at least 20 lux throughout the lift well and be capable of operating for a minimum of one hour.

False cars

Where false cars are to be used for installing lift well equipment, the supply for construction wiring should be 230 volts as a minimum. It should have a 20A socket-outlet sourced from a separate final sub-circuit protected by a 30 mA RCD.

The sole purpose of this supply is to provide adequate power to the climbing hoist including task lighting and power for tools when working from the false car.

The wiring to the false car should be:

- heavy duty, double insulated flexible cord rated at a minimum of 20A with a minimum conductor size of 4mm2.
- compliant with the maximum length in ISO industry standards.
- suspended from a device that does not damage the core wires, such as a built-in thimble.

The flexible cord should be:

- secured at the top of the shaft and at the point of attachment to the false car by a means that prevents mechanical damage.
- suspended in the lift well to allow running clearance between the false-car and the lift well and prevent fouling or damage to the cord.
- long enough to allow for free travel of the false- car through the length of the lift well.

Solar power systems

Installing, operating, and maintaining solar power or photovoltaic (PV) systems is often high risk. Even if disconnected from the mains electrical supply or shutdown at the switchboard, PV systems can be energised by sunlight or stored energy in batteries.

Solar panels are typically installed on a roof so there are also risks from working:

- near overhead electric lines and equipment.
- at height, including falls from roof or through ceiling space.
- in ceiling spaces, including exposure to asbestos, extreme heat, energised electric lines, and
- outdoors, including exposure to ultraviolet radiation, heat, wind, and other weather conditions.

Construction work carried out on or near energised electrical installations or services is high risk construction work and requires a Safe Work Method Statement.

Inspect, test and tag

Regular inspecting and testing of electrical equipment can save lives. It helps identify damage, wear and electrical faults.

You can detect many electrical defects such as damaged cords just by examining them, but regular inspection and testing will make sure you detect electrical faults and deterioration you can't see.

Construction site owner's and Principal Contractor's must ensure electrical equipment is regularly inspected and tested if it is supplied with electricity through an electrical socket outlet and used in a 'hostile operating environment'.

A 'hostile operating environment' is an environment in which the normal use of electrical equipment exposes the equipment to operating conditions that are likely to result in damage to the equipment or a reduction in its expected life span, including conditions that involve exposure to moisture, heat, vibration, mechanical damage, corrosive chemicals or dust.

Inspections and testing must be carried out by a competent and qualified person. The nature and frequency of inspection and testing depends on factors such as the nature of the electrical equipment, how it is used, and its operating environment. For advice on inspection and testing for your construction site, seek the advice of a competent person.

As a general rule, electrical equipment used in 'hostile operating environments' should be tested at least once every 12 months.

Inspecting and testing electrical equipment

Inspecting and testing electrical equipment will assist in determining whether it is electrically safe.

Regular visual inspection can identify obvious damage, wear or other conditions that might make electrical equipment unsafe. Many electrical defects are detectable by visual inspection.

Regular testing can detect electrical faults and deterioration that cannot be detected by visual inspection.

The nature and frequency of inspection and testing will vary depending on the nature of the construction site and the risks associated with the electrical equipment.

Inspecting and testing electrical equipment - other than equipment used in specified higher-risk operating environments

In addition to regular testing, electrical equipment should also be tested:

- after a repair or servicing that could affect the electrical safety of the equipment (i.e., undertaken by the person carrying out the repair or servicing before return to service).
- before its first use if bought second-hand.

Inspection and testing of electrical equipment may involve, in part:

- looking for obvious damage, defects or modifications to the electrical equipment, including accessories, connectors, plugs or cord extension sockets.
- looking for discolouration that may indicate exposure to excessive heat, chemicals or moisture.
- checking the integrity of protective earth and insulation resistance.
- checking that flexible cords are effectively anchored to equipment, plugs, connectors and cord extension sockets.
- looking for damage to flexible cords.
- checking that operating controls are in good working order i.e., they are secure, aligned and appropriately identified.
- checking that covers, guards, etc. are secured and working in the manner intended by the manufacturer or supplier.
- checking that ventilation inlets and exhausts are unobstructed.
- checking that the current rating of the plug matches the current rating of the associated electrical equipment.

New equipment

Brand-new electrical equipment that has never been put into use (i.e., other than second-hand equipment) does not have to be tested before first use.

Brand-new electrical equipment, however, should still be visually inspected to ensure that no damage occurred during transport, delivery, installation or commissioning.

If the electrical equipment is required to be tested regularly for safety, take the necessary steps to ensure that it does not miss its first required test.

The date the electrical equipment was placed into service should be recorded (e.g., on the record of installation or elsewhere). The electrical equipment may also be fitted with a tag stating:

- that the equipment is 'new to service'.
- the date of entry into service.
- the date when the first electrical safety test is due.
- that the equipment has not been tested.

Fitting a 'new to service' tag is an administrative task that can be carried out by an appropriately trained in-house person.

Alternatively, a different system may be put into place to ensure the electrical equipment is properly inspected and tested as required (e.g., the new electrical equipment can be included in the next round of electrical testing carried out at the construction site).

Competency requirements for those carrying out inspection and testing of electrical equipment

Inspection and testing of electrical equipment must be carried out by a person who has acquired, through training, qualification or experience, the knowledge and skills to carry out the task (i.e., be a 'competent person').

Inspection and testing of electrical equipment must be carried out by a competent person who has the relevant knowledge, skills and test instruments to carry out the relevant inspection and testing. The person carrying out any testing of electrical equipment should also be competent to interpret the test results of any equipment they use. For example, a person carrying out testing must be:

- a licensed or registered electrician (whichever applies), or
- in some jurisdictions, a licensed electrical inspector, or
- a person who has successfully completed a structured training course and been deemed competent in the use of a pass-fail type portable appliance tester and the visual inspection of electrical equipment.

The training should be designed to ensure, so far as is reasonably practicable, that upon completion successful participants:

- can use the relevant test equipment safely and effectively.

- understand electrical risks and appreciate the role that inspection and testing plays in ensuring electrical safety.
- understand the legal requirements relevant to the work.

Some kinds of electrical testing must only be carried out by a licensed electrician or electrical inspector under local electrical safety laws. For example, testing requiring the dismantling of electrical equipment should only be carried out by a licensed electrician.

If in doubt, advice should be obtained from a person qualified and experienced in electrical equipment testing, for example an electrician, electrical contractor, electrical inspector, specialist testing provider or relevant regulator.

Recording results of testing

A record of testing must be kept until the electrical equipment is next tested, permanently removed from the construction site or disposed of. A record of testing must specify the following:

- The name of the person who carried out the testing.
- The date of the testing.
- The outcome of the testing.
- The date on which the next testing must be carried out.

The record may be in the form of a tag attached to the electrical equipment tested.

Logbook or other similar form of record

The record of testing may take the form of a logbook, database, register or a similar kind of record, or a tag. Logbooks and similar records have the advantage of:

- ensuring there is a permanent record of inspection and testing (for example, as a backup if tags are damaged or removed).
- facilitating internal audit.
- allowing more detailed information to be recorded.

Tags

If the record of testing is a tag, it should be durable, water resistant, non-metallic, self- adhesive or well-secured, incapable of re-use and have a bright, distinctive surface.

The tag may also be colour-coded to identify the month in which the testing was carried out.

A tag may not include all of the required information. In that case, the rest of the required information must be recorded elsewhere and kept for the relevant period of time.

If a tag is not used you should ensure that tested electrical equipment is marked or labelled so that records of testing can clearly identify the relevant equipment.

Locking off

Isolation points should be fitted with control mechanisms that prevent the electrical equipment from being inadvertently re-energised. The control mechanism should require a deliberate action to engage or disengage the device. It should be able to withstand conditions that could lead to the isolation failing, for example vibration.

This may include switches with a built-in lock and lock-outs for switches, circuit breakers, fuses and safety lock-out jaws (sometimes called 'hasps').

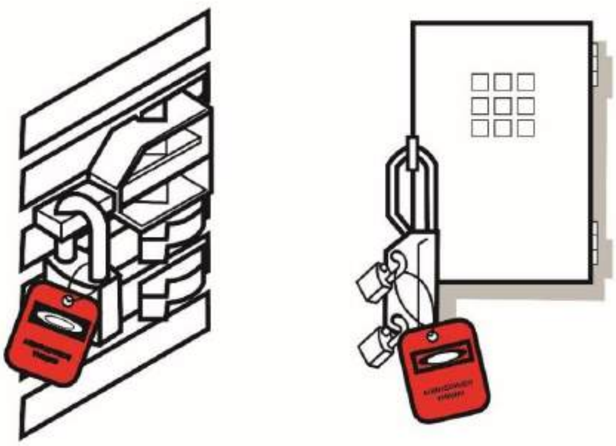
All circuit breakers, switches and combined fuse switch units should be locked off to secure the isolation where possible. See the image below for examples of locking-off methods incorporating danger tags.

Alternative controls may include an additional component, for example a clip, screw, bolt or pin that can be inserted to prevent a switch from being operated. These types of controls should be used in conjunction with additional control measures, for example danger tags and permit systems.

If more than one person is working on the same de-energised electrical installation, individuals should ensure their own personal lock is applied to the isolation point, otherwise the principles of tagging apply (see below).

No-one should operate an isolator or knowingly use equipment where the isolator has a control mechanism attached.

In situations where isolation points are accessible by other persons at the construction site ensure, so far as is reasonably practicable, that the isolation method or system is not able to be inadvertently or easily compromised.



Lock out tags ensure the safety of workers repairing or inspecting equipment

<u>Tagging systems</u>

Danger tags

Isolation involves using suitable warning or safety signs as well as locks or other controls to secure the isolation.

Where possible, a tag should be attached to normal locks at all points of isolation used to de-energise electrical equipment from its electricity supply.

A tag does not perform the isolation function.
Danger tags are not required when using dedicated personal isolation locks.

Danger tags are used for the duration of the electrical work to warn persons at the construction site that:

- the electrical equipment is isolated or out of service.
- the electricity supply must not be switched back on or reconnected.
- reconnecting electricity may endanger the life of the electrical worker(s) working on the equipment.

The danger tag should:

- be durable and securely fixed to the isolator clearly state the warning, including any warning about specific hazards relating to the isolation (for example, multiple points of supply).
- be dated and signed by the worker or workers involved in carrying out the work or, where appropriate, by the supervisor in charge of the workers.
- be attached in a prominent position on each isolation point (i.e., the point or one of many points used to isolate electrical parts) or device.
- only be removed by the signatories to the tag. If unavailable and unable to return, measures must be put in place to manage risks associated with removing the lock or tag (e.g., thorough investigation to ensure all workers and others at the construction site are safe).

If the work is incomplete, for example at a change of shift, the last person removes their danger tag or lock and replaces it with a warning tag e.g., out of service or caution.

When work is resumed, the person in charge of the work removes the warning tag (out of service or caution) and each person then applies their danger tag and/or lock.

When work is finally completed, each person removes their danger tag and/or lock.

Where a formal permit system is used, all reasonable steps must be taken to ensure that the designated sign-on and tagging procedures are followed.

Out of service tags

Out of service or caution tags are used to identify electrical equipment that is not safe to use or fit for purpose. The out of service or caution tag should:

- be durable and securely attached.
- clearly state the nature of the defect or reason why the electrical equipment is unsafe.
- be attached on a prominent position on each isolation point.

- only be removed by a competent person after fixing or rectifying the defect and making the electrical equipment safe or replacing with a danger tag in preparation to work on the equipment.

Example of a danger tag and service tag

Workers must fill out information on a Lock Out Tag for attaching them

<u>**Carrying out work on energised electrical work**</u>

A person carrying out electrical work must ensure the work is not carried out on energised electrical equipment unless:

- it is necessary in the interests of health and safety that the electrical work be carried out while the equipment is energised (e.g., it may be necessary for life-saving equipment to remain energised and operating while electrical work is carried out on the equipment), or

- it is necessary that the electrical equipment to be worked on is energised in order for the work to be carried out properly.
- it is necessary for the purposes of testing to ensure the equipment is de-energised.
- there is no reasonable alternative means of carrying out the work.

These requirements in relation to energised electrical work do not apply to work carried out by or on behalf of electricity supply authorities on the electrical equipment, including line-associated equipment, controlled or operated by the authority to transform, transmit or supply electricity. These authorities may be covered by separate electrical safety requirements.

Energised electrical work is electrical work carried out in circumstances where the part of electrical equipment being worked on is connected to electricity or 'energised'.

Electrical work must not be carried out on electrical equipment while energised only because it is merely more convenient for the electrical equipment to stay energised while the work is being carried out.

Energised electrical work must not be carried out unless the safety risk to those persons directly affected by a supply interruption is higher than the risk to the licensed or registered electrical workers proposed to carry out the energised electrical work. Only in extremely rare circumstances would it be possible to justify that it is not practicable to have a short break in supply. Most electrical installations suffer no harm through unplanned interruptions of this kind to the network supply. In some cases, a short break may allow for the insertion (and removal) of insulated barriers.

A person requiring electrical work to be carried out may provide operational reasons appearing to justify energised electrical work. Requiring electrical work to be carried out while the equipment is energised when it could be avoided places an onerous responsibility on the business or undertaking commissioning the work to minimise the risks. Should an incident occur as a result of carrying out energised electrical work, the person the work is at risk of being found not to have provided a safe construction site.

Planning and preparation

If electrical work is to be carried out on energised electrical equipment Construction Site Owner's and Principal Contractor's must ensure before the work commences that:

- a risk assessment is conducted by a competent person in relation to the proposed work and recorded.
- the area where the electrical work is to be carried out is clear of obstructions so as to allow for easy access and exit.
- the point at which the electrical equipment can be disconnected or isolated from its electricity supply is:
    - clearly marked or labelled, and
    - cleared of obstructions so as to allow for easy access and exit by the worker who is to carry out the electrical work or any other competent person, and
    - capable of being operated quickly.

- the person authorises the electrical work after consulting with the person with management or control of the construction site.

Work position when conducting electrical work

Electrical work should be carried out from a position that minimises the risk of inadvertent contact with exposed energised parts and also the risk of an electric shock path being created. For example, safe work method statements should require, so far as is reasonably practicable, that electrical workers position themselves so that:

- an involuntary action like sneezing would not cause them to touch exposed energised parts.
- no electric shock path can be created due to working in an awkward position, for example testing components towards the rear of a washing machine via the front panel.
- no electric shock path can be created when carrying out phase sequencing or rotation testing on overhead mains or at an underground pillar.

Safety observers

A competent safety observer must be present when work is carried out on energised electrical equipment, unless the work consists only of testing and a risk assessment shows that there is no serious risk associated with the proposed work.

The role of the safety observer should be clearly communicated and understood. The safety observer must:

- be competent to implement the control measures in an emergency.
- be competent to rescue the worker who is carrying out the work if necessary and must have been assessed in the previous 12 months as competent to rescue and resuscitate a person.

The safety observer should:

- not carry out any other work or function that compromises their role, for example they should not be required to observe more than one task at a time.
- not be situated in the work basket of the elevating work platform from which the electrical work is being carried out.
- be able to communicate quickly and effectively with the electrical worker(s) carrying out the work. Specialist equipment may be necessary if there is a barrier to communication.
- not have any known temporary or permanent disabilities that would adversely affect their role and performance.

Safety barriers and signs

Barriers and signs may be designed, erected or installed to:

- protect electrical workers from inadvertently contacting energised exposed parts.

- ensure that access to and egress from the work location of live work allows for clear, unobstructed passage.
- warn others and direct people away from dangerous work areas.

Example of an Electrical Safety Sign

Different kinds of safety barriers may be required for different purposes. For example:

- to protect electrical workers from inadvertently contacting energised exposed parts—a physical safety barrier should consist of a non-conductive material such as wood or plastic or, alternatively, correctly earthed steel and be strong enough to withstand the impact from falling objects or loose material.
- to exclude persons generally from a work area where there is a risk of energised exposed parts - secure housings, enclosures, doors and room may provide appropriate safety barriers.

A risk assessment should be carried out by a competent person to advise on whether a barrier is appropriate to address the relevant risks and, if so, appropriate design and correct materials.

The barrier must be erected safely. This may require switching off or isolating the electricity supply while the barrier is installed.

A barrier may be temporary or permanent and, if applicable, should clearly designate the safe work area by defining the approach path to the relevant piece of equipment.

Restoring power

All reasonable steps must be taken to ensure that restoring electricity supply following isolation does not pose risks to health and safety at the construction site. For example:

- appropriately terminating all conductors.
- carrying out appropriate testing on any new, altered or repaired electrical equipment, for example tests for insulation resistance, earth continuity, polarity, correct connection and function testing.
- removing safeguards, including temporary bonds and short-circuiting devices.
- notifying all workers working on the electrical equipment and other affected workers at the construction site that electricity is to be restored.
- taking precautions as appropriate to ensure that other electrical equipment is not inadvertently energised.
- following procedures for removing any locks (or other control mechanisms), tags, notices and safety signs.
- carrying out a visual inspection to ensure that all tools, surplus material and waste has been removed from the construction site.

When electricity is restored tests must be carried out to confirm that polarity is correct, actives are switched and, where applicable, phase sequences are correct before electrical equipment is used.

Leaving unfinished work

If work is left unfinished, the construction site must be left in a safe state including, for example, by:

- terminating any exposed conductors.
- physically securing any exposed conductors or surrounding metal work.
- tagging, taping off the electrical equipment and the construction site area.
- informing affected persons at the construction site the work is not complete and advising of potential hazards.
- taking any necessary precautions to ensure that electrical equipment cannot become inadvertently re-energised.
- ensuring that the status of switchboards and electrical equipment are clearly and correctly labelled.
- handing over adequate information to workers taking up the unfinished work to allow them to continue the work safely.

Ladders, scaffolds and similar equipment

Certain ladders, scaffolds and similar equipment may pose electrical risks including:

- metallic or wire reinforced ladders and scaffolds are conductive and may create an electric shock path, for example:

  - a ladder slipping while work is being carried out on it, causing the worker on the ladder to touch exposed energised parts, for example grabbing a mains box.
  - a gust of wind blowing an extension ladder into nearby overhead power lines.
  - in switch-rooms and switch-yards - conductive devices such as aluminium ladders and scaffolds creating electric shock paths and current paths to earth, for example a metal wire reinforced ladder causing a fault to ground if the ladder touches a live 33 kV busbar.

- when using ladders, scaffolds and similar equipment, workers are more likely to touch open wiring such as overhead lines.

- in cases where lines are carrying large currents, conductive scaffolds may become subject to induction.
- portable scaffolds may damage insulation when moved if the scaffold strikes conductors or leads.

Consideration should be given to eliminating the use of metallic, wire reinforced or otherwise conductive ladders; these items should not be used in close proximity to equipment where an electrical hazard may result from their use. These types of ladders should be avoided for any kind of electrical work.

Other effective risk control measures may include:

- identifying if there are exposed energised parts nearby. In this situation, risk control measures such as de-energising, fitting covers, using a safety observer, or a combination of these, should be considered.
- employing safe work practices, including:

  - two or more people carrying long devices in switchyards and switch-rooms in a position below shoulder height.
  - two people handling extension ladders in windy conditions.
  - restraining ladders using head ropes or footropes, or both.
  - if practicable - using a platform-style step ladder.

- if conductive scaffolding is used within high-voltage enclosures or in situations where there is induction, bonding the structure to the earthing system. Depending on the construction of the scaffold, a number of sections may need to be bonded to ensure an equipotential state.

Always assess risks when working with ladders or scaffolds near power lines

Personal protective equipment for electrical work (PPE)

PPE for electrical work, including testing and fault finding, must be suitable for the work, properly tested and maintained in good working order. The PPE must be able to withstand the energy at the point of work when working energised.

Training must be provided in how to select and fit the correct type of equipment, as well as training on the use and care of the equipment so that it works effectively.

Depending on the type of work and the risks involved, the following PPE should be considered:

- Face Protection - use of a suitably arc rated full-face shield may be appropriate when working where there is potential for high current and arcing.
- Eye Protection - metal spectacle frames should not be worn.
- Gloves - use gloves insulated to the highest potential voltage expected for the work being undertaken. Leather work gloves may be considered for de-energised electrical work.
- Clothing - use non-synthetic clothing of non-fusible material and flame resistant. Clothing made from conductive material or containing metal threads should not be worn.
- Footwear - use non-conductive footwear, for example steel toe capped boots or shoes manufactured to a suitable standard.
- Safety Belt/Harness - safety belts and harnesses should be checked and inspected each time before use with particular attention being paid to buckles, rings, hooks, clips and webbing.

Overhead and underground electricity lines

Before starting any work near overhead and underground lines, you need to assess the risks and plan how these will be managed:

Overhead lines:

- heights, sway and sag of lines.
- nature, height and shapes of loads.
- approach distances and work zones.

Underground lines:

- identify cable location, for example if you're going to repair potholes.
- talk to asset owners.
- use insulated hand tools.

Always dig at right angles to an underground power line

What should I do before I start work?

- Complete an onsite risk assessment to identify and implement appropriate control measures to prevent any hazards or hazardous work practices and procedures which may have the potential to harm the health or safety of a person or damage equipment.
- Know the location of underground cables and overhead power lines and their proximity to your work activities and construction site transit routes before commencing digging or any other activities.
- Install appropriate signage around power lines and construction sites.

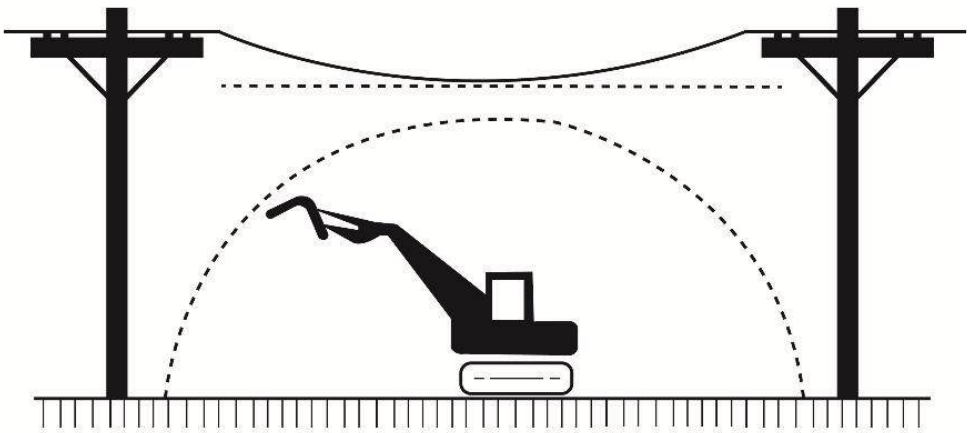
- Visually inspect points of attachment, at both ends, before commencing work as gutters and metal roofs may become "live" due to deteriorating insulation on electrical wiring.
- All electrical portable power tools must be tested and tagged as well as protected by an earth leakage device (RCD).
- Determine electricity asset safety clearances and whether an isolation needs to occur.
- Understand and maintain a safe working distance from overhead power lines.
- Before commencing work, install eye level visual markers in any area where overhead power lines are identified.
- Carefully monitor weather conditions – overhead power lines can sway in the wind, sag as temperatures increase and are difficult to see at dawn and dusk.
- Ensure operators are aware of the height and reach of their machinery in their travel, stowed and working positions to ensure that minimum approach distances to power lines are maintained.
- Engage an observer to monitor machines working near overhead power lines.

Safe work habits

Look up and locate overhead power lines and maintain at least the minimum approach distance from them and do not commence excavation without risk assessment plans.

Workers and their equipment should not approach overhead power lines any closer than the following, when machinery is being operated:

- **Power lines with voltages up to 132,000 volts:** E.g., low voltage distribution and sub-transmission lines, usually on poles = 3 metres minimum Approach Distance.
- **Between 132,000 & 330,000 volts:** E.g., sub-transmission and transmission lines, usually on either poles or towers = 6 metres minimum Approach Distance.
- **More than 330,000 volts:** E.g., transmission lines usually on towers = 8 metres minimum Approach Distance.



Allow for a minimum of 3 metres approach distance when operating machinery near power lines.

- Remember that Industry Standards requires a minimum approach distance of at least three metres from overhead power lines (up to 132,000 volts).
- Exercise extreme caution when working near the point of attachment of the electrical service line to the house/building.
- Look for cables and the signs of underground assets whenever digging, such as changes in grass, depressions or mounds, change of soil conditions and pipe work.
- Look out for signs of electric arcing. If identified, do not commence work.
- To eliminate the possibility of making contact with power lines on a job site, plan and communicate safe traffic paths by providing diagrams of plant and vehicle travel paths away from overhead power lines.
- Assign an observer to each operator of high machinery and excavators to guide movements near overhead power lines and underground cables and ensure that minimum approach distances are maintained.
- Before every relocation, lower all machinery into the transport position.

Permit to work systems

Using a permit to work (PTW) system on your construction site can be an effective way to be sure preventative measures have been taken before any mechanical digging commences. It acts as a checklist that can only enable mechanical digging work to commence (usually with supervisor sign off) once all preventative actions have been taken first.

A typical permit to work checklist should ask/specify the following:

- Have cable location services/technologies been used and their results compared with the risk assessment plans?
- Have the plans been marked up to reflect any new information/changes?
- Has the safest machinery suitable for the job been selected and ordered?
- Has an observer been allocated to this job to observe hand, mechanical or powered digging?
- Is potholing included in the safe work procedure?
- Has the job been assessed to use non-destructive digging?
- Have overhead power lines been identified as a risk? If so, has this risk been managed as low as reasonably practicable?
- Have all persons who may face/are affected by the risk of hitting underground utilities been consulted/ made aware of the safe work procedures?

Working in bad weather - lightning

Lightning kills many people around the world, making lightning an important safety consideration when working outside. All work should cease during a lightning storm.

Knowing what to do when lightning is close is especially important for people who work outdoors. Principal Contractors need to recognize the hazards associated with electrical storms and, where appropriate, have safe procedures and work systems in place, to minimize the risk of injury or harm to workers.

Having a preparedness plan and taking safety measures can prevent many lightning deaths and injuries.

Lightning safety procedures may include:

- outlining what actions workers must take when hearing thunder or seeing lightning or warning signs of an approaching storm.
- having a procedure to notify workers about lightning safety warnings.
- identifying safe locations and shelters.
- requiring workers to reach a safe location within a specified time period.
- establishing criteria for stopping and restarting outdoor work activities.
- checking in with all workers after a thunderstorm has passed.
- training workers on the lightning preparedness plan.

What should you do if you cannot find shelter?

There is no safe place to be outdoors during a thunderstorm (except in appropriate shelters. However, there are areas that might be less dangerous, and help reduce the risk of being struck by lightning when outside.

Stay away from things that are tall (metal framework, poles or posts), water, and other objects that conduct electricity (machinery, metal fences,).

You do not want to become a prime target by being the highest object on the landscape. Take shelter in low-lying areas but watch for flooding.

If you are with a group of people in the open, spread out several metres apart from one another.

If you get caught in a level field far from shelter, crouch down on the balls of your feet immediately, with feet together, place your arms around your knees and bend forward. Be the smallest target possible, and at the same time, minimize your contact with the ground. Don't lie flat.

What should you do if someone has been hit by lightning?

Lightning victims are safe to touch. Bystanders shouldn't hesitate to save a life by calling for help. If the victim is not breathing or they do not have a pulse, a trained rescuer should administer cardio-pulmonary resuscitation (CPR). For more First Aid information, see Chapter 25 First Aid.

Safety checklist

Electricity has the potential to seriously injure and kill. Construction site owners are responsible for ensuring the electrical fittings and electrical equipment in the construction site is safe and inspected and maintained regularly. You should involve your workers in filling out the checklist.

If you mark any NO box on the checklist, you need to take action to make your construction site safer.

Date Checklist Completed:				
Date Checklist to be Reviewed:				
Name:		Company/Construction site:		
Position / Title:				
Electrical switchboards and equipment				
Are switchboards and electrical equipment in a safe condition? *		Yes		No
Is everything on the switchboard clearly labelled?		Yes		No
Have safety switches (residual current devices) been fitted to all circuits?*		Yes		No
Power points, light fittings and switches				
Are all power points, light fittings and switches in a safe place and free from obvious defects (e.g. loose covers or wires, broken or damaged fittings, signs of overheating)		Yes		No
Are isolating switches clearly labelled and accessible?		Yes		No
Power tools, flexible leads and power boards				
Is portable electrical equipment protected by safety switches?		Yes		No
Are all power tools, extension leads, and power boards maintained in a safe operating condition (check for damaged insulation, water leaks, burn marks, bent or loose pins or fittings)?		Yes		No
Are extension leads and power boards located in a safe position to prevent mechanical or other damage (including trips)?		Yes		No
Inspecting and maintaining electrical equipment				
Are all electrical fittings and electrical equipment, including portable power tools, regularly inspected and maintained?		Yes		No
Have all power leads been inspected and tagged?		Yes		No

Table 1: An example of an Electrical Safety Checklist

CHAPTER 9

ENVIRONMENTAL CONTROL AND PROTECTION (NOISE, DUST, RUNOFF, EROSION)

It is crucial that construction site owners, construction site managers and Principal Contractors seek to protect the health, safety and welfare of workers and other people entering a construction site. They must also aim to ensure that the health and safety of the public is not put at risk by activities on a construction site.

NOISE

Noise can have temporary and permanent effects on a person.

Noise can affect the nerve cells in your inner ear, causing a temporary reduction in hearing. Most temporary hearing loss recovers in 24 hours under quiet conditions. There may be ringing or buzzing in your ear too (called tinnitus).

Repeated exposure to loud noise over time may cause permanent hearing loss. This is called noise-induced hearing loss, and it usually happens over many years. Noise-induced hearing loss reduces a person's ability to hear high pitched sounds. How much hearing loss a person has depends on the noise level, how long they are exposed to it, and their susceptibility.

Noise-induced hearing loss can also come from sudden loud noises, like explosions, gun shots or heavy hammering. If the noise is loud enough the damage can be immediate.

Noise-induced hearing loss can't be repaired.

Work-related noise-induced hearing loss is a preventable but irreversible condition that affects many workers.

- Many construction workers are likely to work in an environment where they are exposed to loud noise at work.
- Noise-related injuries are most common in the manufacturing and construction industries with workers, machinery operators, drivers and labourers most exposed.

Constant loud noise without hearing protection will cause hearing loss

Noise exposure standard

Sound pressure level is measured in decibels (dB).

Industry Standards set a noise exposure standard for construction sites. The standard is in 2 parts:

- 85 dB(A) averaged over an 8-hour period.
- a maximum (peak) noise level of 140 dB(C).

If workers are exposed to noise that is above this standard, the construction site is too noisy. Noise exposure measurements are taken at a worker's ear position.

Principal contractor duties

Principal Contractors must ensure that workers, visitors to a construction site and the public’s exposure to noise does not exceed the exposure standard by implementing the following hierarchy of control measures:

- Eliminate the source of noise.
- Substitute noisy machinery for quieter machinery or processes or implement engineering controls.
- Use administrative controls.
- Provide hearing protection.

Principal Contractors must apply each level of the hierarchy so far as is reasonably practicable before moving down to the next control measure. This means that a Principal Contractor cannot go straight to hearing protection without first implementing the higher-level control measures, so far as is reasonably practicable.

Often a combination of control measures is required to effectively control risks associated with construction site noise.

It is the Principal Contractors duty to provide hearing protection to workers

Step by step approach

The following step by step approach may assist in managing noise in your construction site.

A good understanding of the operation of machinery and/or processes used in the construction site is necessary to determine the best possible ways of reducing or controlling construction site noise at its source. This is also a good opportunity to review your machinery and processes and the layout of your construction site.

1. Identify sources of noise

- Develop a checklist and a layout map of the construction site.
- Carry out a general construction site inspection to identify significant sources of noise and the actual cause or type of noise. Types of noise can include impact noise, mechanical vibration, air/fluid noise, compressed air noise, pneumatic tools noise, saw noise, grinder noise and noise from gears and motors.

Principal Contractors must conduct routine inspections of noisy areas identified on a construction site

2. Rank noise sources

Rank or prioritise the noise sources to be controlled by taking the following into account:

- Level of noise.
- Duration of worker exposure.
- number of workers exposed.

The noise levels may be ranked by taking noise measurements or by their relative 'loudness'. When there are multiple noise sources operating at the same time, it may be necessary to run each piece of plant or process separately to do the ranking.

3. Identify potential noise control options

List all reasonably practicable control measures for each source of noise in accordance with the hierarchy of controls (as outlined above).

4. Trial and test potential control options

Trial potential control measures to work out if they are likely to be effective. For example:

- observe noise levels at different distances from machinery.
- move workers away from the machinery or vice versa.
- trial temporary barriers or enclosures using common materials such as MDF or chipboard.
- seal off any gaps in existing enclosures and observe the difference in noise.
- test different insulation materials such as foam, glass wool or rock-wool of different thickness' inside any existing or new mock-up enclosures and barriers.
- test absorbent lining inside any ventilation ducts or tubes using wire to hold it in place.
- trial different drop heights or angles for objects coming off a production process.
- trial different materials such as wire mesh for collection bins instead of sheet metal.
- test the effects of damping on vibrating surfaces.
- trial different materials to cushion impact.

Ensure you test noise levels when barriers and enclosures have been installed

5. Re-evaluate worker, visitor and public exposure to noise

After implementing suitable controls, it is important to re-evaluate exposure to noise in the construction site. If noise in the construction site continues to exceed the noise exposure standard, you should engage a suitably qualified person such as an occupational health and safety consultant to assist you with further risk controls.

If you are not sure whether there is still a noise problem after implementing noise controls, as a Principal Contractor you must ensure that a determination is carried out to determine whether the noise exposure standard is or may be exceeded.

Administrative Controls

If a Principal Contractor has, so far as is reasonably practicable, tried to eliminate the source of, or reduce exposure to, noise and a worker is still exposed to noise that exceeds the noise exposure standard, a Principal Contractor must reduce the exposure of the worker to noise by using administrative controls.

Administrative control measures involve adjusting the way work is organised to reduce the number of workers affected, the level of noise or the length of time that workers are exposed to excessive noise.

Some administrative measures include:

- increasing the distance between noise sources and workers.
- separating quiet areas away from areas with noisy plant and processes.
- doing noisy work out of normal working hours if possible.
- minimising the number of workers working in noisy areas.
- providing quiet areas for rest breaks for workers exposed to noisy work.
- sign posting noisy areas and restricting access.
- rotating workers between noisy and quiet jobs.

Provision of hearing protectors

Hearing protectors such as earmuffs or earplugs, must be used when higher level controls, including elimination, substitution, engineering or administrative measures have been put in place, so far as is reasonably practicable, but workers are still exposed to noise above the exposure standard.

In some cases, hearing protectors should be used as an interim measure until more permanent higher level control measures are implemented.

Selecting hearing protectors

When selecting hearing protectors, a Principal Contractor must consider the nature, level and duration of noise and the systems of work at the construction site. It is important to provide adequate protection without overprotecting. Overprotection makes useful sounds such as warning signals hard to hear and can put a worker’s personal safety at risk. When several workers are exposed to identical sources of noise at the construction site and their exposure is likely to be the same, Principal Contractors should select hearing protectors for those workers by taking into account the factors listed above in respect of one or more of those workers.

Principal Contractors need to also consider:

- the suitability for the type of working environment and the systems of work. For example, earplugs are unhygienic when rolled up and inserted into the ear with dirty hands; in these circumstances' earmuffs are more appropriate. However, earmuffs can be uncomfortable to wear in hot environments and can make it difficult for the worker to wear a helmet.
- the comfort, weight and clamping force of the personal hearing protector.

The individual fit of personal hearing protectors to the user is critical for optimum protection. Wearing additional work equipment (e.g., hard hats, dust masks and eye protection) may affect the performance of a hearing protector. The fit of hearing protectors needs to be checked while the user is wearing regular work equipment. Workers wearing spectacles need to be fitted with hearing protectors while wearing the spectacles.

Personal hearing protectors need to be selected and maintained. Good quality hearing protectors will generally include information about how to maintain them. Principal Contractors need to involve workers in the selection process and offer a reasonable choice from a range of types. It is important that the hearing protector chosen is worn at all times in noisy areas.

Industry standard hearing protectors must be used by workers to protect against hearing loss

Maintenance of hearing protectors

Personal hearing protectors should be regularly inspected and maintained to ensure they remain in clean, workable condition. The inspections should need to check that:

- ear-muff seals are undamaged.
- the tension of headbands is not reduced.
- there are no unofficial modifications.
- compressible earplugs are soft, pliable and clean.

If disposable earplugs are used, they should only be worn once.

Principal Contractors need to provide workers with training, information and instruction in the proper use, fit, care and maintenance of personal hearing protectors. Principal Contractors should also:

- specify the need to wear hearing protectors in safety procedures.
- place someone in charge of issuing and making sure replacements are readily available.
- carry out spot checks to ensure that workers are wearing their hearing protectors when required and are using them correctly.
- ensure all managers and supervisors set a good example and wear personal hearing protectors at all times when in hearing protector areas.

Use disposable earplugs one time only and then discard them into the rubbish

Hearing protector signs and labels

When hearing protectors are required to be provided, the Principal Contractor must clearly identify, by signs, labelling of plant or other appropriate means when and where they are to be worn.

Areas where people need to wear hearing protection must be clearly identified. Hearing protector areas and the boundaries of these areas need to be clearly defined. Workers and other persons, including managers and visitors, should not enter these areas without wearing appropriate personal hearing protectors, regardless of how short the time they stay in the hearing protector area.

Where signposting is not appropriate, make other arrangements to ensure that workers and others know when personal hearing protectors are required. For example:

- attach prominent labels to tools and equipment indicating that personal hearing protectors are required be worn when operating them.
- provide written and verbal instructions on circumstances in which personal hearing protectors are needed.

Principal Contractors must provide adequate training and supervision to workers. This includes ensuring that hearing protectors are worn when needed.

Principal Contractors must erect safety signage in areas that require ear protection

Maintaining risk controls

Principal Contractors must ensure that control measures are properly installed (if applicable), used and maintained. The purpose of maintaining control measures is to ensure that they perform as originally intended and continue to prevent or adequately control exposure to noise. Maintenance of control measures should include:

- frequent inspections.
- visual checks to ensure that they are being properly applied by workers and independent contractors.
- testing of equipment.
- preventative maintenance of engineering controls and PPE.
- any necessary remedial work to ensure physical controls continue to operate effectively.

Sometimes it may be necessary to improve, extend or replace existing control measures to ensure they continue to provide adequate control of risk.

Principal Contractors should have a maintenance procedure in place to ensure that any defects in control measures are detected as early as possible.

Principal Contractors must conduct regular noise inspections to keep workers safe

Review and revision of risk controls

It is important to monitor risk controls to ensure they remain effective. Principal Contractors must ensure that any measures implemented to control a worker's exposure to noise are reviewed and, if necessary, revised in the following circumstances:

- Before any alteration is made to machinery used or a system of work that is likely to result in exposure to noise above the noise exposure standard.
- If an audiological examination report states that a worker has suffered hearing loss that is likely to be due to exposure to noise.
- After the occurrence of any notifiable incident that involves exposure to noise above the exposure standard.
- If for any other reason, the risk control measures do not adequately control noise exposure to a level at or below the exposure standard.

Noise control – circular Saws

Circular saws are widely used in construction sites to cut metal, plastic, wood and masonry. They can be portable saws (e.g., drop saws), hand-held and fixed saws (e.g., panel saws), docking saws or beam saws.

Noise levels generated by circular saws can vary from 80dB(A) up to 120dB(A), depending on the type of saw and the material being cut. Other variables include saw blade diameter and thickness, number of teeth, tooth design, gap between teeth (i.e., gullet), level of damping, speed of blade, feed rate and the condition of the saw.

Control measures

A wide range of noise control measures can be applied to circular saws to achieve noise reductions ranging from 3-20dB(A) or more. Suitable control options may include the following:

Eliminate the use of saws - You can eliminate the need to use saws in the following ways:

- Purchase pre-cut or prefabricated materials (e.g., timber, metal, stone) to eliminate the need to use a circular saw.
- Use a quieter cutting process such as a guillotine or power hack saw.

Substitute noisy circular saws for quieter ones - choose a saw with a quieter motor and a saw blade that has:

- the greatest number of teeth, and the smallest teeth suitable for the job.
- the smallest possible gullets.
- built-in vibration damping (laser cut slots or laminated blade construction).
- tungsten carbide tipped (TCT) teeth which stay sharper longer and can reduce cutting noise by up to 14 dB(A).

Using loud equipment without appropriate hearing protection can cause hearing loss

Noise control – compressed air

Compressed air is widely used on construction sites to operate pneumatic tools and machines, clean surfaces and blow material off constructed parts.

Sources of compressed air noise include the compressor itself and the air turbulence or shearing noise generated when compressed air comes out of an open nozzle or is suddenly exhausted through pneumatic valves or tools at high speed. The noise may be continuous, intermittent or impulsive.

Controlling compressor noise

Common types of compressors include piston and screw types. Screw type compressors are generally quieter and register about 70dB(A). When purchasing a compressor, request noise level data from the supplier or manufacturer.

Suitable risk controls for controlling compressor noise include:

- purchase a quieter compressor (e.g., screw type).
- modify the existing compressor (you should consult with the manufacturer or an engineer to determine if this is reasonably practicable).
- relocate the compressor outside or into another room that is not normally occupied by workers.
- move the compressor further away from workers - doubling the distance from the source can decrease noise levels by up to 6dB(A) (depending on construction site layout).
- install a partial or full enclosure lined with high density sound absorbent material (e.g., mineral wool) around the compressor.
- use an acoustic barrier (solid material lined with sound absorbing material) where only a small reduction of about 5dB is required.
- install isolation mounts on the compressor or attached parts to reduce vibration.

If possible, move noisy machines away from your work area

<u>Noise control – grinders</u>

Hand-held, pedestal or bench grinders and linishers are often used on construction sites. Linishers and bench-mounted grinders can produce noise levels of around 88-95dB(A) and hand-held angle grinders can produce noise levels around 90-115dB(A).

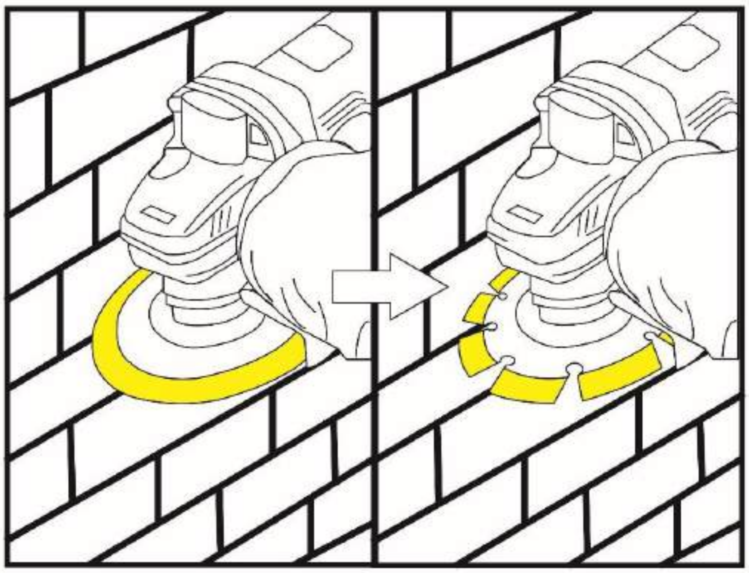
Below are examples of risk control measures you can use to control noise from grinders.

Eliminate the use of grinders:

- Purchase pre-cut or prefabricated materials to eliminate the need to use a grinder.

Substitute grinders with quieter machinery or processes.

- Use a quieter grinding process (e.g., a Linisher is generally quieter).
- Use power hack saws, guillotines or hand shears for cutting sheet metal.
- Use low noise grinding wheels which may reduce noise levels by as much as 10dB.
- Use smaller grinders (e.g., using a 5” grinder instead of a 9” can reduce noise levels by 6-10dB).
- Use grinders with quieter motors (ask manufacturers for information on noise levels).



Using different grinder wheel types can reduce noise emissions

Implement engineering controls:

- Use isolation mounts such as resilient rubber type pads, to reduce vibrations caused by bench mounted or pedestal grinders. Noise reductions of approximately 2-4dB may be achieved by using isolation mounts.
- Clamp work pieces as close as possible to where it is being worked. Use clamps lined with rubber type material.
- Use damped rest pads on bench mounted or pedestal grinders.
- Install full or partial acoustic enclosures/rooms lined with 50-100mm mineral wool or foam, to reduce worker exposure to noise.
- Use fixed or portable acoustic lined partitions or screens to reduce worker exposure to noise. These are not as effective as full or partial enclosures but may be sufficient where grinding is

only carried out for a very short period of time. Screens should be a sufficient height and close to the worker doing the grinding. Minimise any gaps at ground level.

Use administrative controls:

- Relocate the grinding process to another room, building or outdoors if practicable.
- Move workers who are not using grinders, further away from noisy grinding processes.
- Avoid placing noisy grinding processes in a corner where there are highly reflective walls such as walls made of concrete, or line walls with sound absorbing materials to minimize noise reflection.
- Rotate workers to reduce their duration and exposure to grinding noise. Halving the time, a worker spends grinding reduces their exposure by 3dB(A).

Provide workers with personal hearing protection

If worker exposure to noise still exceeds the noise exposure standard after higher order controls have been put in place, hearing protection such as earmuffs or ear plugs must be provided to reduce worker exposure to noise.

Maintenance

Regular maintenance of machinery can make a significant difference to noise levels. This includes:

- keeping cutting tools sharp.
- regularly dressing grinding wheels.
- replacing worn parts (e.g., bearing, brushes etc), damaged patterns or mould boxes.
- tightening loosened parts.

A Principal Contractor conducting checks on noise levels

<u>Noise Control – Impact, vibration and materials handling</u>

Materials handling in a construction site can generate high noise levels due to impact and mechanical vibration of surfaces such as chutes, hoppers, metal panels, machine guards, covers and conveyors.

Damping

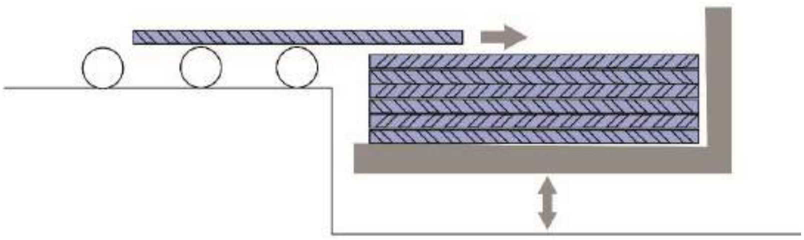
Vibration of structures can also resonate (or 'ring') depending on the size, type and thickness of the material or panel. Resonance (or 'ringing') strongly amplifies the noise emitted by vibrating panels and plates. However, the application of a small amount of damping material can significantly reduce the noise.

Damping (sound deadening) involves applying a viscoelastic or bituminous type material (e.g., mastic, asphalt) to large thin vibrating surfaces such as metal chutes, hoppers and machine guards to reduce the vibration and radiation of noise.

Damping materials can be painted, sprayed, trowelled, or glued onto the noisy surface (usually sheet metal). Self- adhesive dampening sheets are also commercially available and can be stuck on the inside or outside of the surface. Noise reductions of 5-25dB(A) can be achieved when most of the surface is covered with a damping layer of at least half the thickness of the panel to be treated.

Controlling impact or vibration noise

High impact is a common source of noise during materials handling when objects drop from a height onto a hard surface such as metal hoppers or collection bins. The level of noise depends on the size and type of material, weight and speed of the object. Reducing the drop height of an object from 5 meters to 5cm can reduce noise by about 20dB(A).



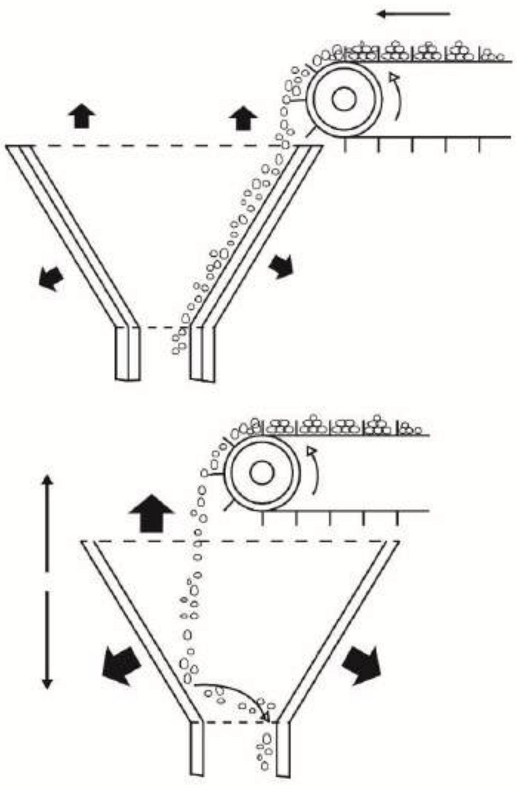
Example of material rolling onto a platform with a high drop height

Control of impact and vibration noise (including resonance) can be achieved by elimination or reducing the force of impact, dampening or stiffening surfaces, isolating mechanical vibration and reducing operating speeds or pressures.

The following is a list of ways to reduce impact or vibration noise:

- Reduce drop heights.
- Change the angle of impact to reduce the force of impact.
- Use resilient rubber type materials to absorb the impact of falling objects.
- Use resilient mats for cut-offs falling on the floor below work benches or guillotines.
- Fit rubber buffers to stop points.
- Apply a progressive cutting edge to punch tooling on power presses to reduce impact noise.
- Use conveyor belts rather than rollers which rattle.

- Use conveyors with spacers to prevent components striking against each other during transportation.
- Reduce the speed of the conveyor belt.
- Use wire mesh guards if solid panels vibrate.
- Apply a layer of damping or 'deadening' material (e.g., bituminous or rubber materials) to vibrating panels.
- Apply temporary dampening panels to sheet metal during fabrication, cutting and machining.
- Stiffen/brace surfaces to reduce vibration.
- Use perforated plates or woven metal mesh instead of sheet metal.
- Use materials with inherent damping (e.g., plastic instead of steel).
- Clamp workpiece using rubber-lined clamps to reduce vibration.
- Dampen or increasing mass of work benches to reduce general impact noise.

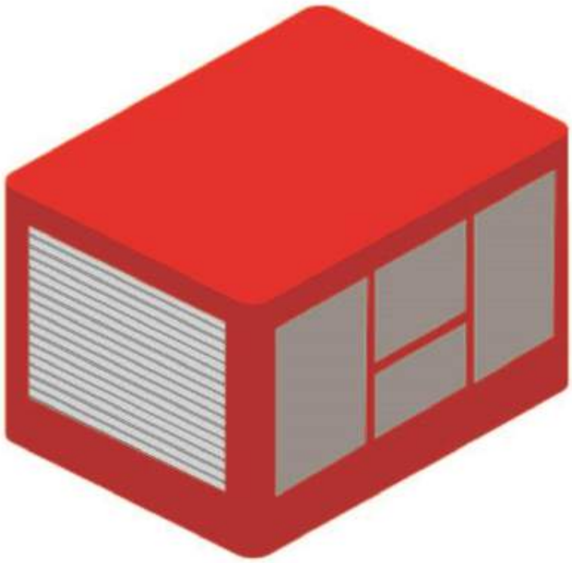


Materials falling and directly impacting catchment areas can be very loud. Reduce the drop height, angle, or use impact absorbing materials to reduce the noise.

Noise control – enclosures, barriers and screens

Full acoustic enclosures of plant

Full acoustic enclosure of machinery can be an effective way to control worker exposure to high levels of noise. A well-designed and relatively airtight full enclosure lined with sound absorbing material can provide as much as 30dB to 40dB of noise reduction.



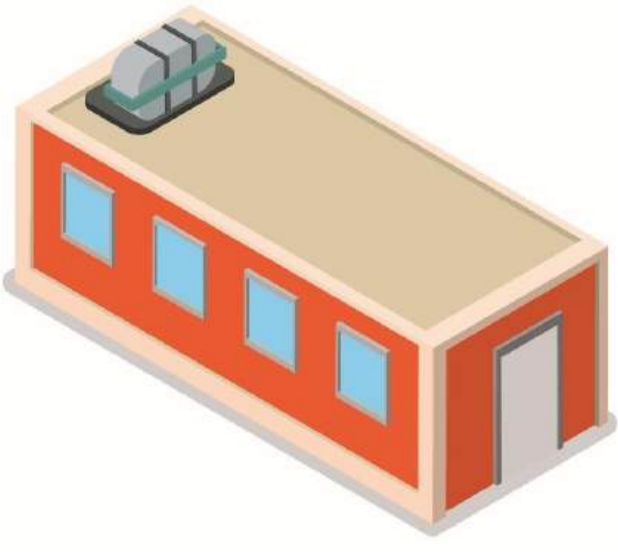
Use enclosures around machinery to dampen noise

Control rooms or worker refuges

Control rooms or worker refuges may be an effective risk control measure when:

- it is not reasonably practicable to enclose plant (e.g., where there are very large machines or a large number of machines).
- there are a small number of workers.
- the process is or can be largely automated or operated remotely.

Portable or demountable sound-insulating cabins are also available and are easy to assemble, dismantle or move. Typical reductions of 15 to 30dB may be achieved.



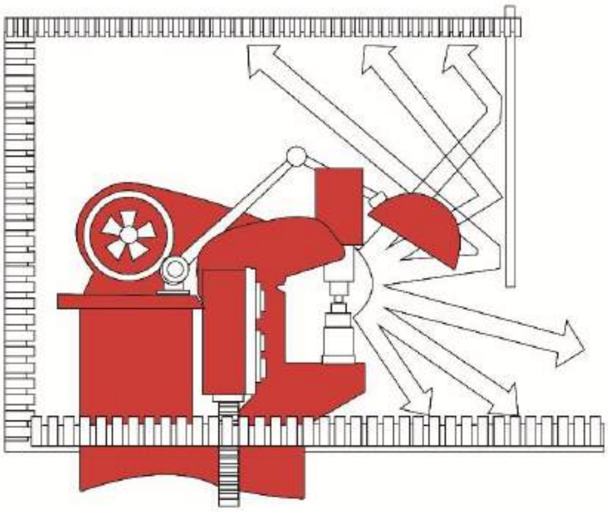
Potable, insulated cabins will give workers a break from a loud workplace

Partial enclosures

Partial enclosures can be used to reduce worker noise exposure where a full enclosure is not reasonably practicable. Partial enclosures do not typically achieve the same amount of noise reduction as full enclosures.

Partial enclosures should be constructed in a similar way to full enclosures. The number and size of any openings should be kept to a minimum and be directed away from workers where possible. Any product access chutes should also be extended and lined with sound-absorbing materials so as far as is reasonably practicable.

The amount of noise reduction achieved by partial enclosures depends on the particular geometry of the enclosure, the number and size of openings and the materials used to build it. Noise reduction of approximately 10dB may be achieved with the use of partial enclosures.



Partially enclosed machines are significantly quieter than open machines

Acoustic barriers and screens

Barriers and screens may be appropriate where a full or partial enclosure is not reasonably practicable to implement or when a small reduction of approximately 5-7dB is needed to avoid exceeding the noise exposure standard.

Fixed, portable or demountable barriers or screens should be placed between the source of noise and workers. Barriers or screens should be as tall and wide as possible and be positioned close to the worker or the noise source.

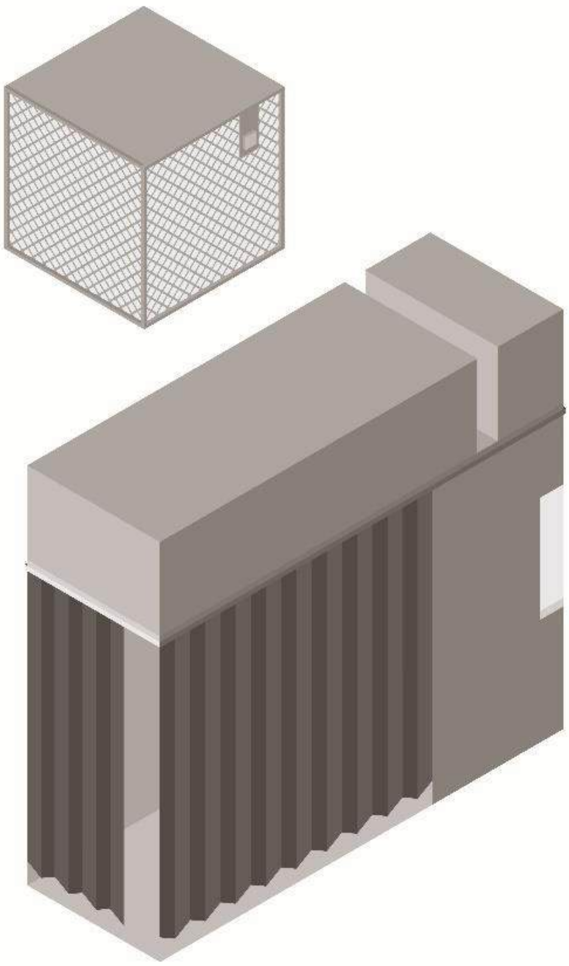
Barriers and screens are less effective in highly reflective environments such as construction sites with concrete floors or walls. Reflective surfaces, such as walls and ceilings, should be lined with sound absorbing material, such as foam, to minimise noise reflection. Gaps at floor level should also be minimised or sealed with flexible materials to increase the effectiveness of barriers and screens.

It is possible to create your own enclosure to reduce worker noise exposure. To design an enclosure that will perform well and significantly reduce worker exposure to noise levels the following guidelines should be observed.

Wall materials

Suitable materials for constructing an acoustic enclosure include bricks, concrete, metal, plywood, MDF, plaster, glass and Perspex.

The level of noise reduction achieved depends on, for example, the type of wall material used, how well it is sealed, the frequency of the noise being controlled and the weight per unit surface area (e.g., kg/m2) of the wall material. Materials that are compact, dense and heavy are typically more effective at reducing noise



Acoustic padded barrier and curtain screen

Dust

Dust can contain a range of materials including sand, dirt, pollen, minerals, wood, micro-organisms, and vehicle and industrial exhausts. Exposure to any dust in excessive amounts can lead to health problems. The size of the dust particles, what they are made of, and how much is in the air all affects how hazardous the dust can be.

The harmful effects of dust can vary, from skin irritation to lung cancer. Dust may not be an obvious hazard because the particles are often invisible, and the health effects of exposure can take years to develop.

Inhalation

The build-up of dust in the lungs can cause lung inflammation and eventually scar tissue (fibrosis). This could lead to breathing impairment. These conditions usually develop slowly, and symptoms may not appear until severe, irreversible changes have taken place.

Some dusts are well known for their ability to produce serious lung diseases, for example Respirable Crystalline Silica (RCS) can cause silicosis and lung cancer.

Long term health effects caused by dust in the lungs are usually permanent and may be disabling. Prevention of the onset of disease should be the highest priority.

Certain dusts (e.g., from grain, flour, wood, reactive dyes and proteolytic enzymes) are respiratory irritants and sensitisers. These can cause occupational asthma (attacks of coughing; wheezing and chest tightness), rhinitis (runny or stuffy nose) and extrinsic allergic alveolitis (symptoms can include fever, cough, worsening breathlessness and weight loss).

Using machinery without breathing protection can affect your health

Skin contact

Some dusts such as epoxy resins, rubber processing chemicals, wood dust and fibreglass can cause skin ulceration, irritation and/or sensitisation (dermatitis).

Eye contact

Dust particles can cause eye damage or irritation, due to the chemical and/or physical properties of the material.

Dust can cause long term eye injuries

Ingestion

Some inhaled dusts can become trapped in the mucus that lines the respiratory tract. This mucus tends to be either spat out or swallowed. Inhaled dusts can get into the digestive tract, where they can cause local effects such as gastrointestinal tract irritation. Alternatively, it can affect other organs and tissues via the bloodstream (e.g., lead).

Dust particles may also enter the digestive tract through eating, drinking and smoking with contaminated (dirty) hands. It is important for workers to maintain good personal hygiene standards and to regularly wash their hands.

Dust can enter your body via food – wash your hands prior to eating

Controls for certain types of dust and dust generating activities

Wood dust

Wood processing causes small particles of wood dust to become suspended in the air. Workers can inhale these particles. A person's upper respiratory system can filter out the larger particles, but smaller particles can go deep into the lungs causing damage and scarring to the lung tissue. Each time this happens a small amount of irreversible damage occurs. This damage reduces the lungs' ability to take in oxygen and over time makes it increasingly difficult to breathe.

The presence of glues, resins, formaldehyde and other wood treatment chemicals in some wood products increase the health risks from wood dust.

Wood dust poses the following risks to worker health:

- Inhaling dust into the lungs can cause breathing problems and lead to lung diseases such as occupational asthma and lung cancer. Breathing in dust is the most common type of exposure to wood dust.
- Getting dust in the eyes can cause irritation and damage.
- Skin contact with wood dust can cause ulceration of the skin, irritation and dermatitis.

The following activities are likely to cause high dust exposures:

- Sawing and cutting.
- Routing and turning.
- Sanding.
- Dry sweeping of dust.
- Bagging dust from dust extraction systems.

How to control wood dust exposure

You should apply the most effective controls measures reasonably practicable. In most cases Personal Protective Equipment (PPE) such as Respiratory Protective Equipment (RPE) shouldn't be the first or only control considered. Listed below are some controls that can be used to manage wood dust. Elimination and engineering controls such as Local Exhaust Ventilation (LEV) are more effective than administrative controls and PPE.

- Eliminate the risk by buying pre-cut or processed wood materials.
- LEV is one of the most effective ways to control dust at the source. Use LEV systems to capture dust from cutting, shaping and sanding wood either by hand or machine.
- Use on-tool extraction on saws and grinders to control wood dust at source.
- Refer to the manufacturer's operating instructions for equipment use and maintenance. For example, use the correct saw blade or planer for the task.
- Use water damping methods where practical.
- Don't use blowers, fans or compressed air to move wood dust.
- Provide a suitable industrial vacuum to remove dust from work areas.

- Minimise worker exposure by limiting the time each person spends doing dusty work.
- Advise workers to wear RPE when emptying vacuum cleaner bags or collection bags – there is a potential for high wood dust exposure.
- Ensure workers wear RPE and other PPE suitable for the task. Advise workers to remove work clothing such as overalls carefully at the end of the task or shift to avoid generating dust clouds.
- Provide washing facilities at work so dust is not taken home.
- Advise workers to wash their face and hands immediately after finishing the task and before eating, drinking or smoking.

Crystalline silica dust

What is crystalline silica?

Crystalline silica (quartz) is a natural mineral. It's found in stone products such as reconstituted stone, granite and sandstone. It's also in other building materials such as concrete, bricks and mortar.

How much crystalline silica is present depends on the material. Reconstituted stone can have very high Crystalline Silica content – up to 95%.

Exposure to crystalline silica dust

When you do things like cut, grind, drill, or polish products that contain Crystalline Silica, it releases very fine dust. Some of the dust is so small you may not be able to see it.

Workers in the construction industry may be exposed to Crystalline Silica dust. Workers who regularly work with reconstituted stone or concrete are at higher risk.

Health risks

Silica dust can be harmful when it's inhaled into your lungs. Exposure can lead to deadly diseases, including:

- silicosis.
- lung cancer.
- kidney disease.
- autoimmune disease.

Silicosis occurs when Crystalline Silica dust scars the lungs. It's a serious and incurable disease, with symptoms including shortness of breath, coughing, fatigue and weight loss. In severe cases, silicosis can require a lung transplant or lead to death.

Eliminating silica dust

Elimination means you completely remove the hazard from your construction site.

In many cases, eliminating silica dust is not practicable. Elimination may not be possible if silica dust is naturally occurring at your construction site or you can't make the end product or deliver a service without generating it.

You can eliminate silica dust at the source by eliminating the processes that generate dust. For example:

- Adopting production processes that generate less dust.
    - For example, any wet method is likely to generate less dust than a dry one.

- Treating the dust at the point of generation, as this is more effective than capturing airborne dust, and
- Treating the dust on its transmission path using dust suppression techniques.
    - For example, water sprays, chemical additives, local exhaust ventilation (LEV), vacuum.

If it is reasonably practicable, eliminate the silica containing products from your construction site. This will effectively remove the risk of workers being exposed to silica dust when working with these products.

Substitution

Substitution is where you replace a product or chemical with something that is less hazardous and therefore has a lower risk.

Effective substitution of silica and silica containing products will depend on your construction site and the work tasks your workers carry out. Again, substitution might not be practicable where silica is naturally occurring or if it means you can't make the end product or deliver a service.

Substitution can be an effective way of managing the risk of exposure to silica dust. For example, you can:

- use products that do not contain silica or have less silica in them.
- use a silica containing product that does not need to be cut, ground or polished, and
- use a liquid or paste form of a silica product.

Isolate workers and others from silica dust

Isolation is where you place barriers or distance between a hazard and your workers.

Isolation is an effective way of protecting your workers from exposure to silica dust. Physical barriers that remove the worker from contact with silica dust are the most effective form of isolation controls.

Isolation controls include:

- isolating high dust generation work processes within an enclosed room with restricted access.

- providing physical barriers and exclusion zones between different workers and workstations to prevent dust or water mist from moving into other work areas or towards other workers.
- distancing a work process from other workers.
  - for example, consider where other workers are working when powered hand tools are used.
- designating a room or area for other tasks such as changing or eating, away from the work area.

You can also use barriers around automated tasks to shield workers from silica dust. Wherever possible, workers should not fabricate silica containing products at the construction site. If modifications at the installation site need to be made, this work should be done outdoors in a designated area, wearing appropriate PPE and using engineering controls, including wet methods and dust collection systems.

Engineering controls

Engineering controls to control silica dust include:

- automation when cutting, grinding or drilling.
- using wet cutting methods.
- local exhaust ventilation.
- drills, routers, saws and other equipment designed to be fitted with H-class local exhaust ventilation and a water attachment to suppress dust.
- using sacrificial backer-boards or spoil boards.
- fitting large machinery such as excavators and bulldozers with positive pressure enclosed cabs, and
- cleaning up dust with a M or H-class industrial vacuum cleaner.

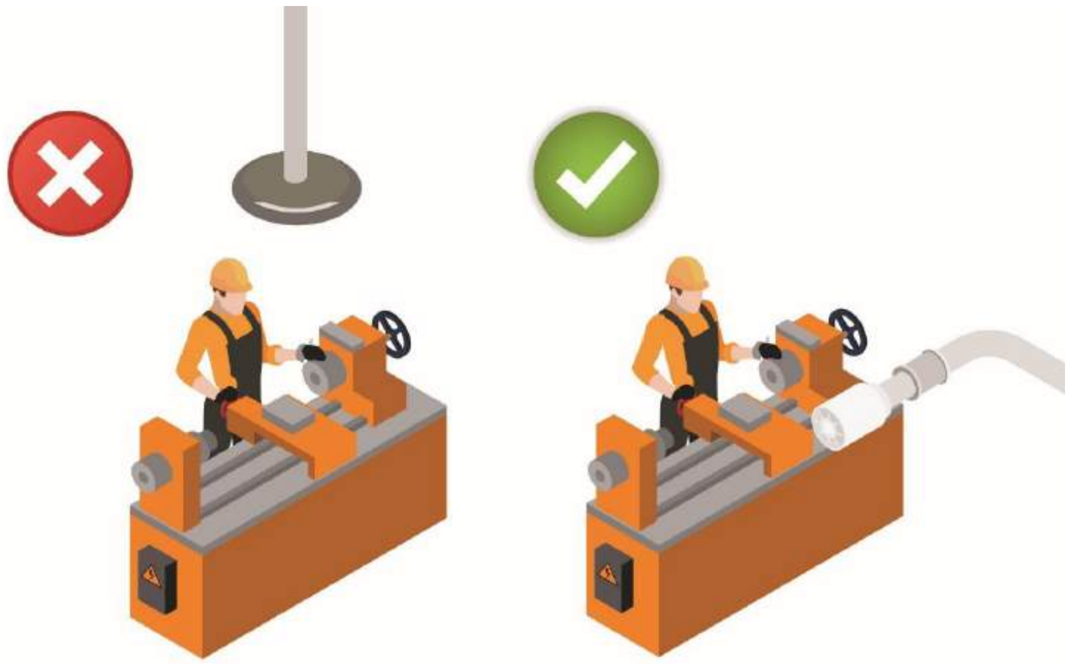
When considering and using engineering controls, be aware of other hazards that may be introduced. As many engineering controls are motorised you should be aware of noise and vibration levels at your construction site and issue personal hearing protection as needed.

Silica dust is abrasive and can damage and wear engineering controls. It is important to have a maintenance schedule in place to keep your equipment in good working order. You should regularly inspect your equipment for:

- wear and tear, corrosion or damaged parts.
- air leaks in pneumatic tools.
- kinks, holes or leaks in water suppression or dust extraction equipment, or
- damage to guards and flaps that contain water spray.

Ventilation

Ventilation is a very effective engineering control when designed correctly. There are a range of different ventilation systems and you need to use the ones that suit your construction site and the tasks your workers carry out.



Example of using local exhaust ventilation

Engineering controls – wet methods

Research has found that even when wet methods are used on products that contain high levels of silica that silica dust is not adequately controlled. Applying water to rotating tools can also generate silica contaminated mist that must also be controlled.

For this reason, properly designed water suppression and local exhaust ventilation should be used in combination when working with these products. It is important to:

- only use tools and machinery that have been specifically designed for use with water attachments with the appropriate Ingress Protection (IP), for example:
    - when cutting slabs, use bridge saws fitted with water attachments to suppress dust.
    - to complete sink and stovetop cut outs, use water suppressed routers, water jet cutters or bridge saws.
    - use hand-held angle grinders fitted with multiple water feeds that deliver water to the cutting disc and the point of contact with the stone.
    - use water suppressed wet edge milling machines or polishing machines.

  - when polishing or grinding stone, use polishers with a centre water feed.

- use an adequate number of water feeds to prevent visible dust during the process.
- maintain adequate water pressure (0.5 L/min or as specified by the manufacturer) to make sure water is reaching the product or tool.
- control water spray using guards, plastic flaps or brush guards.
- prevent workers from being able to turn water suppression systems down or off during operation.
- only use tools and machinery that have been specifically designed for local exhaust ventilation attachments such as drills, circular saws and grinders equipped with a shroud and a h class rated vacuum, and
- install fixed, portable or flexible capturing hoods to capture dust at the point of generation.

The use of a handheld spray bottle, sponge or garden hose to separately apply water to rotating tools is inadequate to suppress silica dust. Wet methods of fabrication can introduce other hazards to your construction site. When using wet methods consider:

- installing ventilation to control water mist that may carry dust.
- providing waterproof aprons, waterproof, non-slip footwear and eye protection that does not fog up and obstruct worker’s vision.
- filtering water that is recycled.
- ensuring run-off is effectively drained away from equipment and work areas.
- installing non-slip flooring.
- implementing housekeeping policies to make sure run-off does not dry to create a dust hazard, and

Example of wet cutting method and suitable PPE

Administrative controls

Administrative controls should only be used to provide additional protection and must only be considered after implementing substitution, isolation and engineering controls.

Administrative controls rely on worker behaviour and it is very important to have administrative policies and worker training when silica is identified at your construction site. You also need to supervise your workers to make sure they understand and follow your administrative policies.

Examples of administrative controls for silica dust include:

- planning cutting tasks to make sure the minimum number of cuts are made.
- written rules and policies for working with silica or cleaning silica waste.
    - for example, having a written clean-up procedure and log.
- a maintenance schedule and log for equipment and PPE.
- a job rotation schedule so that the same workers are not continually exposed to silica, and
- restricted area policies so that only staff who are carrying out a task that generates silica dust are allowed access to high-risk areas.

If you work with silica containing products, you should develop and implement administrative controls to support the higher-level control measures you have in place to protect your workers. These may include:

- shift rotation policies to make sure workers are not exposed to dust above the construction site exposure standard and for extended periods of time.
- providing a laundry service for dusty PPE and work wear supported by a policy outlining:
    - that dusty PPE and work wear are not to be taken home.
    - designated areas where dusty PPE and clothes must be changed.
    - when dusty PPE and clothes must be laundered.
- policies for storage, cleaning and maintenance of equipment and PPE that require:
    - dusty PPE and equipment to be stored in sealed bags when not in use.
    - cleaning of PPE and equipment to be done in designated areas only, and
    - signage at the construction site highlighting there is a dust hazard and any use of RPE and PPE.

Examples of silica dust hazard signs

Training

When you are working with silica or silica containing products, you must talk to your workers about silica dust hazards. Training must be provided:

- as part of induction and refresher training.
- when a worker will be carrying out a particular task or activity where silica dust is present or could be generated, and
- when significant changes are made at the construction site that change how workers might be exposed.

The information you give to workers during training should give them a good understanding of:

- what silica dust is and health effects.
- what controls are in place to protect them.
- when they might be at risk of exposure including.
    - bad work practices, or
    - when controls might not be effective, and
- what to do if they observe unsafe practices at the construction site.

You should encourage your workers to report hazards and health and safety problems immediately. This is important because it allows the risks to be managed before an incident or illness occurs.

Housekeeping

Good housekeeping can eliminate or reduce exposure to silica dust, even after work has stopped. Developing written rules and policies for your construction site is a good way to implement housekeeping as an administrative control. For example, you could require your workers to:

- wet down dusty work areas and processes.
- conduct a cleaning schedule for work areas and a maintenance schedule for engineering controls.

  - for example, regularly cleaning dusty vehicle track or high use areas and keep them wet during the day.

- carry out daily cleaning procedures for slurry and settled dust.
  - for example, placing wet slurry inside a sealed container for disposal.
- never use compressed air, dry sweeping or general-purpose vacuum cleaners to clean surfaces or clothing.
- use a low-pressure water, wet sweeping or a M or H class rated vacuum cleaner to clean dusty floors, walls, other surfaces and equipment, and
- always follow the vacuum manufacturer's operator manuals and instructions for changing dust bags and filters.

If your workers are outdoors, you can cover the ground with plastic sheeting and remove remaining dust using the above methods.

Decontamination

Dusty clothing and PPE can expose workers and others to silica dust. Examples of how you can minimise exposure to dust carried on PPE and work clothes include:

- using an industrial H class vacuum cleaner to remove dust from clothes and uniforms.
  - by positioning these units at the exits of dusty work areas, you can encourage workers to vacuum their clothes before leaving.
  - you should make sure that workers have access to an area to wash their arms, hands, faces and even their hair.
- providing a laundry service for dusty work clothes and PPE so they are not taken home for washing.
  - if you use a commercial laundry, dampen the clothes and place them in a sealed, labelled plastic bag, and inform the laundry that the clothes are contaminated with crystalline silica.
- requiring workers to change dusty clothing after each shift, or if they have just finished a very dusty task to change at their next break, and
- providing workers with rubber boots and aprons.

Worker's clothes and uniforms must be cleaned frequently to stop silica dust from contaminating break rooms, other parts of the construction site and importantly, to stop workers from taking silica dust home.

Personal protective equipment

You should never rely solely on PPE to protect workers from silica dust.

Before using PPE, you need to do a risk assessment to see what other controls can and should be used. PPE should only be considered after implementing substitution, isolation, engineering and administrative controls. It should only be used to supplement higher-level control measures or when no other safety measures are available.

You must make sure the PPE you provide is appropriate and fits the worker who will be wearing it. This will ensure that the PPE is doing its job. Wrong or ill-fitting PPE means that silica dust can harm your workers. For example, the dust can get into worker's eyes or into the worker's breathing zone and into their lungs.

You must make sure PPE is clean, hygienic and in good working order. This is so that you do not introduce other hazards to the worker and that the PPE will work as intended.

You must provide ongoing training, information and instructions for your workers on how to use, clean and store the PPE you provide. Workers must take reasonable care for their own health and safety. They are expected to follow reasonable instructions and cooperate with any construction site policies you have in place to protect them. Workers must use and wear PPE as instructed by you. However, you must also supervise your workers to check they understand their training and are using the PPE correctly.

Recommended PPE for working with Silica Dust

Respiratory protective equipment

As silica dust particles are very small, workers should use a tight-fitting respirator with an effective face seal. This means they need to be clean-shaven or only have facial hair that does not interfere with the fitting surfaces or the respirator valve.

As everyone's face is a different size and shape, there is no 'one size fits all' tight-fitting respirator. This means that you should also fit test each worker and their RPE before they undertake dusty work.

For workers who want to keep facial hair that may interfere with the operation or proper fit of tight-fitting respirator (for example a closely trimmed beard), a powered air purifying respirator with a loose hood may be suitable.

Always use the correct respirator when working around silica dust

When should exposure monitoring be carried out?

If you're not certain if the levels of dust could be harmful, exposure monitoring should be undertaken. Exposure Monitoring should be completed by occupational hygienists or other suitably trained personnel.

This monitoring will help determine the most appropriate wood dust control methods and respiratory protection for workers. Exposure monitoring should be undertaken regularly to check the effectiveness of controls. If the controls are not working seek advice from an occupational health specialist or LEV engineer.

When should health monitoring be carried out?

Health Monitoring is a way to check if workers are getting sick from being exposed to hazards while carrying out their work, it aims to detect early signs of ill-health or disease. Health monitoring can also show if control measures are working effectively.

Where workers are routinely exposed to wood dust you should arrange health monitoring for them. Monitoring should include a baseline and then annual lung function test and a respiratory questionnaire.

Follow the recommendations of an occupational health practitioner with experience in health monitoring when determining what type of health monitoring is required.

Worker training

Educate your workers about risks from dust and the control measures. Regular training is important to ensure worker awareness remains high.

Training should include information on:

- the health risks from exposure to dust.
- safe work practices to follow when dust is created.
- how to use and maintain LEV systems.
- the appropriate use and care of PPE (including protective clothing and RPE).

Asbestos

It is often very difficult to identify the presence of asbestos by sight. The only way to be certain is to have a sample of the material analysed by a laboratory. Sampling of anything you suspect may contain asbestos is itself hazardous and should only be done by a competent person and analysed only in accredited laboratories.

Where materials have not been tested you should assume that it could contain asbestos and take adequate precautions before handling, removing or disturbing it. Sometimes manufacturer information may have been stamped on a product or a label may state it contains asbestos.

Typically, certain products can be identified by their age and likelihood to contain asbestos and must then be treated as asbestos materials.

There are activities you must never do when working with or removing asbestos-containing materials:

1. Never use power tools, such as angle grinders, circular saws and electric sanders (unless enclosed or used with a device or process that prevents dust).
2. Never use high pressure water cleaners.
3. Never use compressed air or abrasive blasting.
4. Never use household vacuum cleaners even if they have a HEPA filter. (Only specially designed cleaners for work with asbestos can be used).

All of these activities are very dangerous because they can release large numbers of asbestos fibres into the air.

Before commencing work, always check for the presence of asbestos

Wearing protective equipment

Wearing the right personal protective equipment is essential to protecting your health when working with asbestos.

A range of personal protective equipment (PPE) should be worn by workers to protect them from exposure to airborne asbestos fibres, including:

- P2 disposable mask or a half-face respirator.
- disposable coveralls suitable to the task, for example, European Standards Type 5 and Type 6.
- face and hand wipes.
- boot covers or gumboots.

An example of correct and incorrect PPE when working with asbestos

Wear the proper respirator

Ordinary dust masks are not effective in preventing the inhalation of asbestos fibres and dust. Cheap masks may save dollars, but they do not provide adequate protection against airborne asbestos fibres.

You will need to purchase and use a specific respirator designed specifically for working with asbestos. Wear a half-face filter respirator fitted with a class P1 or P2 filter cartridge, or a class P1 or P2 disposable respirator appropriate for asbestos.

Males should be clean-shaven to make sure there is a clean seal between their face and the mask. The respirator should have an airtight fit. Read and follow the manufacturer's instructions on how to check the fit of the respirator.

Keep your respirator on until all work and clean-up is done and your contaminated clothing is removed, bagged and sealed.

Wear disposable clothing

Disposable coveralls should be used to prevent the contamination of any clothing, including your shoes/boots. These respirators are available from safety shops or hardware stores. A disposable hat and disposable gloves should also be worn.

Do not keep the clothing, reuse them or shake the dust out of them. After your work is complete, spray your clothing with a light mist of water and remove them. Keep your respirator on when doing this. Seal all of these in your asbestos waste bags for disposal (contaminated clothing can be disposed of with other asbestos waste). Read more information about disposing of asbestos waste.

Have a shower afterwards

To remove any dust and asbestos that may be on your body, have a thorough shower after finishing your work. Make sure you wash your hair as well.

It's essential that you take all the necessary precautions to protect yourself and others when dealing with asbestos. Find out about preparation before you commence the task.

Preparation before commencing the task

It's essential that you take all the necessary precautions to protect yourself and others when dealing with asbestos. The below steps outline ways to assess the risk, ensure you have adequate training and understanding of how to minimise any exposure to asbestos through adequate preparation of the work area.

Risk assessment

A job specific risk assessment must be conducted prior to commencing any possible asbestos work, and include:

- assessing the work to be performed.
- understanding to what degree there is the likelihood of disturbing asbestos containing material (ACM).
- inspecting the asbestos register and a decision made as to whether work can be done without disturbing ACM e.g., instead of drilling a hole for wiring consider re-routing the wiring through non-asbestos material.
- inspecting and evaluating the material to determine if it is ACM. If a sample analysis has not been conducted, assume that the material is ACM.
- assessing the ACM's condition as to whether it is in sound condition or deteriorating and liable to damage.
- assessing implementation of job-specific control measures including:
    - maintaining a safe distance between barriers and the work area.
    - assessing the types and level of personal protective equipment (PPE) required to manage the risk of exposure to airborne asbestos fibres.

- considering other hazards that may impact on the work (e.g., live electric cables in wall cavity, working at heights, working on brittle roofs, confined spaces, heat stress, vermin or pests).

Training of workers

A Principal Contractor must ensure that workers have received training in and aware of:

- in situ identification of asbestos-containing materials, including their common locations.
- identification of appropriate safe work procedures when working with ACM.
- decontamination procedures.
- appropriate selection of ACM waste disposal.
- respirators use and fit.
- relevant codes of practices, fact sheets and work guidance notes.

Site preparation

To prepare the site for work with asbestos:

- ensure that the asbestos register has been sighted to verify the presence of ACM or ensure that a competent person has identified ACM in the work area.
- ensure the work area access permit has been completed.
- prepare a written work procedure for the activity (unless a standard safe work procedure applies).
- determine the number of workers required on site (always perform asbestos-related work with the lowest number of workers possible in the asbestos work area).
- determine the need for a second experienced worker to assist with the works (e.g., shadow vacuuming or the need for a worker to remain on duty outside the asbestos work area).
- advise the site occupants of the intended works.
- ensure there is adequate lighting for the work area.
- establish a buffer zone to separate the work area, by closing all doors to the work area or using plastic curtaining, barricades, signage, and relevant instruction to workers and others.
- erect all safety signage.
- cover the floor with two layers of the 200-um PVC plastic sheeting and secure with duct tape.
- remove all loose furniture and items from the work area or cover with a 200-um plastic cover and secure with duct tape.
- have all equipment ready in the work area (to minimise movement in and out of the area).
- identify potential electrical hazards e.g., cabling in wall cavity.
- shut down air conditioning and vent systems (if applicable); seal ducts and vents with 200 µm PVC plastic sheeting and duct tape.
- control exposure to dust by using a H rated industrial vacuum cleaner that meets Industry Standards, with a High Efficiency Particulate Air (HEPA) filter and is suitable-for-the-task vacuum tools or at a minimum, 'wet' and 'thickened substance' methods for dust control

when drilling into any ACM (unless an electrical hazard exists).

Safety checklist

Before you commence work involving Asbestos, do a final check:

- Change into PPE and remove all jewellery/watches before entering the asbestos work area and continue to wear all the PPE identified in the risk assessment when working within the boundary of the asbestos work area.
- Ensure the workers carrying out the work activity have conducted a fit test on the masks and respirators.
- Activate the site access permit or authority, if required, and insure it is signed by the construction site owner.
- Only perform asbestos-related work when the construction site is unoccupied and when it is outside 'normal' facility operating hours, where possible.
- Leave clean clothing outside the asbestos work area (in the buffer zone) until personal decontamination is complete.
- Restrict access by non-essential workers.

Clean-up and disposal

Asbestos waste and debris must be disposed of quickly and correctly to minimise any asbestos fibre exposure to the homeowners or workers.

- Visually inspect the work area including all horizontal surfaces to ensure they are clear of all visible dust and debris. Air monitoring is not normally required for this task.
- Ensure that the work area is clean and tidy, and all waste has been removed from site. No rubbish should remain on site after the work has been complete.
- Dispose of the waste in accordance with the local government requirements.
- Sign off any access permits and authority with the relevant person.
- Site owner to inspect the site to confirm that the area is clean and tidy and that the work is completed.

Run-off & erosion

Erosion control is one of the biggest concerns for many large construction projects. Multiple factors can cause erosion, and every situation calls for specific solutions based on the site and the severity of the problem.

Controlling erosion is important, not just for preserving the construction site and protecting the new structure but also for minimizing the environmental impact that the project has on the surrounding area.

Erosion prevention should be part of your construction plan, as it’s the best and easiest way to control erosion. Correcting erosion issues after the fact is much more costly and difficult.

Heavy rain can cause havoc on a construction site. Half completed work may be washed out or buried in silt. Disturbed areas can become a sea of mud and turbid water rushes off the site towards the nearest watercourse. Engineering activities will be cheaper, more efficient and less harmful to the environment if attention is given to erosion, run-off and sediment control on the site.

How does erosion occur?

Rain, wind and the sea are continually eroding away the earth's surface, and the resultant material is transported down towards the bed of the sea. Vegetation reduces erosion rates and helps to produce a system that is relatively stable. When vegetation is removed, as on a construction site. soil erosion can occur at rates which are several hundred times greater than those existing in the natural situation.

For soil to be eroded, two processes must occur. Firstly, the soil has to be detached from the parent material and secondly, the detached soil has to be transported away from its original location. Soil particles are detached by raindrops hitting the bare soil surface and transported by run-off water flowing over the detached soil.

Some on-site effects of erosion on construction activities are:

- more run-off to be controlled on site.
- increased dust and visibility problems.
- more eroded soil deposited where it is a hindrance to construction activities.
- wet, muddy conditions during and after wet weather, which greatly increases down-time with machinery.
- more "tidy up" jobs such as de-silting drains or grading off eroded areas at the end of the project.

Some off-site effects of erosion on construction activities are:

- dirty, muddy water for users downstream.
- increased flooding frequency and volume of run-off.
- increased erosion of stream banks and beds.
- transport and deposit of sediment downstream.
- increase in water turbulence during peak flows causing uprooting of vegetation and destruction of aquatic life.
- reduction in stream flow during low flow periods.
- local erosion at the point of discharge of drainage water because of increased concentration and velocity.

Benefits of erosion control on construction sites

There are many on-site benefits resulting in planning and carrying out erosion control works on construction sites. These include.

- LESS DOWN-TIME AFTER RAIN - if a construction site is well drained and protected from run-off entering from outside the site, workers and machinery will not spend much time after rain working in mud; less bogging of machinery will occur and people working on the site will be much happier. A sure way of reducing productivity is to have people and machinery continually bogged down in mud.

- LESS CLEANING UP AFTER RAIN OR AT THE END OF A JOB - if there have been few erosion problems on the site, there will be less culverts to be un-blocked, less drains to be de-silted and less tidying up at the end of a job. This can reduce costs by thousands of dollars on large projects.
- FEWER COMPLAINTS BY DOWNSTREAM NEIGHBOURS - if residential areas receive silt from a construction site, or if streams used for irrigation or water supply are made muddy, the construction organization very quickly, and quite rightly, receives complaints from downstream occupiers.

<u>**Principles of erosion control on construction sites**</u>

Planning phase controls

A practical way of combating erosion is to plan control measures before work starts on a project.

An erosion and sediment control program are based on the following principles:

- Assess the erosion potential of the site before work starts.
- Control drainage coming in from outside the site.
- Control drainage on the site.
- Keep the area disturbed as small as possible and for as short a time as possible.
- Trap any sediment before it leaves the site.
- Retain topsoil for use in reclamation works.
- Revegetate all areas after earthworks are completed.

Principal Contractors should discuss soil erosion strategies before allowing machinery to commence work

Design and construction phase protocols

Plans and specifications for a project should contain details of erosion and sediment control practices. The following points are indicative of the information that may be required as part of the detailed plans and specifications.

- Detailed soils information so that supervisors and operators know which areas are likely to erode and where special care is needed.
- Schedule of all earthworks, showing areas and approximate periods when the soil will be exposed.
- Measures proposed to control and dispose of run-off and sediment from the site.
- Plans for returning the topsoil and the planting of a vegetative cover.
- Standard of restoration to be applied to adjacent areas affected by the project.
- Control of access and access points to the site.
- Control of stockpile and spoil dump locations.
- Restrictions that may be required during wet or dusty conditions.

Success in controlling erosion on construction sites depends greatly on machinery operators and their supervisors. Training on relevant aspects of erosion and sediment control should be provided for machinery operators.

Earthworks need to be planned and scheduled so that erosion is controlled

Maintenance phase controls

The construction site is normally responsible for maintenance of the site and its surroundings and control of drainage during the entire construction period. Maintenance for a limited stabilization period after construction is also normally required.

Typical maintenance requirements include:

- Fertilizing and re-seeding of grassed areas if necessary.
- Tree maintenance and re-planting.
- Correction of culvert levels exit and entrances, if in error.
- Removal of silt and repair of eroded drainage lines.
- Repair of structures undermined or broken up.

Construction site practice

The following gives examples of activities that can be carried out on construction sites to reduce erosion and sedimentation.

Initial clearing and site preparation.

- Development should be programmed to minimize the area disturbed at any one time. Do not disturb the site more than is necessary and only strip areas which are going to be worked in the immediate future. It is tempting to clear the whole works area early, even though it may be 12 months or more before any works will take place on large areas. A lot of erosion can occur in that time. Overall, no money is saved by stripping earlier than necessary.
- Timber, logs and rubbish which will interfere with topsoil removal and respreading over the completed earthworks, should be removed.
- Before stripping topsoil, it is helpful to reduce the vegetative cover by grazing or mowing. Excessive grass or herbage makes topsoil removal and respreading more difficult.
- Topsoil and subsoil should always be handled separately and placed in separate stockpiles.
- Topsoil should be stockpiled for respreading on all exposed areas after final shaping has been completed.

Access around the site

Access control

Make sure access is controlled on the site and that vehicles and machinery keep to well defined haul roads or access tracks. If roads are poorly constructed, drivers and operators will tend to head for open country to keep away from rough or boggy areas, thus increasing the amount of bare ground on the site.

Good access saves money by reducing the turn-around time of machinery and by reducing the time lost in digging out machinery, which is bogged, etc.

Do not let machinery go up and down batters. These areas can be quickly eroded into deep rills or gullies. Where temporary tracks are no longer required they should be revegetated and restored to their original drainage pattern.

Machinery should be confined to specific areas to minimise erosion of soil.

Entry and exit to the site

Local Government has regulations and laws which state that vehicles are not permitted to drop mud from their tyres on the road when they leave a construction site. Dirt on the road is a traffic hazard and when washed off the road after rain, it silts up drains and watercourses.

The movement of construction traffic over unsurfaced roads and areas should be kept to a minimum; haul roads should be sprayed with water, to which a chemical dust suppressant may be added. Vehicles and machinery should not carry mud from a construction site onto public roadways.

Ensure mud and debris is removed from vehicles before they exit the site

Drainage

Control of drainage is one of the most effective ways of controlling erosion on a site.

Protection from outside run-off

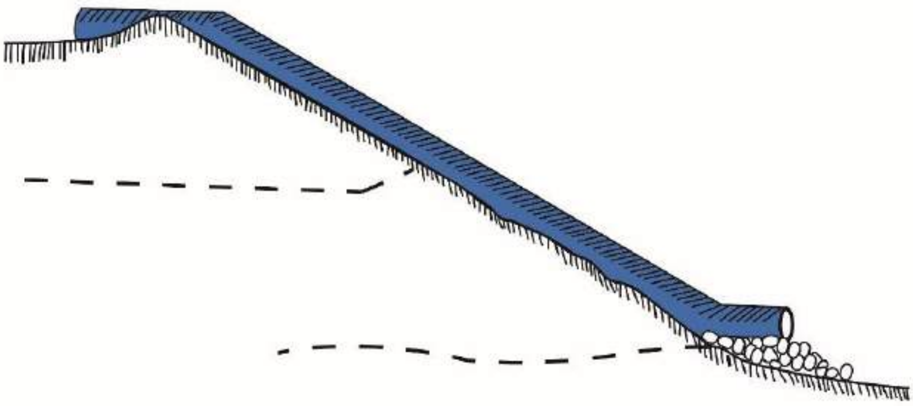
The first priority in drainage control on a site is to make sure that natural drainage water from upstream is diverted around the site before work starts.

Keep all bared areas free draining. Low areas on construction sites collect water and become very muddy. Not only is it difficult to work in such areas, but the mud may eventually get into streams causing muddiness of the water, and siltation of waterways.

Disposing water safely down batters

Slope drains dispose of run-off water from the work area down unprotected cut or fill slopes. They are used in conjunction with banks or drains along the top edge of newly constructed slopes to prevent erosion.

Plastic lining, wooden flumes, half round corrugated steel pipe, and rigid or flexible plastic pipes are commonly used.



Pipes used to control water runoff should slope down to a drain outlet

Pumped discharges

It is often necessary to pump out excavations after rain. These operations may be of such an intermittent or emergency nature that no formal control is possible. However, it is essential that people working on such jobs should be aware of the requirement to minimise the amounts of silt entering the drainage system.

Water should be discharged on to vegetated or surfaced areas, and not on to disturbed soils, fill slopes or stockpiles. Consideration should be given to using a vegetated area to filter the water or alternatively, construction of a temporary silt trap made of hay bales, etc. If possible, a standard procedure should be adopted for the particular project.

Stockpiles and spoil dumps

Stockpiles and spoil dumps can be major causes of erosion if they are not placed correctly. The following points give recommendations for correct, trouble-free handling.

Topsoil for respreading should be stockpiled as close as possible to the job. Stockpiles of topsoil will often grass up naturally if left for a few months. They should be reasonably well compacted, and the slopes can be roughened by moving a crawler tractor with cleated tracks up and down the slope so that the cleat marks are on the contour.

The location of stockpiles and dumps should be controlled and kept away from drainage lines, floodway's and culvert areas.

Grassing or covering stockpiles of clay or subsoil should be considered if they are to be left over the wet season. This can normally be done quite cheaply by sowing annual grass and clover seeds with fertilizer.

If stockpiles are to be placed on sloping ground, they should be protected from outside run-off by constructing a diversion bank or drain around the upstream side so that run-off is disposed of safely away from the dump or stockpile.

Stockpiles and spoil dumps should always be free draining.

Vegetation and reclamation

Vegetation is the best defence that can be provided to protect the soil against erosion.

Vegetation alone will not eliminate all the problems of erosion and sedimentation, but when used in conjunction with good engineering practices, these problems will be greatly reduced.

Vegetation should be established as soon after the completion of earthworks as the season permits. Failed areas will require re-seeding.

CHAPTER 10

HAZARDOUS SUBSTANCES & DANGEROUS GOODS (EXPOSURE AND CONTROL)

Hazardous substances and dangerous goods on a construction site can pose various risks for workers, visitors and people moving nearby.

Construction sites often contain many hazardous substances and dangerous goods such as dust, fumes, chemicals and gases that can be extremely harmful to workers health and safety, as well as affect other people walking near or living near the construction site. Hazardous substances and dangerous goods can also cause harm to animals and the environment.

You can inhale hazardous substances or absorb them through the skin. They can cause immediate and long-term health problems. Health effects include poisoning, irritation, chemical burns, sensitisation, cancer and birth defects. Hazardous substances can also cause diseases of organs such as the skin, lungs, liver, kidneys and nervous system.

This section will explain how to identify hazards and control the risks associated with hazardous substances and dangerous goods on the construction site.

What are hazardous substances?

Hazardous substances are substances that can harm people's health. They may be solids, liquids or gases. In the construction site, they are often in the form of fumes, dusts, mists and vapours.

- Acute toxins such as cyanide.
- Substances harmful after repeated or prolonged exposure such as mercury and silica.
- Corrosives such as sulphuric acid and caustic soda.
- Irritants such as ammonia.
- Sensitising agents such as isocyanates.
- Cancer-causing substances (carcinogens) such as benzene and vinyl chloride.

There are two broad types of hazards associated with hazardous substances which may present an immediate or long-term injury or illness to people. These are:

- Health hazards - these are properties of a substance that have the potential to cause adverse health effects. Exposure usually occurs through inhalation; skin contact or ingestion. Adverse health effects can be acute (short term) or chronic (long term). Typical acute health effects include headaches, nausea or vomiting and skin corrosion, while chronic health effects include asthma, dermatitis, nerve damage or cancer.
- Physicochemical hazards - these are physical or chemical properties of the substance, mixture or article that pose risks to workers other than health risks, as they do not occur as a consequence of the biological interaction of the chemical with people. They arise through inappropriate handling or use and can often result in injury to people and/or damage to property as a result of the intrinsic physical hazard. Examples of physicochemical hazards include flammable, corrosive, explosive, chemically reactive and oxidising chemicals.

Many hazardous substances have both health and physicochemical hazards.

What are the different forms of Hazardous Substances on a Construction Site?

Hazardous substances on a construction site can come in many different forms: These include:

- vapours.
- gases.
- solids – dust, fibre particles.
- liquid – sprays, mists and aerosols.
- micro-organisms – fungi, bacteria and viruses.

The difference between hazardous substances and dangerous goods

Hazardous substances are classified according to different criteria. Hazardous substances are classified on the basis of health effects, while dangerous goods are classified on the basis of physicochemical effects such as fire, explosion and corrosion, on property, the environment or people.

Vapours are an example of a hazardous substance

Dangerous goods are substances and articles (e.g., matches, gas bottles and car batteries) classified on the basis of immediate physical or chemical effects such as fire, explosion, corrosion, oxidation, spontaneous combustion and poisoning that can harm property, the environment or people. They may be solids, liquids, pure substances or mixtures.

Flammable liquids are an example of dangerous goods

What determines the level of risk?

The level of risk posed by a hazardous substance or dangerous good depends on:

- the substance (i.e., form, concentration, toxicity, health effects, and physical and chemical properties).
- the nature of the work (i.e., how the substance is used or handled, quantities, routes of exposure, etc).

Health and safety duties

Principal Contractors responsible for people working on construction sites, have a responsibility to manage the risks to health and safety associated with using, handling, generating and storing hazardous substances and dangerous goods at a construction site.

These include:

- Ensuring correct labelling of containers and pipework, using warning placards and displaying safety signs.
- Maintaining a register of hazardous substances and dangerous goods and notifying government authorities if you store large quantities of hazardous chemicals.
- Identifying any risk of physical or chemical reaction of hazardous substances and dangerous goods and ensuring their stability.
- Ensuring construction site exposure standards for hazardous substances and dangerous are not exceeded.
- Providing health monitoring to workers.
- Providing information, training, instruction and supervision to workers.
- Providing a spill containment system for hazardous substances if necessary.

- Obtaining the current SDS (Safety Data Sheet) from the manufacturer, importer or supplier of the hazardous substance or dangerous goods.
- Controlling ignition sources and accumulation of flammable and combustible substances on the construction site.
- Providing fire protection equipment, firefighting equipment and emergency and safety equipment.
- Providing a copy of your emergency plan to the local emergency services (Police and Fire Police) if you store large quantities of hazardous substances at your construction site.
- Ensuring the stability and support of containers for bulk hazardous substances, including pipework and attachments.
- Ensuring hazardous substance storage and handling systems are decommissioned correctly.

There are also duties relating to the building, operation and management of pipelines used for the transfer of hazardous substances and dangerous goods.

Designers, manufacturers, importers and suppliers of hazardous substances and dangerous goods must ensure, so far as is reasonably practicable, that the substance they design, manufacture, import or supply is without risks to health and safety. Under the WHS Regulations, manufacturers and importers must correctly classify hazardous substances. Importers, manufacturers and suppliers of hazardous substances and dangerous goods must also provide safety data sheets (SDS), disclosing the ingredients, packing, labelling and supply of hazardous substances and dangerous goods. For more information, check the relevant Cambodian Customs and Excise regulations.

Construction Site Owners and Principal Contractors have a duty to exercise due diligence to ensure that the construction site they own or manage complies with the WHS Act and Regulations of Cambodia. This includes taking reasonable steps to ensure that the construction site has and uses appropriate resources and processes to eliminate or minimise risks that arise from hazardous substances and dangerous goods at the construction site.

Workers have a duty to take reasonable care for their own health and safety and must not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to the use, handling and storage of hazardous substances and dangerous goods at the construction site.

Are you using hazardous substances or dangerous goods?

If you are using hazardous substances or dangerous goods on your construction site, a good approach is to audit the substances in your construction site so you can work out which ones are classed as hazardous, carcinogenic or even prohibited.

To understand the hazardous substance you're working with, use the SDS and the label. An SDS will give you information about:

- what's in the product.
- potential health hazards.
- first aid treatment.
- precautions for use.

- safe handling information.

Principal Contractors must:

- keep a register of all the hazardous substances and dangerous goods in the construction site.
- have the current SDS for them and make them available to workers.
- not change the information on an SDS.
- ensure that containers in which hazardous substances are supplied are labelled.
- identify containers of waste.

Labelling

Labelling ensures that containers of hazardous substances can be readily identified and provides basic information about the substance – its ingredients, hazards and precautions for safe use. Manufacturers and importing suppliers must ensure that all containers of hazardous substances are correctly labelled. The label must be firmly secured to the container and all information must be legible. If the container is so small that the label cannot be placed on the actual container, the label can be attached by other means, such as a string tag around the neck of the container.

Label element	Examples
Signal Words – these provide and immediate warning to the reader.	Danger or Warning
Hazard Statements – these describe the nature and severity of the chemical based on a chemical's classification	May cause cancer Fatal if inhaled Flammable liquid and vapour Causes severe burns and skin damage May cause respiratory irritation
Pictograms – these provide a pictorial representation of the type of hazard that can be easily recognised at a glance	 Flammable  Poison  Warning  Health Hazard  Corrosive

Table 1: Examples of what must be on hazardous substance containers

<u>Hazardous substances produced or generated in the construction site</u>

Hazardous substances may be generated from the processing of non-hazardous substances in a construction site. These by- products can be in the form of dusts, fumes, mists, liquids, vapours or gases.

Hazardous substances that arise from the processing of non-hazardous substances are:

- welding fumes.
- grain dust.
- wood dust.
- silica dust (including from grinding or cutting silica-containing materials, such as granite); and
- lead dust (including from the hand sanding of lead paint).

Welding fumes, grain dust, wood dust, silica dust and lead dust.

The most common hazardous substances

Dust

One of the most common substances on construction sites is dust. Although dust may not seem like a hazardous substance, when inhaled repeatedly, it can cause various lung problems and diseases. Dust on construction sites usually falls into one of three groups: wood dust, silica dust, and lower toxicity dust. Wood dust comes from handling wood through sanding and cutting and can damage lungs. Lower toxicity dust comes from working with drywall, marble, and other substances and can also damage lungs and airways. Silica dust is the most dangerous and causes the fastest damage. Silica dust comes from working with materials such as sandstone and concrete. The dust is often very fine, causing it to lodge deeply in the lungs. The results of silica dust inhalation can range from asthma to silicosis to lung cancer.

The best defence against dust is to control it as you work. Try to vacuum the dust as you work and keep the materials wet. Never work in enclosed or small spaces, as it allows the space to fill up with dust much quicker.

Using safety rated personal protection equipment like face masks and breathing respirators is very important in reducing the amount of dust a worker inhales.

Mould

Mould is commonly found on construction sites and can cause permanent damage when repeatedly exposed. Mould comes from working in damp conditions and can become a problem when moisture becomes trapped in buildings. Mouldy conditions can lead to asthma, allergies, and various other respiratory problems. When exposed over a long period, these conditions can become permanent and potentially life threatening. People who already have respiratory conditions, allergies and asthma have an increased risk when working in these types of conditions.

Personal protective equipment is key! Consider using respirators, gloves, and goggles to prevent mould contact with lungs, skin, and eyes.

Mould can be extremely harmful to a worker's health

Solvents

Another common substance found on construction sites is solvents. Solvents are commonly found in paints, adhesives, and cleaning fluids. These substances are not only dangerous to the lungs but the skin as well. Solvents affect nerves and brain function when they come into contact with skin and when they are inhaled. They can lead to irregular heartbeats, cancer, blindness, kidney/liver damage, and even death, making them one of the most hazardous substances on the job site.

Sediment/dirt, concrete and grout, paint, lacquers and primers, cleaning solvents, soaps and detergents, wood preservatives, fuels, lubricants, coolants and fluids, pesticides

Most common solvent exposure symptoms include:

Stomach pain, headache, dizziness, nausea, loss of coordination, cracked/bleeding skin, eye, nose and throat irritation.

When you are working with solvents take extra caution! Keep solvents away from the skin and make sure to wash thoroughly after working with them. Work in spaces with fresh air and not in confined indoor spaces.

Only work with solvents in fresh air environments where possible

Man-made mineral fibres

Man-made mineral fibres are commonly found on the construction site and are usually made from glass, rockwool, ceramic and other substances. These substances are highly irritating when they come into contact with lungs, eyes, and skin and can cause permanent damage.

Be smart! Use protective equipment when working with these substances to protect against the tiny fibres.

When working with insulation, always wear the correct PPE

Decanted substances

Decanted Substances are created when a liquid is poured away (separated) from a solid, and/or transferred to another container. Principal Contractors must ensure that containers that contain decanted hazardous substances are clearly labelled with the product identifier of the substance. If it is not reasonably practicable to label the container with the product identifier, a Principal Contractor must use another means of identifying the substance.

If a decanted substance is used immediately, and the container is cleaned to the extent that it is not a risk to health, or its contents are neutralised, cured or chemically deactivated to the extent that it is not a risk to health, the container does not need to be labelled

Written, stick-on or painted labels are acceptable for labelling containers, as long as they are legible and durable. Alternatively, spare copies of container labels may be available from the manufacturer or supplier of the hazardous substance if the product has been supplied within the last five years.

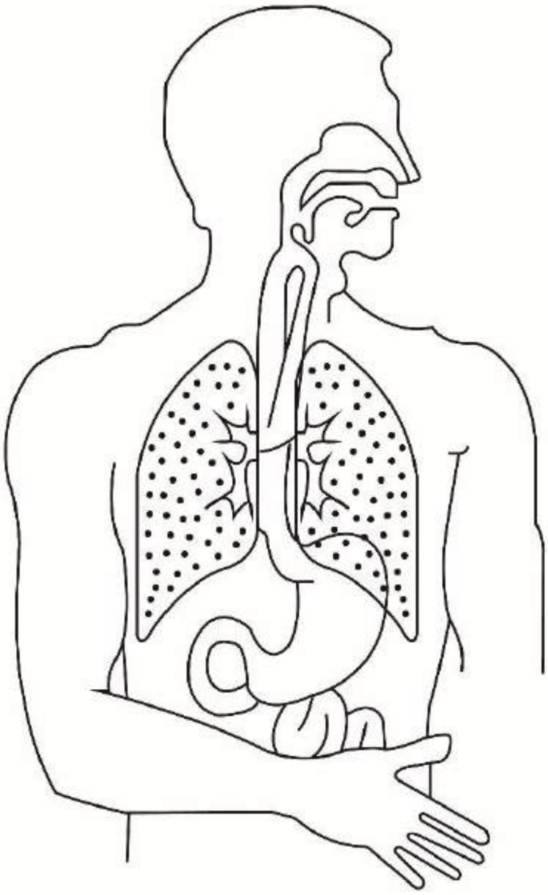
If it is not practicable to label the container into which the substance is decanted with the product identifier, for example, because the container is too small, other means can be used to identify the contents of the container, for example, by a laboratory sample number. Training needs to be provided to ensure that workers including independent contractors understand the meaning of any identification method used.

Containers of waste

Principal Contractors must ensure that any containers of waste produced or generated from hazardous substances are identified. The identification needs to reflect the nature of the waste as closely as possible for example the label may identify the substance as 'chlorinated solvent waste', 'acid waste', or 'caustic waste'.

However, there is no requirement to produce an SDS or label for substances generated as by-products or wastes in the construction site, unless these are supplied for use in another construction site.

Ensure all hazardous waste is labelled correctly



Routes of exposure by which a hazardous substance can affect health

Principal Contractors need to consider how exposure to a hazardous substance might occur. This is necessary to understand the level of risk from likely or potential exposure scenarios in the construction site. For example, exposure may occur by:

- inhalation (i.e., breathing in the substance).
- ingestion (i.e., swallowing, either directly or indirectly as a result of the substance settling on food, or from eating or smoking with contaminated hands).
- absorption through the skin or eyes, either from direct contact or from contaminated surfaces or clothing.
- injection into the body by high pressure equipment or contaminated sharp objects.

Form and concentration of the hazardous substance

It is important to consider the form in which the hazardous substance may be present, such as solid, liquid or gas. Some substances may be harmless in some forms such as a block of metal, but very hazardous in another, such as a fine dust or fume that can be readily inhaled.

The concentration of hazardous substances is also an important factor in the overall risk. Generally, the more concentrated or pure a substance is the more hazardous it will be.

Determining who could be exposed, and when this could occur

Workers can come in contact with a hazardous substance and any waste, intermediate or product generated from the use of the substance if they:

- work with it directly.
- are in the vicinity of where it is used or likely to be generated.
- enter an enclosed space where it might be present.
- disturb deposits of the substance on surfaces (for example, during cleaning) and make them airborne.
- come into contact with contaminated surfaces.

You should consider all people at the construction site, including those who may not be directly involved in using, handling, storing or generating a hazardous chemical, such as:

- ancillary or support/services workers (be aware that cleaners, maintenance and laboratory staff are often exposed to both the hazardous chemicals they use in the course of their work, such as cleaning products, and the hazardous chemicals used in the construction site by other workers).
- contractors.
- visitors.
- supervisors and managers.

You should consider:

- how specific tasks or processes are actually carried out in the construction site (for example, decanting, spraying, heating). By observing and consulting workers you can find out if they are not adhering strictly to standard procedures or if procedures are not adequately providing protection to workers.
- the quantity of the chemicals being used. Use of larger quantities could result in greater potential for exposure.
- the risk controls in place and their effectiveness. For example, a ventilation system may be in use but when poorly designed, installed or maintained it may not achieve the correct level of protection (such as if filters are not regularly cleaned).
- whether each worker’s work technique has a significant bearing on their level of exposure – poor techniques can lead to greater exposure.
- workers who may be working alone with hazardous substances and if any additional precautions or checks may be necessary in case they become incapacitated.

How often is exposure likely to occur and for how long?

- The total dose (amount) of a hazardous substance a worker is likely to receive increases with an increase in the duration or frequency of exposure. Estimations of the duration and frequency of exposure can be based on observation, knowledge and experience of the work.

- Which work activities involve routine and frequent exposure to hazardous substances (for example, daily exposure, including during end of shift cleaning) and who are the people performing these activities?
- What happens when non-routine work, production of one-off items or isolated batches, trials, maintenance or repair operations are performed?
- What happens when there are changes to work practices in events such as cleaning, breakdowns, changes in volume of production, adverse weather conditions?
- Are there differences between workers within a group? Anyone whose work habits or personal hygiene (for example, washing before eating, drinking or smoking) are significantly different should be considered separately.

Control the risks on your construction site

Although hazardous substances cannot be completely avoided, understanding the most common hazards and how to control and handle them is the first step in protecting people.

Construction Site Owners must manage risks associated with using, handling, generating or storing of hazardous substances and dangerous goods at a construction site.

Work through the following list to control the risk of hazardous substances and dangerous goods on your construction site.

- Identify reasonably foreseeable hazards that could give rise to the risk.
- Eliminate and/or remove the hazardous substance or dangerous goods completely.
- If you can't eliminate or remove the risk associated with a hazardous substance or dangerous good, your next steps are to use a safer substance, isolation or using engineering controls. For example, use a detergent instead of a chlorinated solvent for cleaning, or install exhaust extraction to remove contaminants.
- If any risk remains, you can use administrative controls to reduce the risk in relation to the way the work is done. For example, reduce how many workers are exposed to the substance by doing the task out of hours.
- If any risk remains after these have been done, you can use personal protective equipment to reduce the risk. For example, give workers respirators.

When managing the risks, principal contractors must consider:

- The hazardous properties of the substance.
- Any potentially hazardous reaction (chemical or physical) between the hazardous substance and another substance or mixture, including a substance that may be generated by the reaction.
- The nature of the work to be carried out with the hazardous substance or dangerous good.
- Any structure, machinery or system of work that is needed in the use, handling, generation or storage of the hazardous substance or dangerous good.

Eliminating the risk

The primary duty is to eliminate any risk associated with hazardous substances in the construction site. This may be done by removing the hazardous substance or hazardous work practice that gives rise to the risk.

Examples of elimination include use of:

- a physical process rather than a chemical process to clean an object, such as the use of ultra-sound, high pressure water or steam cleaning rather than solvent washing.
- water-based rather than solvent-based paints or powder coating.
- clips, clamps, bolts or rivets instead of an adhesive.
- hot melt or water-based adhesives instead of solvent-based adhesives.

A high-pressure washer is just as effective as a solvent

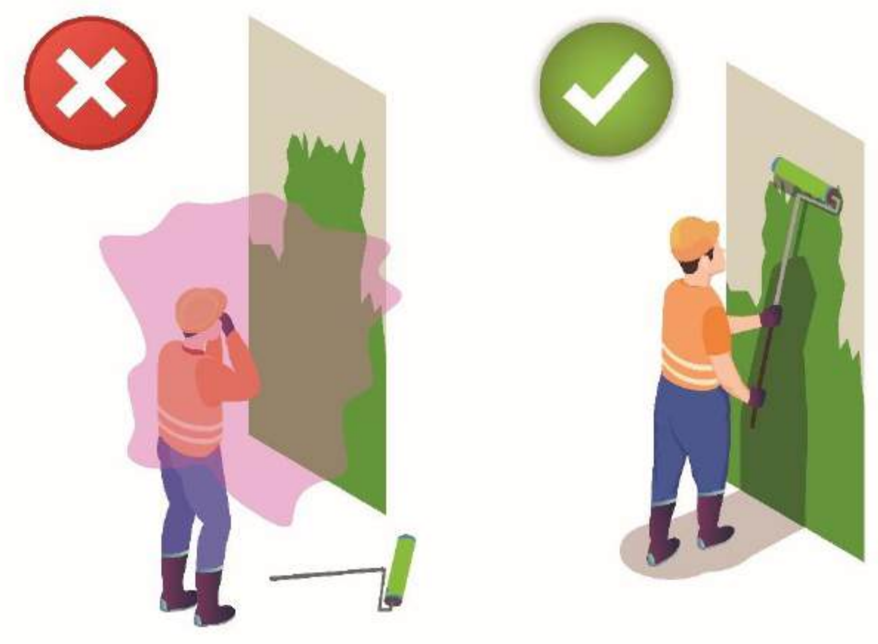
Use clamps instead of adhesives

Substituting the risk

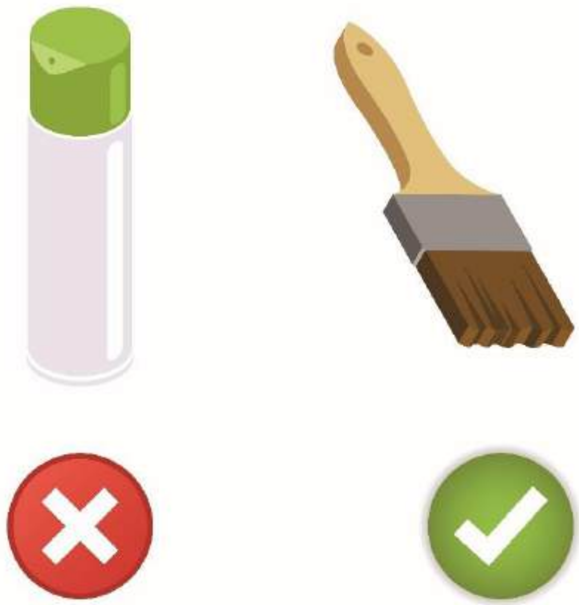
Substitution involves replacing a hazardous substance with a less hazardous substance, or a substance in a less hazardous form, for example:

- using a brush for painting rather than spray painting, which creates a mist.
- using a detergent instead of a chlorinated or volatile solvent for degreasing purposes.
- minimising vapour generation by using solvents with higher boiling points and lower vapour pressure.
- purchasing hazardous substances in a less hazardous form (e.g., pellet, paste or slurry form instead of a powder, or using a more dilute form of the substance).

Use pellets instead of powders



Use water-based paints instead of oil based



Isolation

Isolation involves separating the hazardous substances from persons or property by either distance or a physical barrier. Examples of isolation include:

- closed systems such as those used during the processing and transfer of flammable liquids in petroleum refineries, or the use of glove boxes or glove bags.
- placing a process, or part of it, within an enclosure which may also be fitted with exhaust extraction to remove contaminants.
- isolating operations in one room with access restricted to properly protected personnel.
- placing operators in a positive pressure cabin that prevents airborne contaminants entering.
- distancing workers from hazardous substances and any substances generated by their use.

Exhaust fans are recommended to remove hazardous contaminants

Sometimes isolation rooms are the best method to keep workers safe

Engineering controls

Engineering controls are physical controls (e.g., plant) that reduce the generation of substances, suppress or contain substances, or limit the area of contamination in the event of spills and leaks. For example, an abrasive blasting cabinet.

A blasting cabinet contains contaminants to within the cabinet

For example, local exhaust ventilation is an engineering control that may be used in construction sites where hazardous substances are present in the form of airborne contaminants. Local exhaust ventilation removes airborne contaminants from the working environment before they reach the breathing zone of the operator.

Exhaust ventilation removes unwanted contaminants

Other examples of engineering controls include using:

- robots to minimise operator exposure, for example, spraying in coating operations.
- partially enclosed and ventilated spray booths or fume cupboards.
- fully enclosed ventilation booths.

Administrative controls

If it is not reasonably practicable to either eliminate or reduce risk as far as reasonably practicable with the higher order controls (substitution, isolation, engineering controls), a Principal Contractor must reduce it further using administrative controls, so far as is reasonably practicable, and then (if a risk still remains) through the use of PPE, so far as is reasonably practicable.

Administrative controls involve using systems of work and work procedures to reduce risk and must only be used where higher order control measures are not reasonably practicable, or to supplement other control measures when a risk still remains.

Examples of administrative controls include:

- reducing the number of people exposed to the substance (e.g., by performing the task out of normal work hours or by restricting access to certain areas).

- reducing the duration and/or frequency of exposure through specific work procedures (e.g., job rotation).
- reducing the period of time in which a substance could escape into the work area (e.g., by minimising the time that mixers, reactors or ovens are open to the environment both during and after use).
- good housekeeping, including regular cleaning of work areas.
- changing packaging material to reduce exposure during handling (e.g., purchasing liquids in ready-to-use packages instead of decanting from large containers).
- providing appropriate means for the safe interim storage of wastes containing hazardous substances.
- using vacuuming or wet sweeping methods to suppress dust that may be generated during dry sweeping.
- keeping containers of hazardous substances or rags soaked with these substances tightly lidded when not in use.
- cleaning up spills immediately.
- prompt cleaning of residues from empty containers that have held hazardous substances.
- prohibiting eating, drinking and smoking in potentially contaminated areas.
- providing suitable washing facilities.

Personal protective equipment (PPE)

In most circumstances, PPE should not be relied on to control the risk of hazardous substances. It must be used if all other reasonably practicable control measures have been put in place and a risk still remains, or as an interim protection until higher level controls are implemented.

All PPE provided needs to be suitable for use with the hazardous substances and maintained in a clean and serviceable condition. For more information on the correct PPE to be used, refer to Chapter 4 Use of PPE.

Implementing risk controls

Once Principal Contractors identify and investigate risk control options, they need to decide on and implement the most suitable control.

Some risk controls can be implemented straightaway (e.g., providing gloves to cleaners using a hazardous disinfectant), while other risk controls (e.g., investigating and implementing the use of a less hazardous product) may take longer to put in place. In the meantime, temporary or interim controls need to be used.

In many cases, it will be necessary to put multiple risk controls in place to ensure that risk is reduced so far as reasonably practicable. For example, the following risk controls may be put in place to control risks to workers working in a vehicle spray painting workshop where spray painting is used:

- Installation of a spray booth with downdraft ventilation (engineering control) to perform colour matching and spray-painting tasks.

- Installation of automated gun cleaning equipment (isolation and engineering control) to clean spray-painting guns.
- Ensuring paints and solvents are always stored in lidded containers when not in use (administrative control).
- Ensuring workers and contractors use PPE including a supplied air respirator, overalls and gloves to further reduce risks while working in the spray booth.

Maintaining risk controls

Principal Contractors must ensure that control measures are properly installed (if applicable), used and maintained. The purpose of maintaining control measures is to ensure that they perform as originally intended and continue to prevent or adequately control exposure of workers to hazardous substances.

Maintenance of control measures need to include, for example:

- frequent inspections.
- visual checks to ensure risk controls that rely on human behaviour are being properly applied by workers.
- testing of equipment.
- preventative maintenance of engineering controls and PPE.
- any necessary remedial work to ensure physical controls continue to operate effectively.

Principal Contractors should have a maintenance procedure in place to ensure that any defects in control measures are detected as early as possible.

Review and revision of risk controls

Construction Site Owners must review risk controls to make sure they are working as planned, and revise them if necessary in the following circumstances:

- Before any alteration is made to a system of work that is likely to result in changes to risk associated with the use of hazardous substances (e.g., where the concentration of a particular hazardous substance used in the construction site is increased).
- If advice is received from a registered medical practitioner that adverse health effects have been identified by health monitoring.
- Following a notifiable incident involving hazardous substances e.g., an incident that results in a person requiring medical treatment within 48 hours of exposure to a substance, or injury requiring immediate inpatient treatment in a hospital.

How to assess physicochemical risks

The assessment of physicochemical risks in the construction site is different in many respects from that needed when assessing health risks. Whereas health risks arise from interaction of people with the chemical, physicochemical risks arise mainly from hazardous substances where they come into contact with other things such as ignition sources.

Fire and explosion

Fire and explosion can result in catastrophic consequences, causing serious injuries or death of workers, as well as significant damage to property. They occur when the following three primary elements come together (commonly referred to as the fire triangle - see figure below):

- a source of fuel (a flammable or combustible substance).
- a source of oxygen (usually in the air).
- an ignition source (a source of energy sufficient to cause ignition, e.g., heat).

The Fire Triangle

When identifying hazards, you should have identified all of the sources of fuel in your construction site that could contribute to fire and explosion risks. Fuels that present the highest risk are those hazardous substances that are flammable (for example, flammable solids, liquids or gases, including their vapours and fumes), other fire risk substances in other hazard classes (for example, pyrophoric liquids and solids that ignite spontaneously in contact with air, substances that react with water to emit flammable gasses) and other materials that are not hazardous chemicals, like wood, paper and leaves, and other combustible materials that contribute to the fire load.

Please see Chapter 17 - Fire Safety, for more information on Fire specifics.

You should also identify sources of oxygen, such as oxygen gas and compressed air in cylinders, chemical oxidisers and peroxides. Oxygen is always present in the air.

Note: Chemical reactions and other processes which generate gases can also cause explosions through an increase in the pressure in the container in which the chemical is stored if the gas cannot escape, even if that gas does not itself ignite.

Identifying ignition sources

Ignition sources can be any energy source that has the potential to ignite a fuel. They can be categorised into three broad types: flames, sparks and heat. Some common examples of ignition sources are provided below.

Flames:

- Welding Flames, gas heater, pilot lights

Sparks:

- Welding arcs, starters for fluorescent lighting, electric motors, electrical equipment like power points, cigarette lighters, switches and telephones
- Static electricity including from friction sources
- Lightning
- Friction from drilling, grinding, scraping of metal on concrete

Heat:

- Hot surfaces, including light bulbs, ovens, radiators or heaters, flue pipes, vehicle engines and exhaust systems, pumps, and generators
- Exothermic chemical reactions (those which generate heat)

Some electrical equipment may also be a source of ignition. However, not all electrical equipment is an ignition source if it is specifically designed so that it does not create sparks.

This type of equipment is referred to as "intrinsically safe"

You must identify any ignition source in your construction site that has the potential to ignite a flammable or combustible material. You should also consider sources of ignition that are adjacent to your construction site or may periodically come into your construction site, for example vehicles (with hot engine and exhaust systems) making deliveries, visitors or other portable items like cordless power tools, radios and fans.

Other factors affecting fire and explosion risks

The following physical and chemical characteristics of materials can influence the level of risk of a fire or explosion occurring.

Form and physical state

The form or physical state of chemicals, substances or other materials can have a significant influence on the level of risk of a fire or explosion. The physical state of a material is generally considered as either solid, liquid or gas, however materials can be further categorised as aerosolised droplets, vapours, fumes, mists, powders, dusts or fibres.

Bulk materials in solid, liquid and gas forms behave differently and present different risks. Liquids spread readily compared to solids and have a greater risk of coming into contact with an ignition source if spilled. Gases present a greater risk as concentrations in air are generally higher than for liquids (and their vapours) and can spread more rapidly.

Depending on the vapour density, some gases can flow across surfaces in a similar way to liquids, rather than dissipating quickly. For example, vapours which have a density greater than air can move along the floor and spread to adjacent work areas where ignition sources may be present, thereby creating a significant risk in those areas.

Temperature and pressure

Changes in temperature and pressure can affect the properties of a chemical.

The explosive range of a chemical (for instance, its lower and upper explosive limits) can change with temperature. At higher temperatures, the lower explosive limit is usually lower, meaning that the substance is more likely to ignite at lower concentrations in air. Heating solid or liquid combustible substances can also increase the vapour pressure (for instance, the concentration of vapours emitted) of the substance making it more likely to ignite.

Handling chemicals under pressure increases the risk in several ways. Any loss of containment will occur more rapidly than under normal atmospheric pressure so that more hazardous chemicals are released. Increasing pressure generally increases temperature of the material, and some chemicals also become unstable at higher temperatures and pressures causing an uncontrolled decomposition or reaction.

Confinement

The effects of an explosion can be exacerbated where the fuel and air mixture is contained, for example in a tank, duct or pipework, as well as in larger structures like silos, rooms or buildings. Explosions can be more violent than when unconfined and flying debris (such as from the container or building) can cause serious injuries or death.

Fire risks involving chemical oxidisers

Chemical oxidisers can react violently and unexpectedly with many chemicals such as organic material (for example, wood, paper, cellulose products), hydrocarbon solvents (for example, mineral turpentine, petrol, diesel) and other organic (carbon based) chemicals (for example, ethanol, mineral oils).

You should assess any situation where an oxidiser could come into contact with these types of materials. This includes any containers and other equipment used in handling or transferring the chemicals. Oxidisers should be handled in compatible containers and with compatible equipment to avoid a dangerous reaction occurring.

It is important to note that, since oxidisers provide oxygen through the chemical reaction, rather than air being the oxygen source, a risk of fire or explosion can still exist even if these materials are handled under an inert atmosphere like nitrogen.

Fire risks from other chemical reactions

Fires and explosions can occur as a result of chemical reactions. Many chemical reactions are exothermic - that is they give off heat during the reaction. This heat can act as an ignition source igniting any fuels present, pressure can build up in enclosed systems (for example, containers, flasks, pressure vessels) causing the container to rupture or even explode.

You should assess any situation where incompatible chemicals could interact and cause a dangerous or uncontrolled violent reaction.

Dust explosion risks

Dust explosions present a significant risk in some construction sites; however, they are often overlooked. Dust explosions usually occur where combustible dusts (or fibres, for example from paper, grain, finely divided organic compounds and metals) have accumulated and are then disturbed and released into the air, coming into contact with an ignition source. Common ways in which dusts can be disturbed include from wind when opening doors or windows, during cleaning or sweeping up of waste or using compressed air to blow out material accumulated in crevices, gaps or in machinery.

Dusts may also be generated transferring materials, such as filling the hold of a ship or a silo with grain (liberating grain dust).

When the dust cloud comes into contact with an ignition source such as a flame, hot surface or spark, ignition can occur causing an explosion. Dust-air mixtures can be classified as hazardous atmospheres in the same way as other flammable materials like vapours from flammable liquids and gases.

Dust clouds can be generated by pressure from an explosion in another area, causing damage and propagation much greater than the original explosion.

Effect of particle size on dust explosion risk

The size of particles in dust can have a significant impact on the explosion risk. Smaller particles have a greater surface to mass ratio and present a greater risk, for example a block of metal such as a metal ingot may be practically inert but could be extremely reactive when in the form of filings or shavings, dust or powder.

Similarly, the risk from an aerosol (for instance, fine droplets in air) form of flammable liquid is much greater than for the bulk liquid. Processes that generate fine particles, like grinding and milling of flour and nanomaterials can present significant risks. Special control measures may be needed for handling such materials.

Off-site risks

Some activities, systems of work, structures and equipment that are not directly involved with the use, storage and handling of hazardous substances in the construction site may create a hazard that you need to be aware of when undertaking your risk assessment. These include:

- Hazardous substances on adjacent or nearby premises that could be ignited by activities at your construction site, and other substances and materials that are not hazardous substances but that could add to the overall fire load, such as wooden pallets, paper, combustible liquids or other combustible materials.
- Activities and installations on adjacent premises, such as the operation of machinery, equipment and vehicles, deliveries of hazardous substances, personnel movements in normal and emergency situations, visitor access and the trial of site emergency procedures.
- The proximity of sensitive facilities which may be put at risk by the presence of hazardous substances and during an emergency, such as schools, hospitals, child and aged care facilities, theatres, shopping centres and residences. These may require special consideration when planning for emergencies.

- The presence of incompatible materials, either other substances or the materials that machinery, equipment, storage and handling systems are made of which could react with the substances being stored or handled.

- Foreseeable failures of machinery, equipment, storage systems, as well as natural disasters or extreme weather events such as temperature extremes, wind, lightning or rainfall, including the potential for flooding.
- Other failures which could occur and events which may give rise to new hazards or greater risk. Any examination should be systematic and include consideration of the possibility of human error in the system's operation.

Risks from corrosive substances

Hazardous substances that are corrosive to metals can cause damage to plant and equipment, such as containers, pipes, fixtures and fittings. Corrosion can lead to leaks or complete failure and loss of containment of the substance, resulting in serious damage to property, exposure of workers to the hazardous substances and potential injury and death.

Rusted pipes are a potential health hazard

Compressed gases

Compressed and liquefied gases are used as fuel, a source of oxygen or as shielding gases in certain types of welding. The hazards associated with compressed and liquefied gases include fire, explosion, toxicity, asphyxiation, oxidation and uncontrolled release of pressure. Gas leakage is one of the greatest hazards.

Strict procedures should be followed when using compressed gases

Asphyxiation hazards

Asphyxia is a condition that occurs where there is lack of oxygen. This can occur either through:

- consumption of oxygen in the air (burning of fuel, or oxidation process such as microbial activity or rusting).
- an accumulation of gases displacing oxygen in air.
- inhalation of the substance affecting the ability of the body to use oxygen (for example, hydrogen cyanide can asphyxiate a person by binding to haemoglobin in the blood following inhalation).

All gases, including fuel gases (for example, hydrogen, acetylene and liquid petroleum gas) and inert gases (for example, argon, helium and nitrogen) are an asphyxiation hazard in high concentrations.

Too little oxygen in the air that we breathe can cause fatigue and in extreme cases death. Using compressed and liquefied gases can result in dangerously low levels of oxygen. For example, gases that are heavier than air can accumulate in low lying areas such as pits, wells and cellars and gases that are lighter than air can accumulate in high areas such as roof spaces and lofts. Working in an enclosed or confined space with inadequate ventilation, where hazardous vapours can accumulate, is a potential asphyxiation hazard.

You should identify possible causes of asphyxiation in your construction site. In welding and allied processes, asphyxiation can occur from gas slowly leaking in a work area.

Key considerations in minimising the risk of asphyxiation include:

- avoiding work being carried out in oxygen-depleted (under 19 per cent) atmospheres - for example this could be done by testing the construction site atmosphere using an approved and intrinsically safe gas monitor.

- keeping the work area well-ventilated, particularly in low-lying areas and roof spaces where gases can accumulate - this could be done by ensuring windows are open where necessary and ventilation and extraction systems are on and are fully functional.
- purging.
- using an air-supplied respirator, particularly in confined spaces.
- checking cylinders, cylinder fittings, hoses and connections to ensure that they are not damaged or in poor condition - this might include checking fittings and hoses for signs of corrosion or degradation or spraying them with a small amount of detergent solution or leak-detection spray and looking for bubble formations which may indicate the presence of a gas leak.

Compressed air

Compressed air can be hazardous and should be handled carefully by workers. For example, the sudden release of gas can cause hearing damage or even rupture an eardrum. Compressed air can also deeply penetrate the skin resulting in an air bubble in the blood stream known as an embolism. Even a small quantity of air or other gas in the blood can be fatal.

Ensuring workers are trained to handle compressed air properly can eliminate many of the associated risks. Training and work procedures should emphasise the safe use of air tools and safeguard against the deliberate misuse of compressed air. Also, maintaining air receivers properly prevents the potential for an explosive rupture.

<u>Containing spills of hazardous substances</u>

Principal Contractors must ensure, so far as is reasonably practicable that where there is a risk of a spill or leak of a hazardous substance in a solid or liquid form, provision is made in each part of the construction site where a hazardous substance is used, handled, stored or generated for a spill containment system that contains within the construction site any spill or leak of a hazardous substance and any resulting effluent.

When a spill, leak or accidental release of hazardous substances occurs, appropriate actions must be taken to contain the hazardous substances within the construction site.

The spill containment system must describe how to contain, clean up and dispose of the spill or leak and any resulting effluent. The system must not create a hazard by bringing together different hazardous substances that are not compatible or that would react together to cause a fire, explosion, harmful reaction or evolution of flammable, toxic or corrosive vapour.

Leaving containers open when not in use is one of the main causes of spills and can also lead to generating hazardous atmospheres and fire risks. Procedures, training and supervision should ensure containers are sealed when not in use.

Any spill containment system should be large enough to ensure that all spills can be held safely until cleaned up. Factors you should consider when designing a spill containment system include:

- the nature of the hazardous substances (whether liquid or solid).
- the quantity of the hazardous substances.
- the size of the largest container or reasonably foreseeable largest spill.

- the potential impact if the hazardous substances escape to the environment.
- whether it is necessary to provide for the management of firewater at an incident.
- a separate spill containment is provided for incompatible goods.
- the materials used to construct the containment system, as well as any materials used for absorption, are compatible with the hazardous substances.
- other materials in the vicinity that will prevent contamination of groundwater or soil.
- the system's integrity will be maintained in any reasonably foreseeable incident.

Transfer of hazardous substances

Transferring hazardous substances generally presents a far greater risk than for static storage. During the transfer process, substances will frequently be unconfined at some stage of the transfer process that may include pouring or pumping from one container to another.

Common methods for eliminating or reducing risks during transfer operations include:

- avoiding spillage or overflow, including overflow protection on equipment and receiving vessels.
- providing emergency shut offs to limit the number of hazardous substances released during a loss of containment.
- providing a spill containment system.
- reducing static electricity and vapour generation. This is particularly important for fire risk hazardous substances such as flammable liquids.
- ensuring transfer fittings are compatible.
- avoiding sources of ignition.
- installing flow and pressure regulators on pipe work or pumps.
- installing interlocking of valves and switches.
- implementing systems for detecting losses from pipe work and fittings, such as static pressure loss detectors, measurement to determine losses in transfer or external sensors.
- plumbed eye wash stations and safety showers should be installed in areas where workers may be exposed in the event of a spill during transfer operations.

Controlling risks from compressed gases

Key considerations for safe storage and handling of gas cylinders include:

- maintaining and regularly checking cylinders, regulators, hoses and pipes to cylinders to ensure that there are no leaks or dents.
- storing cylinders in an upright position to ensure the safety device functions correctly.
- securing cylinders to prevent dislodgement.
- transport cylinders with appropriate equipment such as trolleys or gas cages.
- keep the cylinder valve closed when the cylinder is not being used.

- keep all sources of heat and ignition away from gas cylinders, even if the cylinders do not contain flammable material.
- store cylinders outdoors or in very well-ventilated areas.

Ensure all compressed gas cylinders are appropriately stored

Gas cylinders should be fitted with a bursting disc safety device and liquid petroleum gas cylinders should have an operational spring-loaded pressure relief valve.

If a small leak occurs, the cylinder valve should be closed if it is safe to do so. Appropriate personal protective equipment should be put on before attempting to locate the leak point. For toxic gases, self-contained breathing apparatus may be required for emergency use.

The area should be well ventilated and air conditioning systems should be turned off to avoid spreading gas. However, if a large amount of gas escapes, the area should be evacuated.

If it is safe to do so, before evacuating, ventilate the area and remove or isolate ignition sources.

12 Step Plan for handling hazardous substances and dangerous goods on your construction site

Step 1 – Decide who is responsible for key tasks relating to hazardous substances and dangerous goods and plan action.

- Appoint a person or team to oversee or coordinate the use and/or storage of hazardous substances and dangerous goods.
- Set up a plan that outlines what needs to be done, by whom and when.
- Where necessary, provide training to persons who are given roles and responsibilities
- Engage consultants and 3rd party companies who are qualified where necessary.

Allocate responsibilities relating to hazardous substances to competent people at our construction site

Step 2 - Identify all substances and dangerous good used on your construction site.

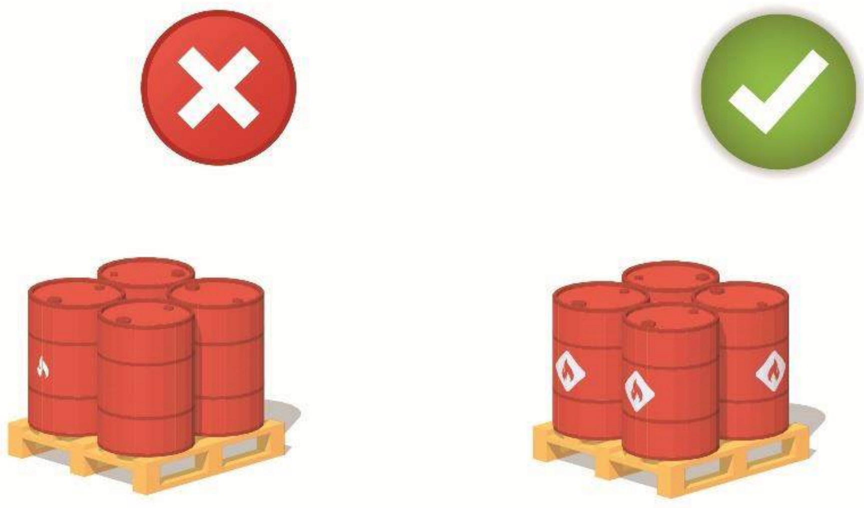
Ensure you identify all hazardous substances at your construction site

Step 3 – Obtain and review safety data sheets (SDS) for all substances and dangerous goods.

You must keep SDS sheets for all hazardous substances on your construction site

Step 4 – Check and ensure containers of substances and dangerous goods are adequately labelled or identified.

- Ensure that containers of substances/goods supplied to the construction site are labelled.
- Ensure that containers of decanted substances are labelled with at least the product name.
- Ensure contents of any unlabelled containers found are labelled appropriately or discarded.
- Ensure that hazardous substances/dangerous goods in systems (such as pipes, vessels or other equipment that forms part of a manufacturing process) are identified.

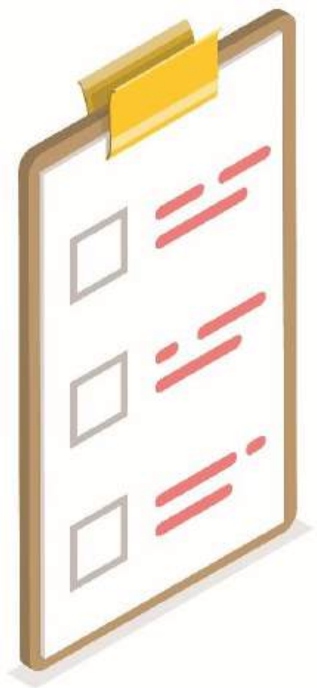


Hazardous substances must be clearly marked

Ensure that you conduct regular inspections of pipes and containers that hold hazardous substances

Step 5 – Set up a hazardous substance/dangerous goods register.

- Check the SDS and label to determine if a substance is classified as dangerous goods or a hazardous substance.
- List the product names of all substances identified as hazardous and/or dangerous goods and keep the relevant SDS's with the list.
- Keep the register up to date.



Create a register of hazardous substances for your construction site

Step 6 – Check and ensure SDS's are available and accessible to workers (and other relevant people).

- Keep SDS's near areas where substances are used.
- Tell workers where SDS's are kept and, where necessary, how to access them.

Ensure the SDS is readily available to all workers on site

Step 7 – Assess the risk associated with substances and dangerous goods (used and stored).

- Decide who will conduct the risk assessments.
- Plan and prioritise the risk assessments.
- Carry out the risk assessments.
- Record the result of the risk assessment.
- Regularly Review and revise the risk assessment as necessary and at least every five years.

Step 8 – Undertake atmospheric monitoring and/or health monitoring if required.

- Determine if atmospheric monitoring is required.
- Conduct atmospheric monitoring if required.
- Decide if health monitoring is required for substances used.
- Establish a health monitoring program where required.

Create a monitoring system to protect the health of your workers

Step 9 – Eliminate or minimise any risks to people and property.

- Determine appropriate safety measures.
- Plan what, how and when safety measures will be implemented and by whom.
- Ensure safety measures are used and maintained.

Step 10 – Provide information, instruction and training.

- Identify who needs to be provided with information, instruction and training.
- Decide what information, instruction and training is to be provided, when, and how it is to be done.
- Decide who will prepare and provide information, instruction and training.
- Provide information, instruction and training and keep relevant records.
- Review and information, instruction and training provided to see how effective and useful it is.

Regular training for your staff about the risk of hazardous substances is crucial

Step 11 – Identify and undertake specific duties if scheduled carcinogens and threshold quantities of dangerous goods are stored or used.

- Determine whether scheduled carcinogenic substances are used.
- Determine if threshold quantities of dangerous goods are located on site.
- Submit a notification or licence application to applicable authorities if required.
- Ensure compliance with the terms and conditions of any licence or notification.

Step 12 – Document and check the way you do things.

- Record how chemicals are managed in your construction site.
- Conduct regular inspections or checks to ensure that policies, procedures, work instructions etc are followed and remain effective.
- Record the results of the inspections/checks and provide feedback to relevant people.

10 most hazardous chemicals found on a construction site

Below is a list of 10 of the most hazardous chemicals that can be found on a construction site and their associated health risks.

1. Arsenic

- Physical state - Solid.

- Where it’s found in the construction site - Agriculture, wood preservatives, glass production, electronics.
- Health risks: Cancer, respiratory and circulatory problems, damage to the nervous system.

2. Lead

- Physical state - Solid.
- Where it’s found in the construction site - Often found near mining sites as well as in-car batteries, roofing materials, statues, electronics, ammunition, sailboats, and scuba diving gear.
- Health risks - Anaemia, brain damage, kidney disease, birth defects.

3. Benzene

- Physical state - Liquid.
- Where it’s found in the construction site - Crude oil and gas. Benzene is also used to make plastics, detergents, pesticides, and other chemicals. Benzene is produced naturally by volcanoes and forest fires.
- Health risks - Bone marrow damage, anaemia, excessive bleeding, weakened immune system.

4. Chromium

- Physical state - Solid.
- Where it’s found in the construction site - Chromium is often mixed with other metals to make alloys and stainless steel. Chromium is also used as a coating to prevent rust on metallic surfaces.
- Health risks - Asthma, respiratory irritation, cancer, damage to the eyes, eardrums, kidneys, and liver.

5. Toluene

- Physical state - Liquid.
- Where it’s found in the construction site - Paint thinners, nail polish removers, glues, correction fluids (White-Out), explosives, printing, leather tanning, inks, stain removers.
- Health risks - Dizziness and confusion, anxiety, muscle fatigue, insomnia, numbness, dermatitis, liver and kidney damage.

6. Cadmium

- Physical state - Solid.
- Where it’s found in the construction site - Rechargeable batteries, coatings, solar cells, pigments, plastic stabilizers, plating.
- Health risks - Flu-like symptoms, lung and respiratory damage, kidney disease, bone disease, cancer, damage to the neurological, reproductive, and gastrointestinal systems.

7. Zinc

- Physical state - Solid.
- Where it's found in the construction site - Pipe organs, auto parts, sensing devices, sunblock, ointments, concrete, paint. Also used to form alloys with other types of metals.
- Health risks - Nausea, vomiting, cramps, diarrhea, headaches, kidney, and stomach problems.

8. Mercury

- Physical state - Liquid.
- Where it's found in the construction site - Measuring instruments such as thermometers and barometers, fluorescent lamps, mercury vapor lamps, dental fillings, telescopes, cosmetics, vaccines.
- Health risks - Damage to the nervous system, digestive system, immune system, lungs, thyroid, kidneys, memory loss, insomnia, tremors, neuromuscular changes, and paralysis.

9. Pesticides

- Physical state - Liquid, solid, gas.
- Where it's found in the construction site: While not a chemical in itself, many construction sites such as agriculture and pesticide production plants contain a presence of pesticides that are used for pest control.
- Health risks: Blindness, rashes, blisters, nausea, diarrhea, respiratory problems, cancer, asthma, seizures, Parkinson's disease.

10. E-Waste

- Physical state - Liquid, solid, gas.
- Where it's found in the construction site - Like pesticides, electronic waste is not a chemical in itself but rather a collection of harmful chemicals found in and around disposed appliances such as televisions, refrigerators, microwaves, computers, and other household appliances.
- Health risks - Inflammation, oxidative stress, cardiovascular disease, DNA damage, kidney damage, damage to the nervous system, cancer.

GLOSSARY

Abrade - to scrape or wear away by friction or erosion.

Administrative control - controls that alter the way the work is done, including timing of work, policies and other rules, and work practices such as standards and operating procedures (including training, housekeeping, and equipment maintenance, and personal hygiene practices).

Alcohol - is a colourless volatile flammable liquid which is produced by the natural fermentation of sugars and is the intoxicating constituent of wine, beer, spirits, and other drinks, and is also used as an industrial solvent and as fuel.

Arc Eye or **welders flash** - is a painful eye condition caused by damage to the cornea from ultraviolet radiation during arc welding.

Atmosphere - is the air in a particular place or area.

Auxiliary Hoist - is a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

Boom-type elevating work platform - refers to a telescoping device, hinged device, articulated device or any combination of these, used to support a platform on which personnel, equipment and materials may be elevated.

Breathalysers - are devices used to measure the amount of alcohol in a person's breath.

Building work - refers to land work, building work of a new construction, repair work, modification work, and installation**.**

Cable Locator - is an instrument used for detecting the presence and approximate location of buried services in advance of undertaking excavation works. It aims to avoid accidents while excavating.

Cantilevered suspension rig - is a rigid structural element that extends horizontally and is supported at only one end. Typically, it extends from a flat vertical surface.

Carcinogen - is a substance capable of causing cancer in living tissue.

Certification work - refers to examination, analysis and certification of a design document, calculation, technical instructions for building or demolition work and operation of building or demolition work, compliance with building technical regulations and other existing regulations to ensure safety, well-being in building or demolition work and in the use of the construction.

Commission - refers to bringing (usually something newly produced) into working condition.

Competent authority - refers to Government Ministries, departments and its officers who have been given responsibility to monitor and enforce regulations and laws relating to the construction industry.

Competent Person - refers to a person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to workers, and who has authorization to take prompt corrective measures to eliminate them.

Control Strategies - refers to the way to manage the execution of your strategic plan.

Control measure - a thing, work process or system of work that controls the WHS hazard or risk.

Construction - refers to the process of construction work or to a building, a structure or permanent or temporary architecture constructed with construction materials, equipment or products.

Construction contract - refers to a contract between a construction owner and a builder and a contract between a builder and a sub-contractor to carry out building or demolition work.

Construction controller - refers to a technical official who is appointed by the competent authority in order to check building or demolition works and controls construction quality and safety.

Construction equipment - refers to equipment that is assembled, made, or produced to be used in or fixed to a construction in order to increase quality, comfort and ease of construction use, namely lamp, electric wire, optic wire, sink, faucet, bathtub, air- conditioner, elevator, pipe.

Construction material - refers to a raw material to be mixed, combined, assembled, or used as a construction structure, equipment or products, such as sand, crushed stone (aggregate), gravel, cement, steel, glass, clay, ceramic, wood.

Construction owner - refers to an owner or a real estate developer of a construction that is built on his/her own land or on someone else's land with the landowner's permission or a perpetual lessee who builds a construction on the lessor's land.

Construction product - refers to finished or semi-finished product that is made or produced with construction materials and used to build a construction structure, such as roof tile, brick, mortar, concrete, pillar, wall, decorated ridge-piece on rooftop, concrete floor, concrete pipe, ceiling plaster, corrugated iron/steel, fibreboard, wallpaper, paint, or tile adhesive.

Construction project management - refers to the work that a construction project manager carries out on behalf of a construction site owner in order to ensure that a building or demolition project operates efficiently in terms of time, cost, quality and safety.

Construction work - refers to design work, surveying work, building work, demolition work, site management work, certification work, testing work, construction project management or construction safety and quality control.

Contaminant - is a polluting or poisonous substance that makes something impure.

COVID Safe Plan - refers to an implemented Covid-19 plan consisting of construction site and Cambodian laws and regulations, procedures and policies to prevent and combat Covid-19 on the worksite.

Dangerous building - refers to a construction or any part of a construction or construction materials, equipment attached to the construction which may cause danger to a neighbouring construction(s), lives, bodies, and health of construction users, neighbours and the public.

Dead load (scaffolding) - refers to the weight of the scaffold itself

Decommissioning - is when equipment or machinery is removed and/or taken out of working service

Demolition work - refers to the work of dismantling or removing any part of a construction, or removing a whole construction, or the work of destroying the construction.

Design document - refers to a technical document for the purpose of construction works such as architectural design, structural design, mechanical system plan, electrical system design, wastewater-clean water system design, fire safety system design, or other technical designs/plans, documents, and instructions for building or demolishing and using a construction.

Design work - refers to plan/design drawing work, research work and data analysis for architectural and engineering work, planning work, preparation of lists of estimated costs, preparation of technical instructions, and detailed plan/design drawing work.

Dismantling - means to take a machine apart or to come apart into separate pieces.

Drugs - are a medicine or other substance which has a physiological effect when ingested or otherwise introduced into the body.

Electricity Supply Authority - refers to a person or body engaged in the distribution of electricity to the public or the transmission or supply, directly or indirectly, to the public. An electricity supply authority may also be known as a network operator, a network service provider or an electricity entity.

Worker - a person employed under a contract of employment or contract of training.

Fire Warden - a person(s) designated by the person with responsibility for workplace activities, or workplace manager, to assist them in implementing the necessary fire safety arrangements as identified by the manager to prevent a fire from endangering the health and safety of occupants and other relevant person for whom a duty of care is held.

Flammable Waste Materials - refers to waste that will create fires under certain conditions, perhaps spontaneously combust, and have a flash point less than 60 °C (140 °F). Examples include waste ethanol, methanol, hexane, acetic acid and acetone.

Fatigue - is extreme tiredness resulting from mental or physical exertion or illness.

Formwork - is the term used for the process of creating a temporary mould into which concrete is poured and formed. Traditional formwork is fabricated using timber, but it can also be constructed from steel, glass fibre reinforced plastics and other materials.

Hazard - refers to a potential source of harm, illness, injury, disease or death, including the potential to cause illness, injury, disease or death.

Hazard and operability analysis (HAZOP) - is a structured and systematic technique for system examination and risk management.

Health and safety officer (HSO) - refers to a person at a worksite given the responsibility to monitor and identify health and safety issues at the worksite.

Hierarchy of control - is a system for controlling risks in the workplace. The hierarchy of control is a step-by-step approach to eliminating or reducing risks and it ranks risk controls from the highest level of protection and reliability through to the lowest and least reliable protection.

High-risk work licence - is a photographic licence, issued to persons who have been trained and assessed as competent to work in a class of work defined as high-risk work.

Hot Work - refers to work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

Housekeeping Program - refers to the routine cleaning and organizing of the workplace. As housekeeping is an ongoing safety practice, orderly conditions in the workplace should be maintained on a consistent basis, not restored after orderliness has been allowed to slip.

HSR - refers to Health and Safety Representative.

Hungover - refers to someone who is unwell because they drank too much alcohol on the previous day.

Ignition Source - is a flame, spark or hot surface capable of igniting flammable vapours or fumes, or any substance capable of burning.

Independent contractor - is a self-employed person or entity contracted to perform work for or provide services to another entity as a nonworker.

Interlocking Door - is an interlocking system that is composed of two doors electronically connected so one cannot open until the other has closed.

Live load (scaffolding) - is the weight of the workers, equipment and materials which will be used on at any one time on the scaffold

Load - refers to weight, pressure, or any force that presses or has impact on a construction structure.

Local authorities - refers to any authority that needs to be contacted prior, during, and post construction, e.g., law enforcement, emergency services, and government departments.

Material Safety Data Sheet - is a technical document which provides detailed and. comprehensive information on a controlled product related to health effects of exposure to the product, hazard evaluation related to the product's handling storage or use and measure to protect workers at risk of exposure.

Metabolic Heat Load - is the term used to measure how hard muscles are working during physical activity.

Modification work - refers to alteration of the function of the whole or a part of a construction.

Musculoskeletal injury or disorder - refers to an injury relating to the muscles and skeleton, including bones, joints, tendons, and muscles.

Nip-point or **pinch point** - is a point of convergence between two rolling parts, or a rolling part and a stationary part, where all or part of the human body could become trapped and injured.

Other persons - refers to site inspectors, government officials, and persons who do not fall into the categories of contractor, worker, or visitor.

Passive Fall Prevention Device - material or equipment, or a combination of material and equipment, that is designed for the purpose of preventing a fall and that, after initial installation, does not require any ongoing adjustment, alteration or operation by any person to ensure the integrity of the device to perform its function.

pH neutral - refers to a chemical that is neither acidic nor alkaline.

Power Take Off (PTO) - refers to any of several methods for taking power from a power source, such as a running engine, and transmitting it to an application such as an attached implement or separate machine.

Principal contractor - refers to a person who employs one or more people to work on a construction site.

Registered Training Organisation - is an organisation providing Vocational Education and Training courses to students, resulting in qualifications or statements of attainment that are recognised and accepted by industry and other educational institutions.

Reinforced Concrete - is concrete in which metal bars or wire is embedded to increase its tensile strength.

Residual Current Device (RCD) - is a safety device that quickly breaks an electrical circuit to protect equipment and to reduce the risk of serious harm from an ongoing electric shock.

Risk - refers to the chance or likelihood that a hazard will cause harm to a person.

Safe system of work - is a formal procedure based on a systematic examination of work in order to identify the hazards.

Safe working load (SWL) - sometimes stated as the Normal Working Load is the maximum safe force that a piece of lifting equipment, lifting device or accessory can exert to lift, suspend, or lower, a given mass without fear of breaking.

Safe Work Method Statement (SWMS) - is a document that sets out the high-risk construction work activities to be carried out at a workplace, the hazards arising from these activities and the measures to be put in place to control the risks.

Scaffolding - is a temporary structure on the outside of a building, made of wooden planks and metal poles, used by workmen while building, repairing, or cleaning the building.

Scaffold designer - is usually a civil engineer who designs scaffolding structures to support construction work.

Shear - refers to when something, especially something made of metal, shears, it breaks into two pieces, usually because of a sideways force.

Shoring Up - is the process of temporarily supporting a building, vessel, structure, or trench with shores (props) when in danger of collapse or during repairs or alterations.

Task Analysis - is the analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task.

Testing work - refers to study, analysis, geological calculation of construction structures, construction tools and machinery, and construction materials, equipment and products.

Trades person - refers to a construction technician (skilled worker/workman) who has received a training at a related specialized technical school or who is skilled and experienced in carrying out building works, or a tradesperson whose professional board has not been created.

Under the influence - refers to someone affected by alcoholic drink or drugs.

Utility Owner - means the owner or operator of any Utility (including both privately held and publicly held entities, cooperative Utilities, and municipalities and other governmental agencies.

Young Worker - refers to an inexperienced worker between the ages of 18 and 24 years old.

Contact Details:

Ministry of Land Management, Urban Planning & Construction	
Contact Ph:	+855 (0) 23 215 279
Address:	771-773, Preah Monivong Blvd., Sangkat Boeung Trabek, Khan Chamkarmon Phnom Penh
Email:	mlmupc.cabinet@gmail.com
Website:	www.mlmupc.gov.kh
Ministry of Public Works and Transport	
Contact Ph:	1275 (free call)
Address:	St 598 (Street HE Chea Sophara) Sangkat Chrang Chamres 2, Khan Russey Keo, Phnom Penh
Email:	info@mpwt.gov.kh
Website:	www.mpwt.gov.kh
Police Department	
Contact Ph:	117
Fire Department	
Contact Ph:	118
Ambulance (Calmette Hospital)	
Contact Ph:	119
Electricity of Cambodia	
Contact Ph:	023 723 871
Address:	Ang Yukanthor (St. 19), Wat Phnom, 12202, Phnom Penh
Phnom Penh Water Supply	
Contact Ph:	023 724 046
Address:	No. 45, Preah Moha Ksat Triani Kossomak (Ave. 106), north of the Railway Station, 12201, Phnom Penh

CONSTRUCTION WORKPLACE HEALTH & SAFETY GUIDELINES

VOLUME 2

Ministry of Land Management, Urban Planning and Construction

Preface

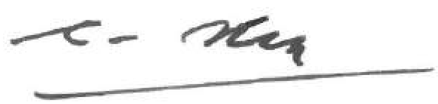
The Royal Government of Cambodia has considered the construction sector as an engine of economic growth and it has become a pillar along with three other pillars, such as agriculture, garment and footwear industry, and tourism. The Ministry of Land Management, Urban Planning and Construction has been effectively implementing the Law on Construction.

With the growth of the construction sector, construction site safety and health require great attention in order to assure the safety of and mitigate risks to individuals engaged in construction works, especially workers employees, and staff at construction sites. In this regard, the Ministry of Land Management, Urban Planning and Construction has continually introduced legal measures and regulations to further strengthen and promote well-being and safety of workers, employees, and staff at construction sites.

Addressing these issues the Ministry of Land Management, Urban Planning and Construction cooperate with the Australian Embassy in Cambodia to develop Construction Workplace Health and Safety Guidelines which are a regulation for workers employees ad design companies and construction companies, and individuals involved in construction works so as to avoid accidents at construction sites which affect people's health and lives as well the planning and plans of construction projects.

I requires that investors, workers, employees, and people involved in Cambodia's construction sector pay close attention to their own safety and health while working at construction sites.

Deputy Prime Minister
Minister of Land Management, Urban Planning and Construction



CHEA SOPHARA

Preface of

His Excellency the Australian Ambassador to the Kingdom of Cambodia

Cambodia's dynamic and growing construction sector is a key driver of economic growth. It also supports the livelihoods of 150,000 construction sector workers and their families. While the construction sector has supported Cambodia's rapid development, it also presents new challenges including the need to improve workplace safety on Cambodia's construction sites.

Following several serious incidents at construction sites, Australia responded quickly and effectively to the Royal Government of Cambodia's request for support to improve the safety of Cambodia's construction workers, their families and the public.

In September 2021, I had the pleasure of participating in the signing ceremony for the Memorandum of Subsidiary Agreement (MSA) between Australia's Department of Foreign Affairs and Trade and the Ministry Land Management Urban Planning and Construction (MLMUPC) to enhance construction safety in Cambodia.

Since the signing, a technical adviser funded by the Government of Australia and a team of experts from the MLMUPC has developed the Construction Workplace Health and Safety (WHS) Guidelines. These Guidelines are an important step to improving the health and safety of Cambodians engaged in the Kingdom's dynamic building construction sector.

I commend these Guidelines to all the designers, engineers, project managers, contractors and workers involved in Cambodia's construction sector. By diligently managing safety risks, we will see the necessary improvements in an industry that is vital to Cambodia's future.

The Australian Ambassador to the Kingdom of Cambodia

Pablo Kang

Introduction

Throughout the country, in all facets of construction and demolition activities, measures to guarantee the health and safety of workers and employees need to be considered and put into practice. In doing so, construction workers and employees will be protected from the hazards and dangers that are present on construction sites. To meet this goal, before implementing any measures, it is necessary for those controlling and managing construction sites to consult with and inform workers and employees, or their representatives, in all aspects of construction work, to prevent accidents and incidents and the potential impacts on health and safety.

There are many professionals, technical experts and skilled and unskilled workers involved in Cambodia's construction sector. On any given day, between 150,000 to 180,000 individuals are engaged in construction work. Some workers do receive training in health and safety and are offered at least a basic guarantee of a safe workplace. However, through careful implementation of safety measures, all workers and employees can return safely to their homes and families at the end of each workday

The Construction Workplace Health and Safety Guidelines focus on key areas of construction safety risk. They aim to protect and promote the health and safety of workers and employees. Also, by reducing injury and time lost to accidents, the Guidelines will assist in enhancing the productivity of the construction sector.

The Guidelines do not in any way substitute for the provisions set forth in the Law on Construction promulgated by Royal Kram NS/RKM/1119/019 on 2 November 2019. Nor do they substitute for other legal documents prepared by the General Department of Construction of the Ministry of Land Management Urban Planning and Construction or other government entities. The Guidelines act as a supplementary to existing legal measures and regulations, and serve to inform and guide the workers, employees, design companies, construction companies and individuals involved in construction work.

The production of the Construction Health and Safety Guidelines represents a further example of the effective cooperation between the Ministry of Land Management, Urban Planning and Construction and the Australian Embassy in the Kingdom of Cambodia. They offer a roadmap for construction site workers, employers, professionals, businesspeople in the field of construction and officials at all levels of government for advancing workplace health and safety on Cambodia's construction sites.

TABLE OF CONTENTS

CHAPTER 11

WORKING AT HEIGHT

Falls from height are a leading cause of death and serious injury in the construction industry in Cambodia. Falls from even moderate heights can leave workers with permanent and debilitating injuries. The risk of serious injury or death from a fall increases significantly if you are working at heights over two metres.

This section is designed to help Principal Contractors and workers understand the risks whilst working at height and provide a guide on how to keep the construction site safe from the risk of falls.

What are falls?

Principal Contractors have a duty to ensure their construction site is safe and this means controlling the risk of falls from any height.

Analysis has shown that the risk of injury from a fall is much higher in falls from two metres or more. Falls from height are a common cause of serious injury on construction sites. Even from a relatively low height, a fall can cause very serious injuries, including fractures, spinal cord injury, concussions and brain damage.

Typical falls that cause injury and death include those resulting from:

- using unsafe or incomplete scaffolds.
- inappropriate ladders/ladder use.
- falling from or through roofs.
- falling from trucks.
- falling into holes, pits or shafts.
- accessing shelving.
- accessing mezzanine areas.

Principal contractor responsibility

As a Principal Contractor, you have a general duty to make your construction site safe. This includes controlling the risk of falls and identifying any task where a person may fall more than two metres.

If it is reasonably practicable, you must eliminate the risk of a fall. If this is not reasonably practicable, you must control the risk using the following measures in order of priority, so far as is reasonably practicable:

- Use a passive fall prevention device.
- Use a work positioning system to ensure workers work within a safe area.
- Install a fall arrest system to limit the risk of injuries in the event of a fall.
- Use a fixed or portable ladder, or
- Implement an administrative control.

If you use a control measure other than working on the ground or on a solid construction, then you must establish emergency procedures covering the rescue of a worker in the event of a fall and the provision of first aid.

Any equipment or materials used to control the risk of a fall must be appropriately designed and constructed for the task and the conditions it will be used in. In addition, fixed or portable ladders must be fit for purpose, appropriate for the duration of the task, and set up properly.

If you are using only an administrative control, you must record what it is and the task for which it is being used.

You must review (and, where necessary, revise) your risk controls if things change or at the request of a health and safety representative. Principal Contractors also have a duty to consult workers and health & safety representatives when identifying hazards and deciding on control measures.

Worker responsibility

Your Principal Contractor is required to protect you from the risk of falls in the construction site. At the same time, you have a general duty to take reasonable care for your own health and safety, and that of others who may be affected by your work, and to cooperate with your Principal Contractor's efforts to make the construction site safe.

This includes following construction site policies and procedures, using equipment properly, and attending health and safety training as well as helping to identify hazards and risks.

You must inform your Principal Contractor if you identify any falls hazards and/or if you have concerns about the safety control measures or equipment provided to you.

Inform your manager immediately if you identify a fall hazard

Compliance strategy

Every construction site should adopt a working at height, fall prevention strategy to ensure that the construction site is safe for everyone. All strategies should include:

- Consult phase.
- Find phase.
- Control phase.
- Review phase.

Consult phase

A Workers' expertise can make a significant contribution to improving workplace health and safety. Regular, proactive consultation can help identify issues in the construction site and build a strong commitment to health and safety by including all views in the decision-making process.

Principal Contractors should consult with workers when identifying and assessing falls hazards or risks and making decisions about risk control. 'Workers' includes independent contractors (and any workers of the independent contractors) who perform work which the Principal Contractor has, or should have, control over.

If workers are represented by health and safety representatives, the consultation must involve those representatives.

Find phase

To prevent serious injuries occurring at your construction site, you need to identify all tasks that involve the possibility of someone falling more than two metres.

Tasks that may involve the risk of a fall include:

- work done on any machinery, equipment or structure being constructed, inspected, tested, maintained, repaired or cleaned.
- tasks on a fragile, slippery or potentially unstable surface.
- Using equipment to gain access to an elevated level or to work at an elevated level.
- work on a sloping surface where it is difficult to maintain balance.
- work near an unprotected edge or in close proximity to a hole, shaft or pit into which a person could fall.

Some examples of work practices that involve the risk of a fall include:

- maintenance work on a roof, such as gutter clearing, painting or roof restoration, with no guarding or fall protection.
- working from the bucket of a front-end loader or tractor, or from a pallet lifted by a forklift.
- no guarding, railing or signage around holes, pits or shafts.
- Working on the side of buildings without any fall prevention measures like guard rails.

- setting up a ladder on a slippery or uneven surface without securing it to prevent it slipping.
- using a cherry picker without a secure lanyard and safety harness connecting the worker to the basket.

Control phase

During the control phase Principal Contractors must follow a 'hierarchy of control' system to eliminate risk. The following hierarchy of control is set out in the order that Principal Contractors must consider and apply, so far as is reasonably practicable, to eliminate or reduce risks associated with falls from above two metres.

Work through this list in the following order to control the risk of falls at your construction site. In many instances, a combination of approaches will result in the best solution.

Do the work on the ground or on a solid construction

Eliminating work at height is the most effective way of protecting workers from a risk associated with a fall at a construction site. Workers need to consider how work can be done at ground level to eliminate the need for work at height. Examples of elimination include:

- prefabricating roofs at ground level.
- prefabricating wall frames horizontally, then standing them up.
- using precast or tilt-up concrete construction instead of concrete walls constructed in situ.
- using paint rollers with extendable handles.
- using remote release clutches for crane-lifted loads positioned at height.

Work on a solid construction area

Careful and ongoing assessment of the physical location needs to be undertaken to eliminate areas in which workers could fall. Many areas of a construction site can be turned into a solid construction area.

Solid construction means an area that has:

- a surface that is structurally capable of supporting persons, material and any other loads applied to it.
- barriers around its perimeter, and any open penetrations, to prevent a fall from the area.
- an even and readily negotiable surface and gradient.
- a safe means of entry and exit.

Ladders, trestle scaffolding or similar, should not be used on a solid construction unless additional control measures are in place to control the risk of persons falling over guard-railing.

An area will meet the definition of a 'solid construction' if it satisfies all of the following elements:

(a) Structural strength

The surface (and its supports) must be structurally capable of supporting persons, material and any other loads applied to it. Different types of work involve different loads on the supporting surface. If the duty holder is unsure of the structural strength of the surface, a structural engineer needs to determine the safe load capacity before use.

Where props are used to support suspended floors, formwork or similar areas, the props need to meet the following:

- proprietary brand props are marked with their safe working load.
- timber props are designed for the loads imposed.
- the props are secured top and bottom, and
- the props are tied to each other in the longitudinal and transverse directions to form a stable, free-standing structure.

(b) Surface and gradient

The area must have an even and readily negotiable surface and gradient. Surfaces need to be non-slip and free from trip hazards and penetrations. Smooth surface working areas should not be steeper than 7 degrees (1 in 8 gradient). Cleated or grated surfaces, which provide greater slip resistance, should not be steeper than 23 degrees (approximately 1 in 2.4 gradient).

(c) Edge protection

The solid construction must have barriers around its perimeter to prevent a fall from the area. Perimeter protection needs to be provided for all exposed edges, including:

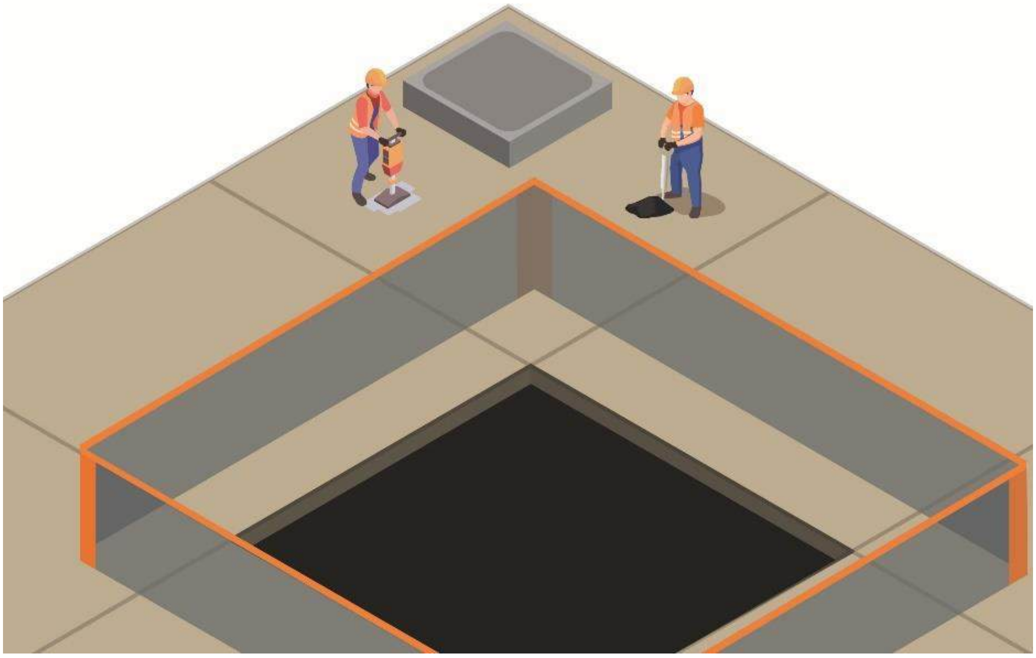
- the perimeters of buildings or other structures.
- the perimeters of skylights or other fragile roof materials.

(d) Void protection

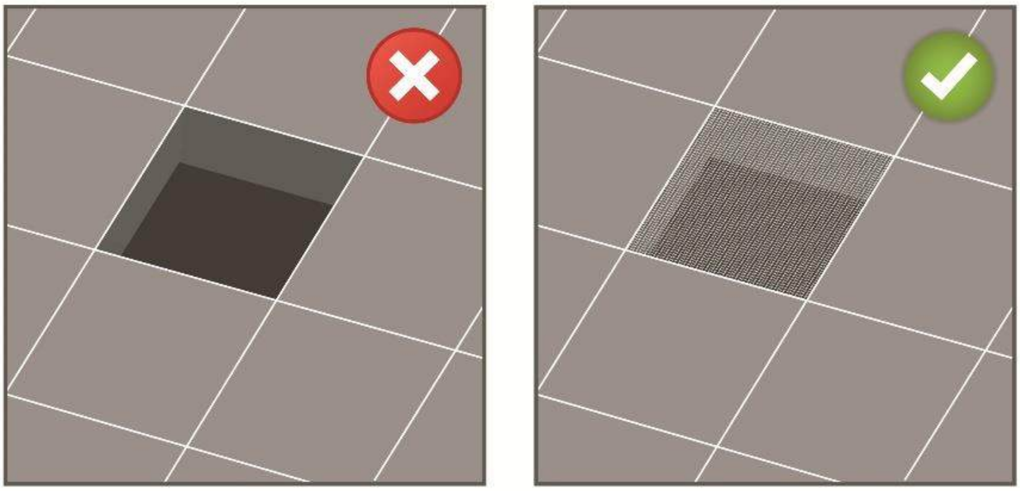
The solid construction must have barriers around any open penetrations to prevent a fall from the area. For example, open penetrations such as stair voids and service penetrations need to be covered or provided with barriers, such as guard-railing (see figure 1).

Where there is a risk that workers performing tasks from work platforms or ladders may fall over the guard-railing, voids need to be covered. Coverings need to be secured in place to prevent dislodgement and be designed to withstand any loads that may be applied (for example during construction work or in the event of a fall). Fall protection may be provided using embedded wire mesh as shown in figure 2.

Holes or openings protected with embedded wire mesh should not be used as a work platform.



Use barricades and fencing to protect workers from fall hazards



Cover open holes with a protective grate

(e) Access and egress

The area must have a safe means of entry and exit. Common means of entry and exit include:

- existing floor levels.
- permanently installed platforms, ramps, stairways and fixed ladders.
- temporary access ways and temporary stair systems.

- secured single portable ladders set up at a slope of between 4:1 and 6:1 and extending at least 1m above the stepping- off point.

Ladder and stairway landings need to have the same level of edge protection adjacent to their open sides and ends as a solid construction.

Step ladders and trestle ladders should not be used for entry to or exit from a solid construction.

Passive fall prevention devices

A ‘passive fall prevention device’ is material or equipment, or a combination of material and equipment, that is designed for the purpose of preventing a fall and that, after initial installation, does not require any ongoing adjustment, alteration or operation by any person to ensure the integrity of the device to perform its function. Examples include temporary work platforms, perimeter screens, guardrails, roof safety mesh and covers over trenches.

If it is not reasonably practicable to eliminate a risk associated with a fall of more than two metres, Principal Contractors must reduce the risk, so far as is reasonably practicable, by using a passive fall prevention device.

Temporary work platforms

A ‘temporary work platform’ is:

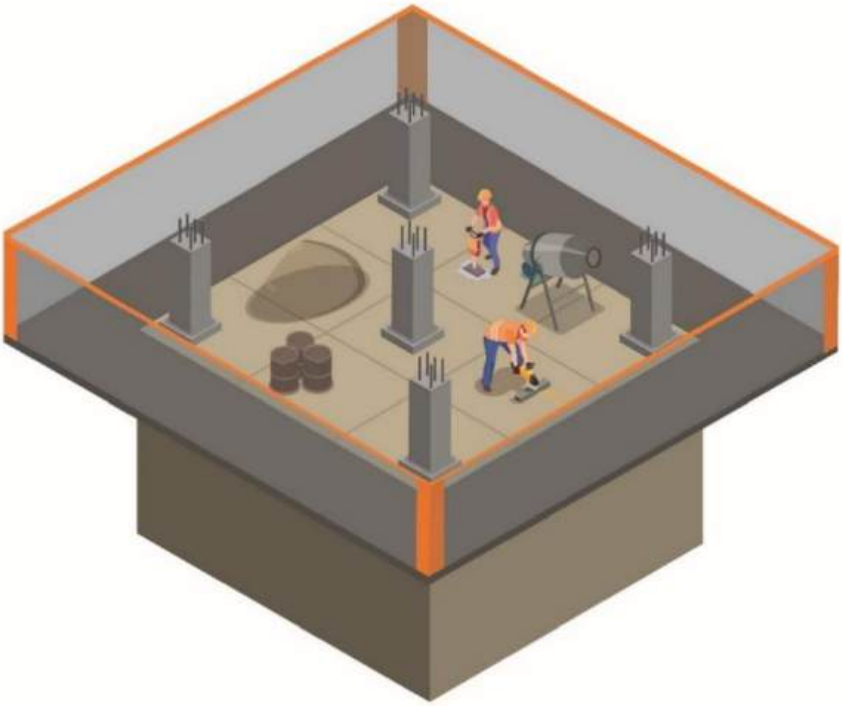
- a fixed, mobile or suspended scaffold.
- an elevating work platform.
- a mast climbing work platform.
- a work box supported and suspended by a crane, hoist, forklift truck or other form of mechanical plant.
- building maintenance equipment, including a building maintenance unit.
- a portable or mobile fabricated platform, or
- any other temporary platform that provides a working area for the duration of work performed at height and is designed to prevent a fall.

Scaffolds

Scaffolds area common means of providing a safe work platform for working at height. There is a wide variety of scaffolding systems available. For more information, please see Chapter 19 Safe Use of Personnel Scaffold.

Perimeter screens

Perimeter Screens that are purpose designed for a building, provide a high level of protection in preventing persons and any debris, tools or building material from falling from the building (see figure below).



Some screens incorporate prefabricated formwork to enable the casting of perimeter edge beams or stop ends for the edge of the floor. They may also be designed to cover two or more floors, with trailing screens to protect construction workers on lower levels while they are stripping the formwork and installing back propping.

Perimeter screens normally extend one floor above the floor they are supported from. The top of the screen needs to be high enough to provide perimeter protection for the floor that is to be built before anyone has to access this floor or its formwork deck. The framework supporting the screen needs to be able to bear the load of the screen. The mesh needs to be of minimum gauge 2.5mm, and have a maximum mesh opening size of:

- 25mm nominal where no lining is used, or
- 50mm nominal where lining is used.

Perimeter screens need to be designed by an engineer and fitted by licensed riggers in accordance with the design engineer's requirements. Gaps between screens and between the screens and the structure should not exceed 25mm.

Perimeter guardrails

Guardrails should be used to provide effective fall prevention at:

- the edges of roofs and roof framing.
- the edges of scaffolds.
- the edges of work platforms, suspended slabs, formwork and falsework, walkways, stairways, ramps and landings.

- the perimeters of buildings and other structures.
- the perimeters of skylights and other fragile roof material.
- openings in floor and roof structures.
- the edges of shafts, pits and other excavations.

Before a guardrail system is adopted, the Principal Contractor needs to ensure it will be adequate for the potential load of a falling person. Proprietary systems need to be configured, installed, used and dismantled by a competent person in accordance with the manufacturers' instructions.

Guard rails are an effective fall prevention control measure

Guard-railing the edges of roofs

Guard-railing may be used as fall prevention around the edge of a roof as a proprietary designed system or through incorporation into scaffolding. Figures 8(a–g) show common examples of appropriate roof guard-railing arrangements on scaffolding.

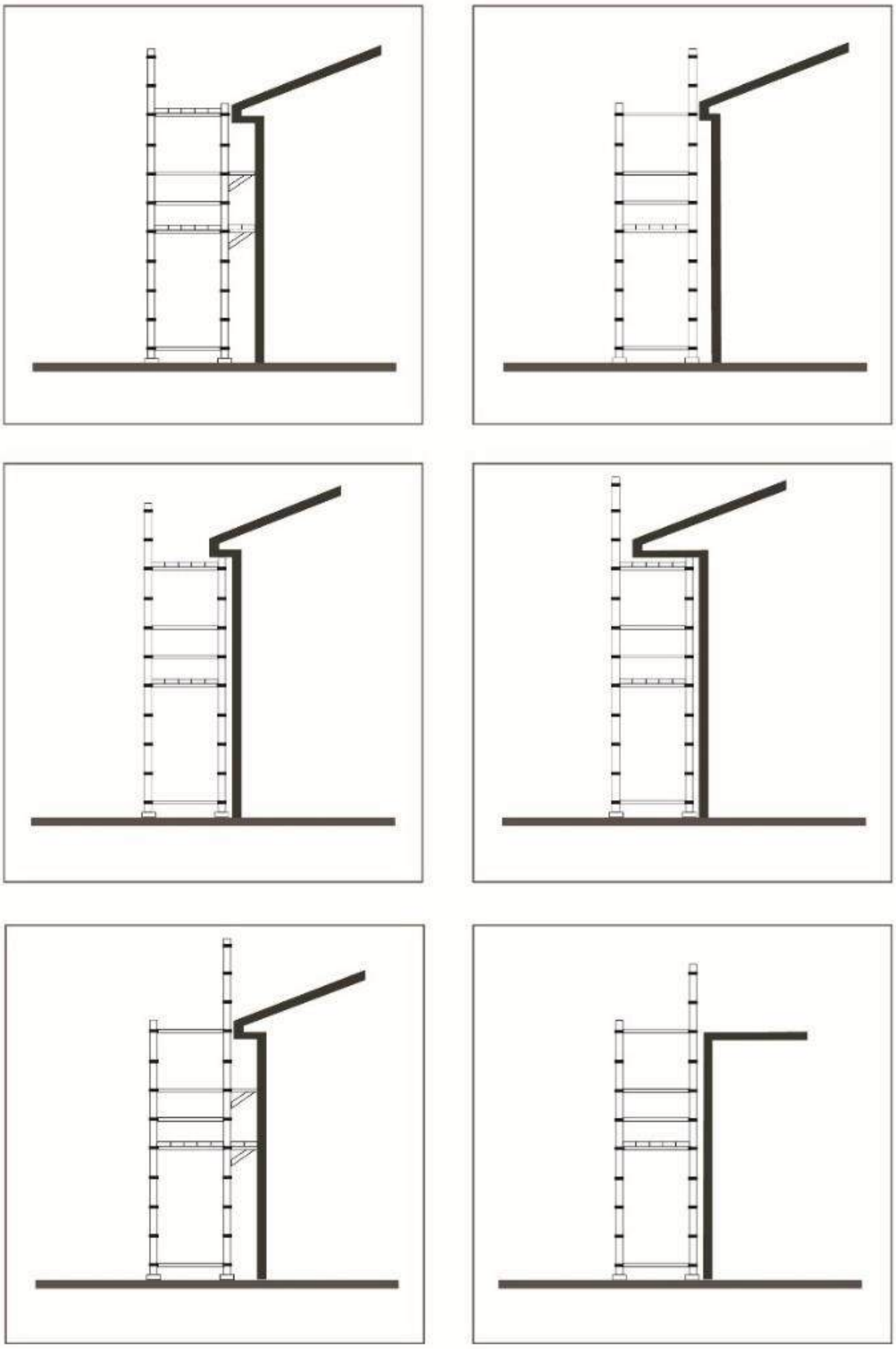
Where the slope of the roof exceeds 35 degrees, the roof is an inappropriate surface to stand on. Perimeter guardrails and catch platforms alone are inappropriate measures to protect workers on a steeply sloping roof.

In these circumstances, roof workers need to have a system to prevent sliding and to prevent falls from the perimeter, comprising one or more of the following:

- Aerial access equipment, such as an elevating work platform.

- A work positioning system, such as a travel restraint or industrial rope access system.
- A scaffold platform located at the roof edge.
- A roof ladder.

Proprietary systems need to be configured, installed, used and dismantled in accordance with the manufacturers' instructions.



Types of guard-railing on roofs

Barriers to restrict access

Barriers need to be used to cordon off elevated areas including roofs and balconies where edge protection is not provided, and access is not permitted.

The barriers need to be secure and restrict access to authorised people only. Signage needs to be erected that warns against entry to those areas. Suitable barriers may include locking the door to a balcony and controlling the possession of the key.

Where possible, barriers need to be placed at least two metres inside any unprotected edge or opening. They can include steel mesh panels, metal posts and rails and metal posts with timber rail assemblies. They need to be highly visible and securely fixed to prevent displacement.

Safety mesh

Safety mesh is designed to prevent falls through a roof, which is one of the most common fall problems in the construction industry. If securely fixed, safety mesh provides fall protection for roof installers and offers long-term protection against falling for maintenance and repair workers.

Where new or existing safety mesh is to be used to control the risk of workers falling, the integrity of the mesh and its fixings needs to also be verified by a competent person prior to use.

Safety mesh does not control the risk of falling from the perimeter or through penetration hazards. Therefore, safety mesh always needs to be used with appropriate edge protection, guardrails or fall arrest systems and devices. Used in conjunction with these control measures, safety mesh is the preferred system for protecting workers from falling when they are laying roof sheets.

Elevating work platforms

Elevating Work Platforms (EWPs)are available in a wide variety of types and sizes. They include scissor lifts, cherry pickers, boom lifts and travel towers (see figures 9 and 10). \

There is battery powered and internal combustion engine types. Some are designed for hard and flat surfaces only, while others are designed for operation on rough terrain. Units powered by internal combustion engines are not suitable for use in buildings or areas with poor natural ventilation unless appropriate artificial ventilation is provided.

EWPs:

- need to be used on a solid level surface; the surface area needs to be checked to make sure that there are no penetrations or obstructions that could cause uncontrolled movement or overturning of the platform.
- may be used on other surfaces (when designed as ‘rough terrain’ units) in accordance with the manufacturers’ directions; the surface area needs to be checked for hazards (e.g., penetrations or obstructions).
- need to be clearly marked with the safe working load limit.

An example of an Elevating Work Platform (EWP)

Operators working in travel towers or boom type EWPs need to wear an anchored safety harness that is able to arrest a fall before the user hits the ground. The lanyard needs to be as short as possible and be attached directly to the designated anchor point, not to the handrail.

A safety harness system only needs to be used for a scissor-lift EWP if advised by the manufacturer or indicated in the risk assessment. Where a safety harness is used, a suitable anchor point needs to be provided.

People operating boom-type EWP’s with boom lengths exceeding 11 metres must have an appropriate operator’s licence and/or a high-risk work licence.

An example of an EWP Truck

Mast climbing work platforms

Mast climbing work platforms are hoists with a working platform that is used to raise personnel and materials to a temporary working position. They use a drive system mounted on an extendable mast. The mast may need to be tied to a building in accordance with the manufacturers' directions.

An example of a typical mast climbing platform

Mast Climbing Work Platforms can be set up in either single-mast or multi-mast configurations. They are generally not suitable for use if the profile of a structure changes at different elevations (for example if the upper floors of a building 'step back' or balconies protrude from the building).

The erection and dismantling of mast climbing work platforms must be carried out by a person holding a high-risk work licence of the appropriate type of rigging or scaffolding licence.

Work boxes

Work Boxes are personnel-carrying devices designed to be suspended from a crane for the purpose of providing an elevated working area. They consist of a platform surrounded by an edge protection system.

It is preferred that other types of temporary work platforms be used instead of work boxes where reasonably practicable.

Cranes used to lift work boxes need to have two independent braking systems so that the failure of any single component will not result in the loss of control of the load.

An example of a Work Box

Covers over trenches

Covers over open trenches may be used to control the risk of a fall. Covers need to be:

- designed to withstand any loads imposed during construction or in the event of a fall.
- sufficiently robust to withstand rough handling.
- inspected to ensure they have not degraded over time.
- installed in a manner which prevents ready dislodgement by non-authorised persons.

Work positioning systems

A work positioning system is:

- an industrial rope access system.
- a travel restraint system, or
- any other equipment, other than a temporary work platform, that enables a person to be positioned and safely supported at a work location for the duration of the task being undertaken at height.

If it is not reasonably practicable to reduce a risk associated with a fall by using higher level control measures of the types described above (level 1 and 2 controls), the Principal Contractor must reduce the risk so far as is reasonably practicable by using a work positioning system.

Industrial rope access systems

An industrial rope access system is a system designed for the purpose of performing work on a building or structure by a person and consists of:

- equipment that enables the person to manually raise or lower themselves in a harness or seat supported by one or more fibre ropes, and
- equipment used to anchor the ropes.

Industrial rope access systems are used for gaining access to and working at elevated work areas, usually by means of vertically suspended ropes. Although fall arrest components are used in the industrial rope access system, the main purpose of the system is to gain access to a work area rather than to provide backup fall protection.

Other methods of accessing such work areas (example: an elevating work platform or building maintenance unit) also need to be considered before implementing rope access systems, as a high level of skill is essential for safe use.

Users, including supervisors, need to undertake a competency-based course of training before using rope access systems.

An example of a travel restraint system on a rooftop

Travel restraint systems

A travel restraint system is a type of work positioning system, and is equipment worn by, or attached to, a person and designed for the purpose of physically restraining the person from reaching an edge or elevated surface from which the person may fall.

Generally, the system consists of a safety harness that is connected by a lanyard to a suitable anchorage point or static line. The system needs to be set up to prevent the wearer from reaching the edge. Each anchorage point needs to be designed as a fall arrest anchorage point.

Where a temporary roof anchor is used as an anchorage for a travel restraint system, it needs to be installed in accordance with the manufacturers' or designers' instructions.

The roof or other building component to which an anchor is to be attached needs to be checked by a competent person to verify that it is suitable for supporting the anchor.

It is preferable that travel restraint systems are used in conjunction with other fall prevention methods, such as guardrails, safety nets and catch platforms.

An example of a safe working area when using a Fall Arrest System

Travel restraint systems are not fall arrest devices

Where there is any possibility that a person using a travel-restraint device may approach an edge from where a fall is possible, a travel-restraint system should not be used.

Use of a fall arrest system instead of a restraint system

Although fall arrest systems are not generally preferred (being low in the hierarchy of control measures), an individual fall arrest system needs to be used instead of a travel-restraint system if any of the following situations apply:

- The user can reach a position where a fall is possible.
- The user has a restraint line that can be adjusted in length so that a free fall position can be reached.
- There is a danger the user may fall through the surface (for example fragile roofing material).
- There is any other reasonably likely use or misuse of the system, which could lead to a free fall.

Fall arrest systems

A fall arrest system means equipment or material, or a combination of equipment and material, that is designed to arrest the fall of a person. Examples include industrial safety nets, catch platforms and safety harness or inertia reel systems (other than a travel-restraint system).

Fall arrest systems must only be used if it is not reasonably practicable to use higher level control measures.

Catch platforms

A catch platform is a temporary platform located below a work area, designed to catch a falling person. The platform needs to be of robust construction and designed to withstand the maximum potential impact load. Scaffolding components may be used to construct fixed and mobile catch platforms. For more information on Catch Platforms, see Chapter 19 Safe Use of Personnel Scaffolding.

A catch platform should:

- incorporate a fully planked-out deck.
- be positioned so the deck extends at least two metres beyond all unprotected edges of the work area, except where extended guard-railing is fitted to the catch platform.
- be positioned as close as possible to the underside of the work area (the distance a person could fall before landing on the catch platform should be no more than one metre).
- always be used with an adequate form of edge protection.

Safety harness systems

There are considerable hazards in using a safety harness fall arrest system. Their use should only be considered where measures higher in the control hierarchy are not reasonably practicable.

A safety harness fall arrest system should only be used where it is not reasonably practicable to use a fall-prevention measure, or where the fall prevention applied is not fully effective on its own. A safety harness fall arrest system requires considerable skill to use safely, and in the event of an arrested fall, it is likely to cause some physical injury to the user.

Where it is possible for a person to strike their head, a protective helmet needs to be provided and worn.

A safety harness fall arrest system is intended to safely control a fall and reduce any impact. The system is an assembly of interconnected components, comprising a harness connected to an anchorage, either directly or by means of a lanyard. Safety harness fall arrest systems can be used where workers are required to carry out their work near an unprotected edge.

Safety harness fall arrest systems need to be evaluated to ensure not only that they will be effective, but also that no new hazards will be created by their use. Examples of possible new hazards include trip hazards and such severe restrictions on a person's movements that they cannot safely perform their work.

A person should not use a safety harness fall arrest system unless there is at least one other person on the site who has been trained and can rescue them if they fall. In some situations, at least two people are required to safely rescue a person who has fallen.

Industrial safety nets

Industrial safety nets can provide a satisfactory means of protection while allowing workers maximum freedom of movement. In some circumstances, an internal safety net may be an effective method of arresting falls for buildings, structures or stairwell openings.

Administrative controls and fixed or portable ladders

Ladders

Ladders must only be used when it is not reasonably practicable to use a higher order control measure and need to be used primarily as a means of access to or egress from a work area. Ladders should only be used as a work platform if other methods of working at the required height are not reasonably practicable.

If a fixed or portable ladder is used to control the risk of a fall, the Principal Contractor must ensure that the ladder is:

- fit for purpose.
- appropriate for the duration of the task, and
- set up in a correct manner.

Selection of ladders

Ladders must be correctly selected for the task to be undertaken and appropriate for the duration of the task.

The physical surroundings of where the task is to be undertaken and the prevailing weather conditions should be taken into consideration. For example, metal ladders or metal-reinforced ladders should not be used for live electrical work.

Typically, construction work involves repetitive, high volume use and handling of ladders, requiring them to be of robust design and construction. Therefore, ladders used for construction work need to be industrial grade rather than domestic grade.

Fixed vertical ladders are generally not suitable for construction work.

Safe use of ladders

Any ladder used at a construction site needs to be used on a surface that is solid and stable, and set up so as to prevent the ladder from slipping.

Slipping of ladders can be prevented by:

- placing single and extension ladders at a slope of 4:1.
- setting up stepladders in the fully opened position.
- securing single and extension ladders at both the top and bottom.

Secure your ladder at the top and bottom to prevent slipping

People using ladders should not:

- handle or use ladders where it is possible for the worker or the ladder to make contact with powerlines.
- use metal or metal-reinforced ladders when working on live electrical installations.
- set up the ladder in places, such as driveways and doorways, where a person or vehicle could hit it (if necessary, erect a barrier or lock the door shut).
- use a ladder near the edge of an open floor, penetration or on scaffolding to gain extra height.
- over-reach (the worker's belt buckle needs to be within the ladder stiles throughout the work).
- use any power (air, hydraulic, electric or battery) equipment or tool specifically designed to be operated with two hands, such as concrete cutting saws and circular saws.
- use tools that require a high degree of leverage type force (such as a pipe wrench or pinch bars) which, if released, may cause the user to overbalance or fall from the ladder.
- carry out work such as arc welding or oxy cutting.
- work over other people, or
- allow anyone else to be on the ladder at the same time.

Except where a pole strap (or similar device providing the user with full body support) is used, any person using a ladder should not:

- face away from the ladder when going up or down, or when working from it.
- stand on a rung closer than 900mm from the top of a single or extension ladder.
- stand higher than the second tread below the top plate of any stepladder.

An example of a worker using a ladder and fall restraint system

Where possible, ladders being used for access need to be set up at right angles to the working surface to allow workers to step off the ladder rather than having to step around or over the ladder.

Examples of the correct and incorrect ladder setup and usage

Ladder maintenance

Ladders need to be regularly inspected by a competent person. Ladders with any of the following faults need to be replaced or repaired by a competent person:

- Timber stiles that are warped, splintered, cracked or bruised.
- Metal stiles that are twisted, bent, kinked, crushed or have cracked welds or damaged feet.
- Rungs, steps, treads or top plates that are missing, worn, damaged or loose.
- Tie rods that are missing, broken or loose.
- Ropes, braces, or brackets that are missing, broken or worn.
- Timber members that, apart from narrow identification bands, are covered with opaque paint or other treatment that could disguise faults in the timber.

Safety protocols when using a ladder include:

- Maintain 3 points of contact on the ladder at all times.
- Use a tool belt or pouch.
- Ensure only light work is carried out on the ladder where tools can be operated safely with one hand.
- Make sure that no-one works underneath the ladder.
- Do not straddle the ladder.
- Wear slip-resistant footwear.

Administrative controls

An 'administrative control' is a system of work or a work procedure that is designed to reduce a risk but does not include a physical control or the use of personal protective equipment. Administrative controls must only be used when it is not reasonably practicable to use a higher order control measure.

Administrative controls are often used to support other fall protection measures. They may also be used to limit the time workers are exposed to a fall hazard or the number of workers involved in the task.

If an administrative control is used as the only means of reducing the risk associated with a particular task, the Principal Contractor must, before the task is undertaken, record:

- a description of the administrative control used, and
- a description of the task to which the administrative control relates.

Recording administrative controls

If a task is routinely carried out, it may be appropriate to record a standard safe work procedure for the task. A Principal Contractor may make a generic record in respect of a task to which an administrative control relates if the task will be undertaken in the same or similar circumstances at more than one construction site or at more than one area within a construction site.

However, the record must include a description of the task to which the administrative control relates. A generic record cannot be relied on if the task is undertaken in conditions that are not the same or similar, for example if there is variation in the working environment.

The Principal Contractor must keep the records until the work covered by the administrative control has been completed.

If relying on administrative controls, a high level of training and supervision needs to be provided to ensure that the safe work procedure is being followed. The procedures need to be regularly reviewed to determine their effectiveness.

Examples of administrative controls

Administrative controls may include 'no-go' areas, permit systems, the sequencing of work and safe work procedures.

'No-go' areas

'No-go' areas can be an effective method of making sure people are not exposed to fall hazards. They require adequate delineation from the general work area. They can be used to control the risks of entry to an area where there is an unguarded fall hazard or to areas where work is being undertaken overhead and there is a risk of falling material.

Delineation needs to include a physical barrier such as temporary fencing or guard-railing where the distance is less than two metres to the hazard or, where the distance is more than two metres, secured para webbing or barrier tape may be suitable. All controls need to include adequate signage to warn against access to the hazardous area.

Principal Contractors need to ensure that relevant information and instruction is provided to construction workers at the construction site (for example on the construction site) about 'no-go' areas and ensure there is adequate supervision so that unauthorised workers do not enter the 'no-go' areas.

An example of signage for a "no-go area"

Permit systems

Permit systems ensure that only competent people who are trained in the use of appropriate control measures work in an area where there is a fall hazard.

Examples of permit systems include:

- tagging all access points to a scaffold with wording such as 'Only licensed scaffolders permitted on an incomplete scaffold', to prevent unauthorised access during erection and dismantling.
- requiring permits for access to areas where travel restraint systems or fall arrest systems are to be used.

Organising and sequencing of work

Work needs to be organised so that people do not increase the risk of a fall for themselves or others. For example, by sequencing jobs so that different trades are not working above or below each other at the same time. Work should be planned so tasks are not performed for extended periods from a ladder and work at height is minimised in extremely hot or cold weather.

Safe work procedures

An administrative control may be as simple as a safe work procedure that describes in a SWMS the steps involved in safely undertaking a task. It may also include any particular training, instruction and supervision required.

A safe work procedure can be generic and applicable to a task that is routinely or repeatedly carried out. However, safe work procedures that rely on a generic record must only be used where the task is undertaken in the same or similar circumstances.

Review phase

Principal Contractors have a duty to ensure that workers are kept safe whilst working at height and any risk control measures are properly installed, used, maintained and routinely reviewed.

The purpose of reviewing risk controls is to ensure that they are working as originally intended and continue to prevent or adequately control risks associated with falls. Review and Maintenance of control measures should include:

- monitoring activities and work practices.
- frequent inspections of physical controls such as guardrails, scaffolding and covers over trenches.
- visual checks to ensure risk controls that rely on human behaviour are being properly applied by workers.
- testing of equipment and PPE.
- preventative maintenance of engineering controls and PPE.
- any necessary remedial work to ensure physical controls continue to work effectively.

Principal Contractors need to have a review and maintenance procedure in place to ensure that any defects in risk controls are detected as early as possible.

Safe work method statement

A Safe Work Method Statement (SWMS) is a document that sets out the high-risk construction work activities to be carried out at a construction site, the hazards arising from these activities and the measures to be put in place.

Creating a SWMS for work relating to working at height that creates considerable risk, should be implemented as part of your working at height compliance strategy.

Preparing a SWMS?

The SWMS should describe to workers in clear terms how risks from working at height will be effectively controlled to enable the work to be done safely.

The duty to prepare a SWMS before commencing working at height rests with the Principal Contractor of the workers intending to undertake work at height. However, in practice there will often be multiple Principal Contractors to whom that duty applies (e.g., construction site manager, the builder or a sub-contractor who has workers).

It is normally best for the direct manager of a worker who will work at height to understand and control the hazards and risks associated with the working at height work that the worker is engaged to perform.

A Principal Contractor may, however, agree to prepare the SWMS on behalf of or in conjunction with their sub-contractor, providing this is done in consultation with affected workers and their health and safety representatives (HSRs).

What needs to be included in a SWMS?

As a minimum, the SWMS for working at height should include:

- identify work at height duties that are high risk.
- state the hazards and risks to health and safety from that work.
- clearly detail the measures selected to control those risks.
- describe how the risk control measures will be implemented, and
- be set out and expressed in a way that is readily accessible and comprehensible to the workers who use it.

The SWMS should also identify the:

- date and location the work at height is to be performed.
- person/s responsible for ensuring selected risk controls are installed and maintained.
- names of workers consulted in the document's preparation.

How do I prepare a SWMS?

This is a typical approach to developing a SWMS:

- Assemble the relevant workers who will be working at height, any site HSR's and supervisors, ideally at the location of proposed works.
- Review the proposed working at height duties and consider any site-specific factors with potential to impact the works.
- Ensure all proposed high risk working at height activities are identified and hazards and risks listed.
- Select the risk control measures and describe them alongside each of the hazards and risks that are listed.

Working at height training, accreditation & licences

A Principal Contractor has a duty to ensure that any worker who performs high risk work, particularly working at heights, has an appropriate level of training and experience. A person who is not experienced and has not received any specific working at height training, must not do any high-risk work at height.

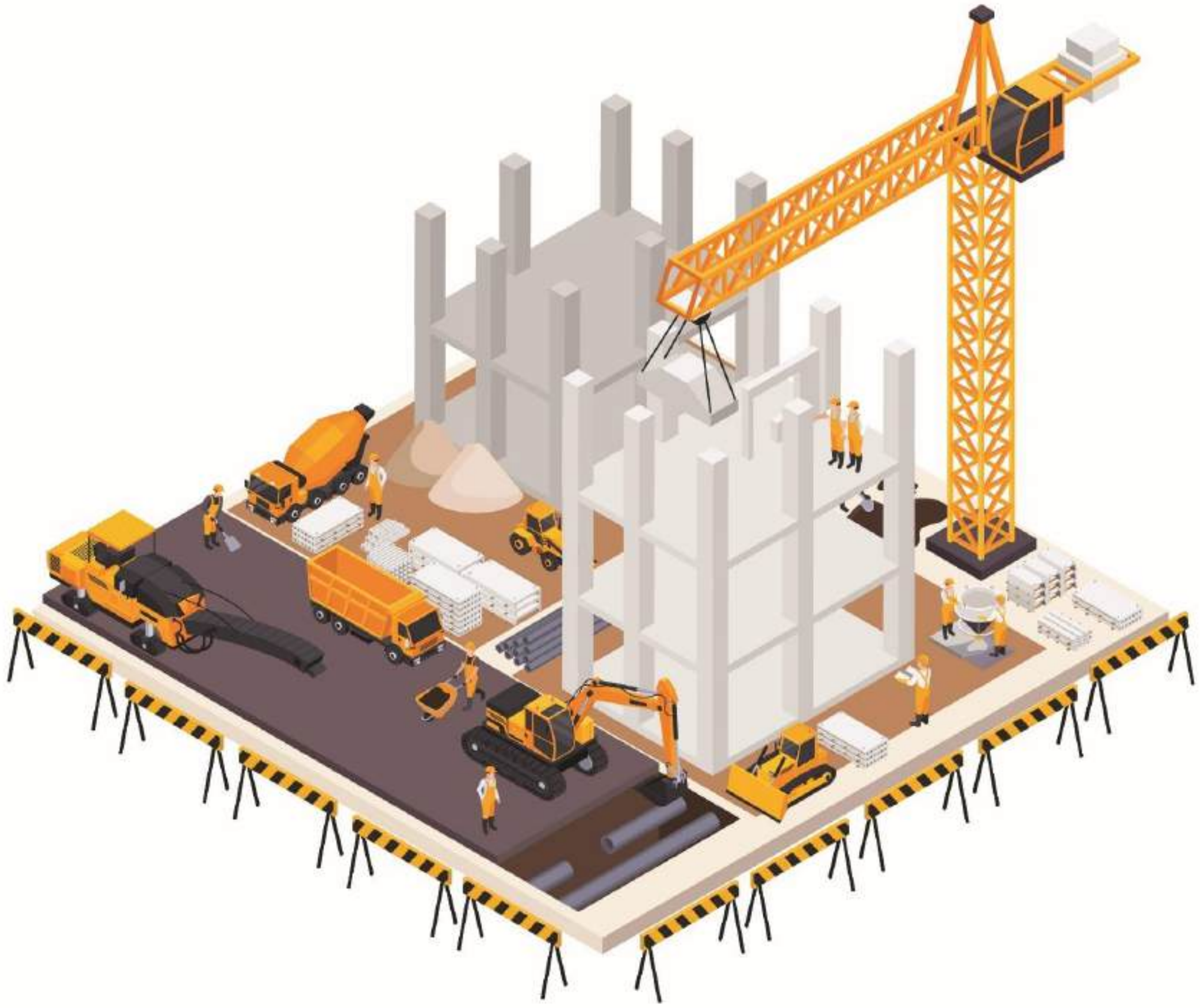
Principal Contractors must also ensure that any subcontractors that are hired to perform duties on a construction site, have adequate qualifications and experience to perform the tasks they are hired to perform, particularly high-risk work involving working at height.

Workers and sub-contractors who install equipment relating to working at height, particularly those who are responsible for installing scaffolding and fall protection equipment, must be qualified and experienced in installing such equipment.

Operators of working at height machinery, like lift platforms or boom-type elevating work platforms must have formal training. Principal Contractors must not allow workers, who have little to no experience operating working at height machinery, to use such machinery without appropriate supervision from a qualified and experienced operator.

CHAPTER 12

SITE SECURITY, PROTECTION AND BARRIERS



This guidance is to remind Construction Site Owners of the need to provide appropriate site security measures, such as temporary fencing and protection barriers on construction sites. It can help you identify and manage on-site hazards to ensure a safer construction site for everyone.

Risks

A construction site can be a dangerous place to work due to changing and ongoing risks, including those associated with:

- demolition of existing structures.
- excavations.
- slips, trips and falls.
- temporary electrical installations.
- partially constructed structures.
- stored construction materials.
- on-site plant and equipment.

Construction sites are dangerous and should have 'danger' signage at the entrance to the site

Occupational health and safety duties

A person who has management or control of a construction site or construction site, must ensure, so far as is reasonably practicable, that the construction site is safe and without risks to health.

This general duty applies even when work is not taking place, such as outside of working hours. It extends to members of the public, who may enter an unoccupied construction site, exposing them to serious health and safety risks.

The principals of health and safety protection require that members of the public are given the highest level of protection against risks to their health and safety that is reasonably practicable in the circumstances.

When assessing risks to the public, Construction Site Owners should consider the possibility of children entering an unoccupied construction site, noting that risks may increase when the site is located near:

- a school, including a route travelled by children to and from school.
- parks or recreational areas.
- built up areas.

Controlling the risks

Unauthorised visitors, (including children), may not be deterred by warning signs, have no awareness of the dangers that may be present on a construction site and have no idea of the risks that they may be exposed to once they have entered a site. These risks can include serious injury from falls from partially constructed buildings and scaffolding, electric shock from "live" cables, drowning in open excavations, suffocation or crushing from collapsing material, coming into contact with hazardous substances, protruding objects or falling onto protruding reinforcement bars.

Ideally, all hazards and risks should be eliminated on the site, but this is not always achievable.

The most acceptable method to control risk adopted by industry is the use of appropriate temporary site security fencing. Security fencing can effectively control unauthorised entry onto an unoccupied construction site and can discourage or prevent young children from entry.

Other controls, such as surveillance by security personnel, should only be considered for short duration periods where it is not reasonably practicable to provide security fencing.

Security fencing

When a security fence is used to control unauthorised entry onto a construction site, it should be:

- at least 2.8m high.
- well-constructed - gates and joints in fence sections should be securely connected, without any weak points for entry.
- stable and able to withstand anticipated loads or forces, such as strong winds (Note: fencing with signage and shade cloth type coverings may require additional support to resist wind loadings).
- difficult to climb and prevent access from underneath (Note: sheets of reinforcing mesh should not be used as site fencing because it may allow adequate hand and foot hold for children to climb over. Protruding ends may also cause injury).

CHECKLIST FOR SAFETY AND SECURITY FENCING		
PART 1 This checklist will help you to determine if you need safety and security fencing for your construction site. If you tick 'yes' to any question, you may need to install fencing.		
Known hazards and potential risks	**Yes**	**No**
Is the site near to other residential buildings where children may play out of site working hours		
Is the site near to local schools or routes that children may take home?		
Are there excavations on site – e.g., open trenches, utilities, pier holes, or swimming pools?		
Are there any impaling materials left on site – e.g., reo bars, nails in timber or from work materials?		

Is there a potential for collapse – e.g., concrete formwork or battered areas of soil from side cuts?		
Is there a potential for unauthorised access on the site by any individuals? Consider access: To hazardous materials To plant materials Overnight or when the site is unsupervised By climbing over or under the existing fence To electricity or services To scaffolding, upper story floor levels, ladders or penetrations		
Are there any other hazards on site that need to be isolated?		
If you tick 'yes' to any of the questions but choose not to install fencing, explain here how you will secure the site:		
PART 2 Where you have decided that you need to fence your construction site, this checklist will ensure that your fencing meets work health and safety requirements. If you tick 'no' to any question, you need to address the issue before starting work.		
Criteria for Safety and Security Fencing	**Yes**	**No**
Is the fencing constructed from suitable, dedicated materials with no holes or gaps?		
Are the fencing panels difficult to climb?		
Is access under or through the fence barricaded – i.e., no gaps throughout the construction process?		
Is fencing erected on a firm foundation throughout the construction process?		
Is the fencing installed on level ground – i.e., a lean of less than 3 degrees out of vertical?		
Is the fence erected in a general straight line within the site boundary?		
Are any star pickets or sharp posts capped?		
If you have temporary fencing, is it erected within the boundaries of the construction site? (if fencing protrudes onto public areas, you need permission from the local authorities)		
Are electrical turrets external to the installed fence?		
Is fencing stable and able to withstand any anticipated loads to which it will be subjected – including wind loads, people attempting to scale it, forces caused by people in heavy pedestrian areas or impact forces vehicles or plant?		
Is fencing installed in-line with designers, manufacturers, and suppliers' instructions and specifications?		
Are adequate support brackets installed – especially if shade cloth, signage, or advertisements are installed on any section of the fencing?		
Are all fence fittings – including clamps – installed securely, with the nuts on the inside for added security?		
Do fencing gates provide the same level of security as the rest of the fence? (locks and chains should be fitted for added site security and safety)		
Are gates overlapping so they can be locked easily, and are they reasonable level for opening gates?		
Does signage on the fence include relevant information – including 24-hour emergency contact name and telephone numbers?		
Are all fencing panels handled safely and stored in the flat (horizontal) position?		
Is the fence regularly inspected (weekly, dependant on the work and activities undertaken on the site) to ensure it is safe, secure and still fit for purpose?		

Site signage

The purpose of signage is to provide information about what building work is happening, or proposed for the site, and warning messages about what people can or can't do when entering a site.

Signage should also provide information about who management or supervisors working on the site and how to contact them if need be.

Safety barriers - traffic

Safety barriers are installed at construction sites along roadways to protect workers from passing traffic and vehicle occupants from hazards within the construction site.

Safety barriers are an important safety measure as they:

- physically separate the work area and the travelled way,
- will inhibit penetration by an out-of-control vehicle; and
- will have vehicle redirection properties.

When should I use a safety barrier?

Safety barriers should be used when:

- There is potential for workers or roadwork plant to be struck by passing traffic.
- There is potential for passing traffic to impact hazardous objects or deep excavations within the construction site.
- There is potential for a vehicle to impact a construction site structure and cause collapse.
- The safety risk to pedestrians or cyclists will be increased.

Barriers may be particularly useful in situations where:

- long term works are being undertaken and physical separation between the worker and the traffic will minimise the risk of injury for both parties.
- it is desirable to keep the speed limit of passing vehicles higher to allow greater traffic volumes to pass the construction site.
- it is not possible to close a lane to provide increased clearance between workers and traffic.

General construction site safety guidelines state that "safety barrier protection should be considered where practicable for construction sites adjacent to moving traffic".

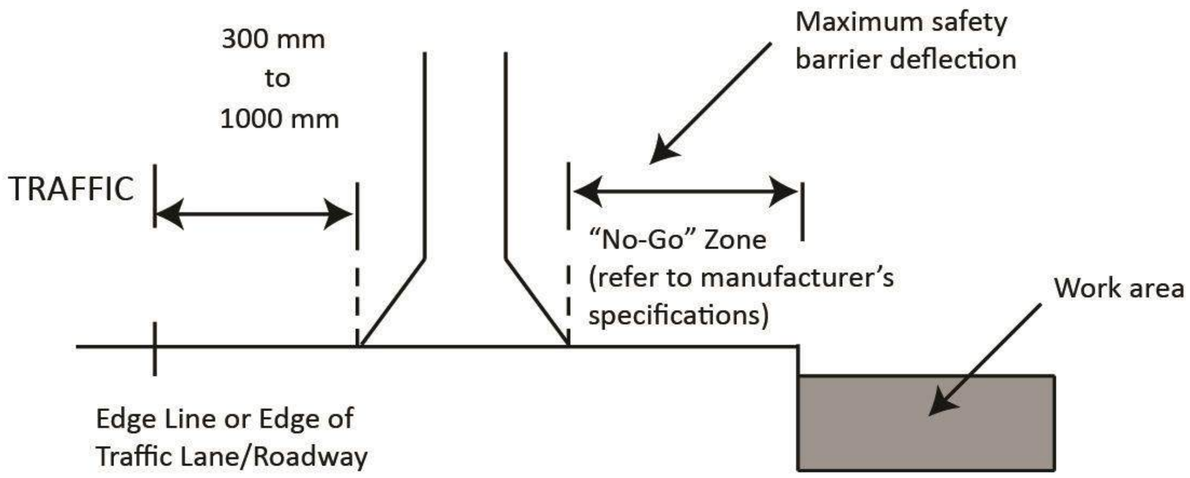
While an increased clearance to traffic or reduced speed limit will reduce the likelihood of impact, physical separation is preferred to minimise the risk of injury when an incident occurs.

How do safety barriers function?

When an errant vehicle strikes a temporary safety barrier, the barrier acts to redirect the vehicle away from the construction site.

Safety barriers will have some deflection when they are struck; that is to say that at the point of contact the barrier will be pushed, or bend, backwards to some extent. This softens the impact for the vehicle occupants, however, may create a hazard for workers or pedestrians close to the back of the safety barrier.

This area is known as the “No-Go zone”, in which there should not be any workers or pedestrians.



Safety barrier clearance

What do safety barriers look like?

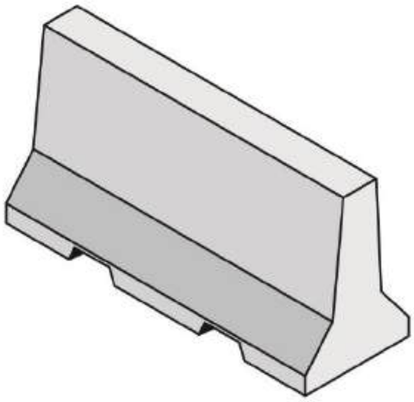
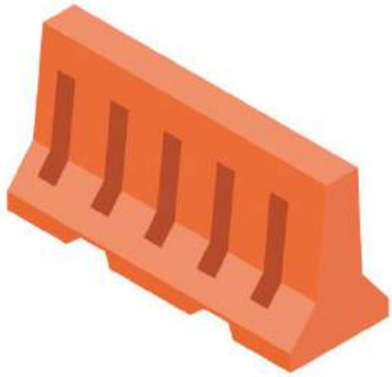
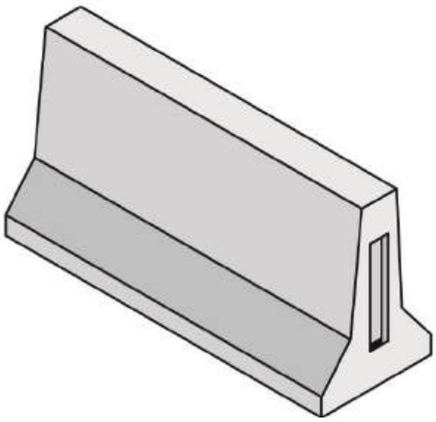
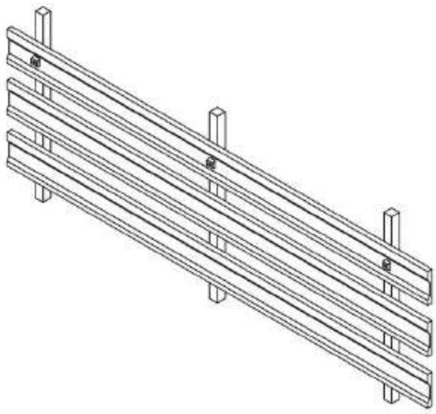
Safety barriers may be permanent or temporary and may be made of various materials including concrete, steel and plastic.

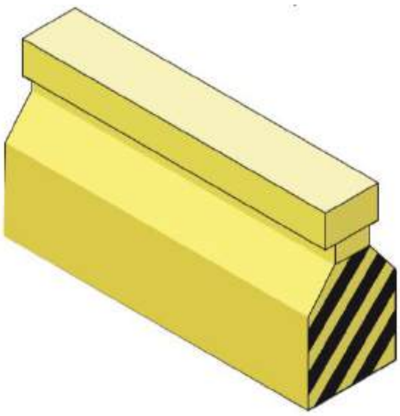
Where the end of a barrier can be impacted by traffic, an accepted end treatment/terminal is required.

Safety barriers that meet safety ratings and standards would have been crash tested with various vehicles in specific configurations. It is crucial to install the barrier as it was crash tested to ensure the product will work as intended. Most products require interconnection, and some are pinned to the surface to reduce deflection.

Do different barriers provide different levels of protection?

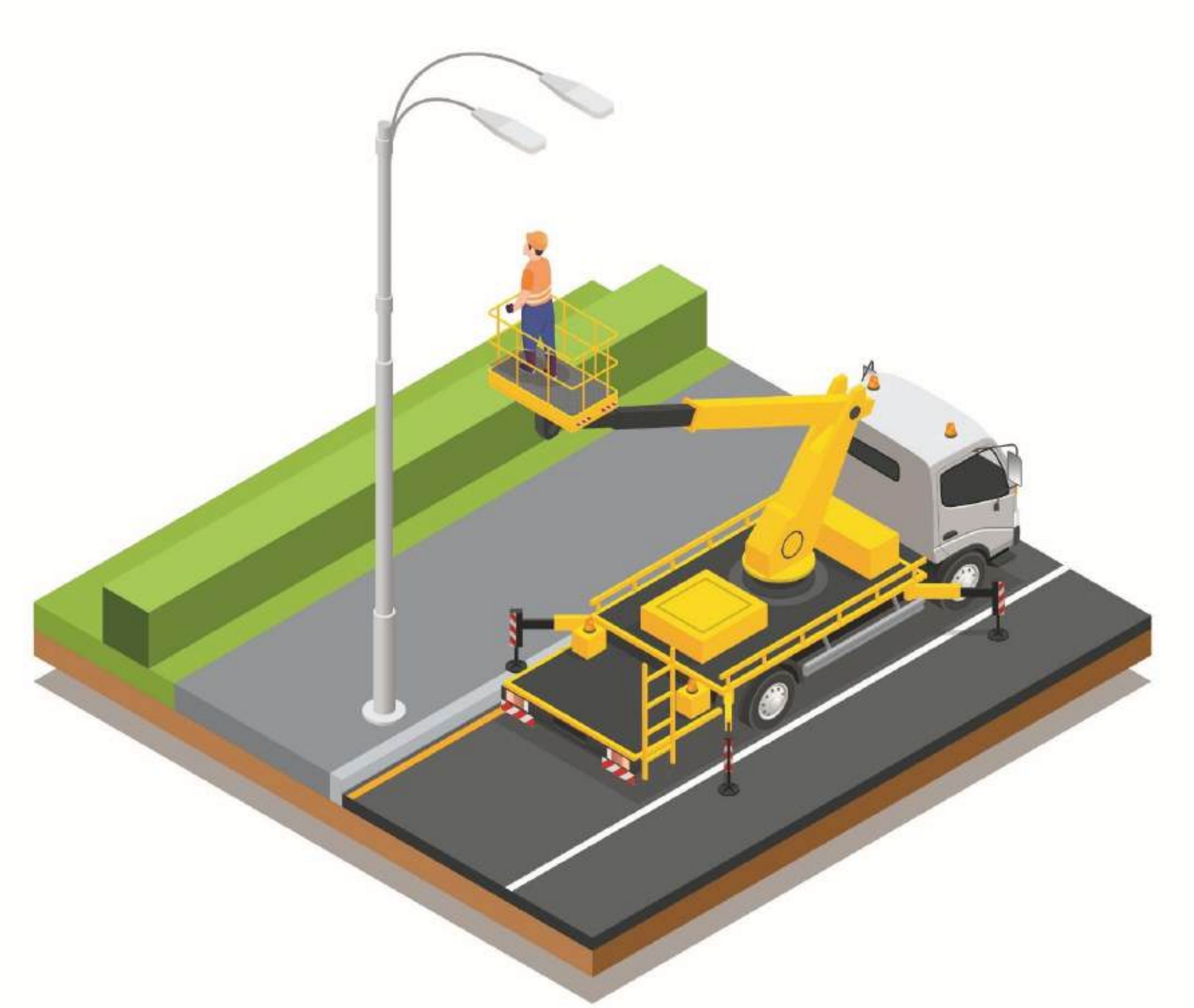
There are several different levels to which barrier suppliers may test their product. Essentially, the speed and size of passing vehicles are considered when choosing a test level.

Concrete Longitudinal Barriers	Plastic Longitudinal Barriers
	
Concrete Longitudinal Barriers typically have less deflection than other freestanding barrier types and require less development length to achieve the desired deflection. These barriers can be interconnected, and barrier ends are hazardous and must have a protective shield fitted.	Freestanding Plastic barriers have the greatest deflection. Plastic barrier units cannot be pinned and must be filled with water to function properly. To achieve the expected deflection, a minimum development length is required. Vehicle impacts near the terminal will deflect more than specified.
Steel Longitudinal Barriers	**Crash Cushions / Impact Attenuators**
	
Freestanding steel barriers will have greater deflection than freestanding concrete but can be more manageable on site. Steel barrier units can be pinned to reduce deflection and must be interconnected. Barrier ends are considered a rigid hazard for vehicles and must be protected.	Crash cushions must be pinned to the ground surface. Crash cushions will redirect vehicles from the nose and can be used to shield the construction site. Crash cushions can be attached to longitudinal barriers to eliminate the need for development length and provide expected deflection from the nose

Plastic End Terminals

Plastic end terminals protect the longitudinal barrier end but do not shield the construction site. Plastic end terminals cannot be pinned and must be filled with water to function properly. Plastic end terminals are gating and will allow a vehicle to pass through when impacted on an angle.

CHAPTER 13

SAFE USE OF CRANES



Operating cranes is complex and dangerous, and workers must have the necessary training, skills, and capabilities to do it safely. Every year there are injuries and deaths on construction sites that involve cranes.

Cranes: a definition

A crane is an item of plant used to raise or lower a load and move it horizontally.

There are a range of fixed (tower, bridge, gantry, portal boom, vessel-mounted) and mobile (slewing, non-slewing, vehicle loading) cranes.

A range of multi-purpose powered mobile plant, including multi-purpose tool carriers and telescopic handlers, may be classed as cranes in some operating configurations.

Work health and safety duties

Everyone in the construction site has a work, health & safety duty when it comes to operating cranes. A range of people have specific responsibilities for cranes including the:

- crane designer, manufacturer, importer and/or supplier.
- crane owner and others with management or control of the crane or the construction site where a crane will operate.
- competent person who inspects cranes.
- crane operator.

Managing risks associated with cranes

You should manage risks by following a systematic process of:

- Identifying hazards - find out what could go wrong and what could cause harm.
- Assessing risks if necessary - understand the nature of the harm each hazard could cause; how serious the harm could be and the likelihood of it happening.
- Controlling risks - implement the most effective control measures that are reasonably practicable in the circumstances.
- Reviewing control measures to ensure they are working as planned.

Identify hazards

When it comes to cranes the following can help you identify potential hazards:

- Observe the construction site to identify areas where cranes operate and how they interact with other vehicles, pedestrians and fixed structures like overhead electric lines.
- Ask the crane operator, crane crew and others about problems they encounter at the construction site including with operation, inspection, maintenance, repair, transport and storage requirements.
- Review your inspection, test and maintenance records, for example logbooks and incident and injury records including near misses.

Assess the risk

In many cases the *risks* and related control measures will be well known. In other cases, you may need to carry out a risk assessment to identify the likelihood of somebody being harmed by the hazard and how serious it could be. People who work with or near cranes are most at risk. Some of the risks when using a crane include:

- structural failure, overturning, or collapse of the crane.
- contact or collision of the crane or its load with people or other plant and structures.
- falling objects.

A risk assessment can help you determine what action you should take to control the risk and how urgently the action needs to be taken.

What could go wrong	Possible causes
The Crane could tip over	➢ The crane is set up on soft, unstable ground ➢ The crane is not set up level ➢ The crane is positioned above underground services ➢ The outriggers of a mobile crane are not fully extended or used as directed in the manufacturer's instructions ➢ Insufficient counterweights are used ➢ Wind ➢ The weight of the load is calculated incorrectly
The structure of the crane could fall	➢ The rigging components are overloaded ➢ The load swings or drops suddenly ➢ The load is hoisted beyond the capacity of the crane ➢ The crane has not been maintained properly ➢ The crane has not been assembled properly ➢ The weight of the load is calculated incorrectly
During the lift, the boom of the crane could hit people, structures, or other machinery in its path	➢ There is insufficient clearance between the crane and other structures or machinery ➢ The path of the load is not carefully planned ➢ Safe Zones are not maintained, and unauthorized people enter the lift area
The Dogman, Ground Workers and/or Crane Operator could be electrocuted	➢ The crane comes in contact with overhead power lines ➢ There is an arcing of electrical current when the crane comes close to power lines
Objects could fall off the load being lifted and hit people, structures or other machinery	➢ Material is not properly secured ➢ The load is rigged incorrectly ➢ Safe Zones are not maintained, and unauthorized people enter the lift area
The load could be dropped	➢ The lifting equipment has not been maintained ➢ The lifting equipment is not rated to the load being lifted

	➢ A component of the crane fails

Table 1: The many risks involved in Crane Operation

Take action to control the risk

The first thing to consider is whether crane related hazards can be completely removed from the construction site.

- For example, designing items of a size, shape and weight so they can be delivered, handled or assembled at the location where they will be used without the need for a crane.

If it is not reasonably practicable to completely eliminate the risk then consider the following options in the order they appear below to minimise risks, so far as is reasonably practicable:

- Substitute the hazard for something safer, for example replace a crane operating cabin with a restricted field of vision with one that has a clear field of vision or use a remote control, for example a pendant control.
- Isolate the hazard from people, for example use concrete barriers to create an exclusion zone to separate crane operations from workers and powered mobile plant.
- Use engineering controls, for example enclosing the operator with a (falling object protection structure (*FOPS*) to minimise the risk of the operator being hit by a falling object.

If after implementing the above control measures a risk still remains, consider the following controls in the order below to minimise the remaining risk, so far as is reasonably practicable:

- Use administrative controls, for example schedule crane operations to avoid or reduce the need for pedestrians and vehicles to interact with the crane in the area of operation.
- Use PPE, for example gloves, hard hats, high visibility vests, ear plugs/muffs and eye protection.

A combination of the controls set out above may be used if a single control is not enough to minimise the risks.

Deciding what is reasonably practicable includes the availability and suitability of control measures, with a preference for using substitution, isolation or engineering controls to minimise risks before using administrative controls or PPE. Cost may also be relevant, but you can only consider this after all other factors have been taken into account.

Consultation

You must consult your workers and their health and safety representatives, if any, when deciding how to manage the risks of using a crane in the construction site.

If there is more than one business or undertaking involved at your construction site, you must consult them to find out who is doing what and work together so risks are eliminated or minimised, so far as is reasonably practicable.

This may involve discussing site-specific requirements including the type of crane to use, operator training and traffic management.

Choosing a crane

Before you choose a crane, you should discuss your construction site needs with suppliers and identify cranes most suited to the construction site and the work it will be used for. You should take into consideration:

- the complete life cycle of the crane.
- how long you are likely to keep the crane.
- how often the crane is likely to be used.
- the conditions under which it will be used.
- the maximum loads the crane is likely to bear.

Some of the things to look for when choosing a crane include:

- safe access points - ladders, footholds, steps and grabs rails.
- seat design - comfort and back support.
- visibility - mirror, window and windscreen design.
- environmental controls - temperature control units to avoid worker heat stress.

Hiring a crane

Anyone hiring or leasing a crane has duties as both a supplier and a person with management or control of the crane at the construction site. They must check the crane is safe to use and properly maintained and provide specific information including instructions on how to operate it safely.

- Before you hire a crane you should check that it is suitable for its intended use. You should also consider whether you need to hire a crane only or you need a crane with a trained and licensed crane crew.

If you do not have the knowledge or expertise about crane specifications, limitations and operational requirements, you should talk to the crane supplier and provide relevant information about the work to be done, the construction site and the type of lifts to be completed so the supplier can provide a suitable crane.

SETTING UP AND OPERATING A CRANE

Documentation and markings

Load charts

A crane of variable radius, for example a tower or mobile crane, will have a crane-specific load chart (also known as a ‘rated capacity chart’) setting out how the crane lifting capacity varies depending on how the crane is set up i.e., how far the boom is extended and the angle of the boom. Using the load chart correctly is critical to ensure the crane is used safely.

Where the crane has one main load chart it should be fixed in the operator's cabin in a place that is easy to see and read. Where the crane has more than one load chart, for example for different boom and fly jib configurations, the charts should be easily accessible for the operator to verify the crane will not be overloaded. The charts may be kept electronically or in hard copy.

The lifting capacity of a crane is generally limited by:

- the structural strength when the working radius is small, and
- stability when the working radius is greater.

However, there are structural limits at both the minimum and maximum working radius. If a crane is overloaded, a structural or mechanical component of the crane may fail, or the crane may overturn.

The lifting capacities specified on a load chart should not be exceeded except during testing of the crane by a competent person under controlled conditions.

Each load chart should include enough information to identify the crane configuration it applies to. For example:

- the safe working zone.
- the counterweight masses.
- whether a fly jib is fitted, in use, in place or stowed.
- outrigger extension or pick-and-carry mode.
- maximum speed for mobiling a load.
- rope and reeving details, including number of falls of rope in the hook block.
- main or auxiliary hoist in use, and
- whether the hook block is included or excluded.

Some important factors which are often overlooked when reading load charts are:

- subtracting the mass of the hook block and lifting slings from the capacity of the crane at the particular radius. This should be noted on the load chart. For example, if the load chart states the crane can lift 20 tonnes at a given radius but the hook and lifting gear have a combined mass of 1 tonne, the load to be lifted cannot be more than 19 tonnes. This issue is critical for heavier hook blocks and lifting gear, for example spreader beams.

- subtracting the mass of the fly jib (adjustment mass) from the capacity of the main hook when lifting from the main hook on the main boom with a fly jib attached to the boom head. This adjustment mass should be noted on the load chart - there may be two different masses for some cranes with swing around fly jibs - one for the fly jib in place and another for the stowed position. Capacities of the main boom are generally based on the fly jib being removed. If this issue is ignored, the crane is likely to overturn.

- the increased maximum working radius that may result when using a fly jib.

Limiting and indicating devices

Limiting and indicating devices, for example rated capacity limiters, motion limiting devices, load indicators and radius indicators are intended to prevent a crane moving beyond its safe operating limits or to aid crane operators. The devices should not be relied on in place of using the crane's load chart and operating instructions. Sole reliance on these devices, especially indicating devices, in place of safe operating practices may cause an incident.

Free-fall lock-out

When a crane is fitted with a free-fall facility this function should be able to be positively locked out and not able to be unintentionally activated.

Operator protective devices

Suitable operator protective devices must, so far as reasonably practicable, be provided for powered mobile plant including cranes. Typically, these include FOPS and operator restraints e.g., seat belts. A roll-overprotective structure (ROPS) may also be an appropriate device for some types of cranes.

Siting the crane

You should choose where to site a crane during the planning phase after considering relevant factors including:

- the risk of the crane overturning or collapsing from the:
  - foundations or supporting structure failing, and
  - crane and foundations/supporting structure combination not being able to withstand the forces likely to be imposed on it.
- the risk of the crane colliding with other plant, structures or objects at the construction site, and
- the loads and lift paths including the load pickup and drop off or installation locations.

Crane standing area

The crane standing design should conform to the crane manufacturer's instructions or a competent person's recommendations, for example an engineer. The crane standing should be designed to withstand the forces likely to be imposed on it by the crane while in-service, out-of-service and during erecting and dismantling. These forces include:

- the dead weight of the crane.
- the dead weight of the load and lifting attachments.
- dynamic forces caused from the crane moving.
- bearing pressure being applied by the crane's outriggers and/or tyres/tracks.
- wind loadings, and
- loads identified by the designer of the crane standing area.

When a crane is to be supported on, or tied to a permanent or temporary structure, the design of the structure should be capable of withstanding the forces designed to be imposed on it by the crane. Precautions should also be taken to ensure the stability of the crane when the crane will be sited near underground services, excavations or embankments.

Collision between the crane and other plant and structures

If there is a possibility of cranes colliding with other plant or structures you should position the crane so the clearance between the crane and its load and other plant, structures and workers minimises the risk of collision.

Where cranes are operating near one another they may share the same air space. The people in each work area should consult and develop safe systems of work to make sure there is enough space between the cranes and where they work. Each work area should nominate a person to implement the safe system of work.

A safety observer (also known as a 'spotter') should be used where a collision between a crane and other plant or structures may occur.

Where cranes are set up in or near flight paths, you should contact the local airport operator to find out where these are in the area where the crane is operating. Where necessary, aircraft warning lights should be fitted to the highest part of the crane.

Working near electric lines

You must ensure, so far as is reasonably practicable, no person or crane at the construction site comes within an unsafe distance of an overhead or underground electric line.

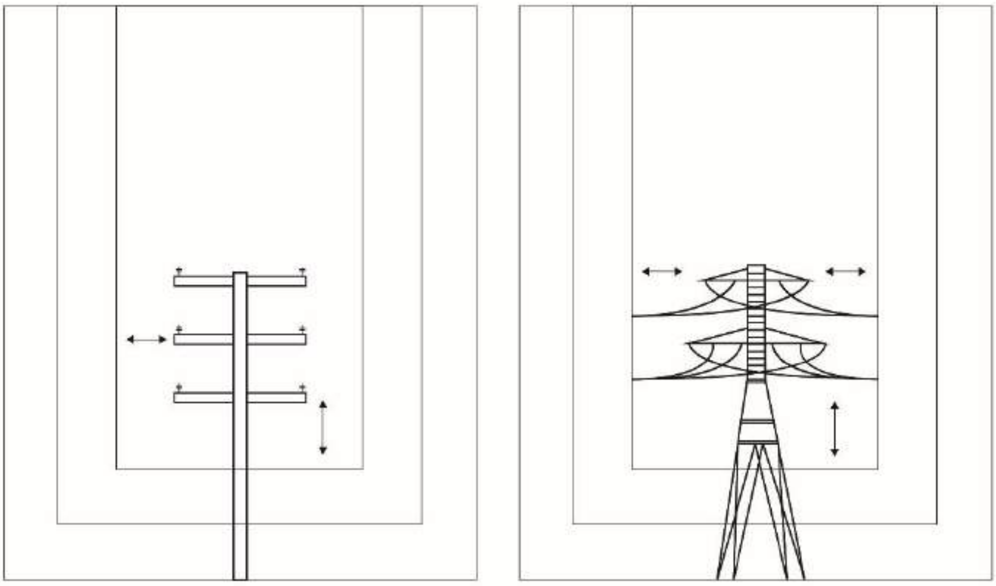
If this is not reasonably practicable then you must carry out a risk assessment and implement control measures to manage the risks. The control measures must be consistent with requirements of the Electricity Supply Authority.

A safety observer should be used when the crane, its load, or anyone working from the plant are in motion and likely to enter a restricted work zone established around electric lines.

Electric lines can have significant risks including electrocution, arcing, explosion or fire causing burns, unpredictable cable whiplash and other objects being electrified like signs, poles, trees or branches. Contact with energised overhead or underground electric lines can be fatal regardless of the voltage they carry. It is not necessary to touch an overhead electric line to be electrocuted. A 'flashover' or 'arc' can electrocute you when you are close to a line conductor.

Most risks can be controlled by observing safe working distances for people and cranes working near electric lines. Safe working distances will depend on the type of work being carried out and the voltage of the electric lines. You should contact the relevant Electricity Supply Authority to determine the type of control measures required. This may include isolating the electric line for the duration of the work.

Contact with energised overhead electric lines may have an impact on parts of the crane for example tyres, hydraulic and electrical systems. If contact occurs, the crane should be immediately placed out-of-service until it has been inspected by a competent person and proven to be safe to resume normal operation.



Examples of “No-Go” zones for electrical power lines

Working at height

People installing, erecting and dismantling some types of cranes may be exposed to the risk of falling when working at height. An activity carried out in relation to construction work where a person could fall more than 2 metres is defined as high-risk construction work and requires a safe work method statement (SWMS).

To minimise the risk of workers falling from a height control measures may include:

- temporary work platforms e.g., an elevating work platform.
- travel restraint systems.
- fall-arrest harness systems, and
- edge protection systems.

Pick and carry

Pick and carry activities occur when a mobile crane carrying a suspended load travels with the load (also known as mobiling). Pick and carry activities are only to be carried out with cranes designed for this purpose and in accordance with the manufacturer’s instructions.

The rated lifting capacity of pick and carry cranes is de-rated by design to take into account the reduced stability when the crane moves across various terrain types. Pick and carry crane manufacturers may also provide a de-rating chart to help determine a crane’s rated lifting capacity when working on specified side slopes.

Operational risks such as ground conditions, intended travel pathway, and wind speeds also need to be considered.

Unless otherwise specified by the manufacturer, cranes designed to remain in one location during the lift, for example vehicle loading cranes, are not to be used in a pick and carry mode.

When plant, for example earthmoving equipment or telescopic handlers are used for pick and carry activities, the manufacturer's instructions or those of a competent person must be followed.

Crane stability

Failure to maintain stability is one of the key factors associated with serious crane incidents. Things to consider are:

- crane operation parameters resulting in an overturning moment greater than the stabilising moment of the crane - the crane counterweight generally provides the primary stabilising moment.
- the ground conditions and means of supporting the outrigger pads or the crane tyres.
- the slope of the ground including both the side slope and the slope of the ground in the direction of the crane travel if the crane has mobile ratings.
- wind conditions - will vary depending on the size and shape of the suspended load and crane boom, and
- the way loads are lifted or moved e.g., a sudden stop when mobiling a load may cause the load to swing and destabilise the crane.

If the crane moves unexpectedly while mobiling or slewing, the load may swing unexpectedly. Cranes should only be sited and operated on stable surfaces, designed by a competent person where applicable, with the correct bearing pressure and without significant holes or indentations that may cause the crane and load to move unexpectedly from being unstable.

Carefully stabilize crane before rigging

Mobile cranes use outriggers or other stabilizing features to prevent the crane from tipping over during operation. When stabilizing the crane, keep the following in mind:

- Follow **manufacturer guidelines** to determine how far to extend outriggers.
- Always use **outrigger pads** or **crane pads** underneath outriggers.
- Never place outriggers over **voids**, **depressions** or **unsteady ground**.

Many crane accidents and tip-overs occur due to improper outrigger set up, so be certain that you've made a solid safety assessment of outrigger placement.

Wind conditions

Winds impose extra loads on a crane and affect the crane's stability. Where wind speeds are greater than those recommended by the manufacturer, crane operations should be stopped and if necessary, the crane should be stowed.

The design wind speed for the crane should be listed in the manufacturer's instructions and marked on the load chart(s).

Crane operators should recognise that dependent on the boom length and luffing angle, the wind speed may be greater at the height of the load compared to the wind speed at the height of the crane's cabin. Also, wind gusts have a different effect on the crane than a constant wind.

Given these variables, crane operators should make their decision to conduct a lift based on the information provided by the crane manufacturer, advice provided by competent people like an engineer, dogger or rigger.

If the crane operator considers it is unsafe to lift the load it should not be lifted until:

- a written authorisation is provided by a competent person confirming the load is safe to lift and how it is to be lifted, or
- the conditions change and the crane operator decides it is safe to make the lift.

Inspection and pre-use safety checks

Making sure cranes at your construction site are inspected and maintained is part of your responsibility as a Principal Contractor, Construction Site Owner and Crane Operator.

Inspecting and testing cranes must include:

- major inspection required for registrable mobile and tower cranes.
- regular inspection and testing required for plant.
- inspection and testing for plant item re-registration.

Before a crane is used tests, inspections and specific adjustments must be carried out to make sure the crane can be used safely. This includes:

- construction site factors including ground load bearing capacity and wet or windy conditions are taken into account.
- confirming the crane will not adversely affect or be affected by other plant and structures in the area.
- installation and commissioning activities are supervised by a competent person.
- assembling the components in the correct sequence using the right tools and equipment.
- limit switches and load indication devices are functioning and correctly calibrated.
- the crane being installed and commissioned to the designer's or manufacturer's instructions and specified technical standards.
- the crane being stable.
- safe entry to and exit from the crane - including in an emergency.

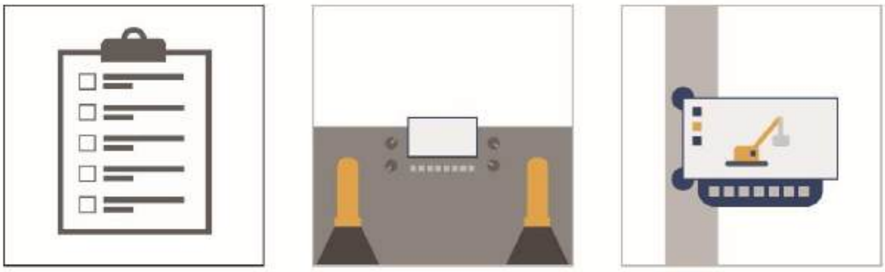
A preventative inspection, maintenance and testing program will help ensure a crane is safe to use.

- Inspections and maintenance should be done in accordance with the manufacturer's instructions or, if these are not available, a competent person's specifications or according to relevant technical standards and engineering principles.

Perform daily operator checks

A crane operator must use a daily inspection checklist to ensure the crane is safe prior to operation. These checks include pre-start checks, engine start-up checks and safety system checks.

- **Pre-start checks**: Before starting the crane, the operator should check tire condition, oil levels, seat belts, air reservoir and the battery, among other things.
- **Engine start-up checks**: Before daily work begins, the operator should start the engine, check the pressure gauge, fuel level, turn signals, horn, suspension and brain system, among other things.
- **Safety system checks**: Most importantly, safety system checks should be performed to prevent catastrophic accidents. Make sure to evaluate the anti-two blocks, the rated capacity limiter and outriggers.



Evaluate the anti-two blocks, the rated capacity limiter and outriggers before operating the crane

Emergency plan

An emergency plan must be prepared for each construction site where a crane will be operated. It must be tested in the

construction site and include emergency procedures like effective response and evacuation, notifying emergency services and medical treatment. Emergency procedure training must be provided to workers.

Contact numbers for emergency services should be easily seen or found. Workers should know what system is in place to contact emergency services and how to use it.

Documentation

The type of documentation you may need will depend on the type of work being carried out.

For example, work that involves tilt-up or precast concrete and work that is carried out in an area at a construction site where there is any movement of powered mobile plant is 'high risk construction work', and may need approval from relevant authorities, require trained and licenced operators and require the Principal Contractor and/or Construction Site Owner to conduct a SWMS.

A SWMS will identify and specify the hazards relating to the work and the risks to health and safety. It will also describe the measures to be implemented to control the risks and describe how the control measures are to be implemented, monitored and reviewed.

Licences

Operating a crane is high risk work and requires a high-risk work licence. There are various high-risk work training courses and licences available in Cambodia for crane operation.

High-Risk Work Licence	Description of class of High-Risk work
Tower crane	Use of a tower crane
Self-erecting tower crane	Use of a self-erecting tower crane
Derrick crane	Use of a derrick crane
Portal boom crane	Use of a portal boom crane
Bridge and gantry crane	Use of a bridge crane or gantry crane that is: ▪ controlled from a permanent cabin or control station on the crane ▪ remotely controlled and having more than 3 powered operations, including the application of load estimation and slinging techniques to move a load.
Vehicle loading crane	Use of a vehicle loading crane with a capacity of 10 metre tonnes or more, including the application of load estimation and slinging techniques to move a load.
Non slewing mobile crane	Use of a non-slewing mobile crane with a capacity exceeding 3 tonnes
Slewing mobile crane—with a capacity up to 20 tonnes	Use of a slewing mobile crane with a capacity of 20 tonnes or less
Slewing mobile crane—with a capacity up to 60 tonnes	Use of a slewing mobile crane with a capacity of 60 tonnes or less
Slewing mobile crane—with a capacity up to 100 tonnes	Use of a slewing mobile crane with a capacity of 100 tonnes or less
Slewing mobile crane—with a capacity over 100 tonnes	Use of a slewing mobile crane with a capacity exceeding 100 tonnes

Table 2: The types of high risk work licences

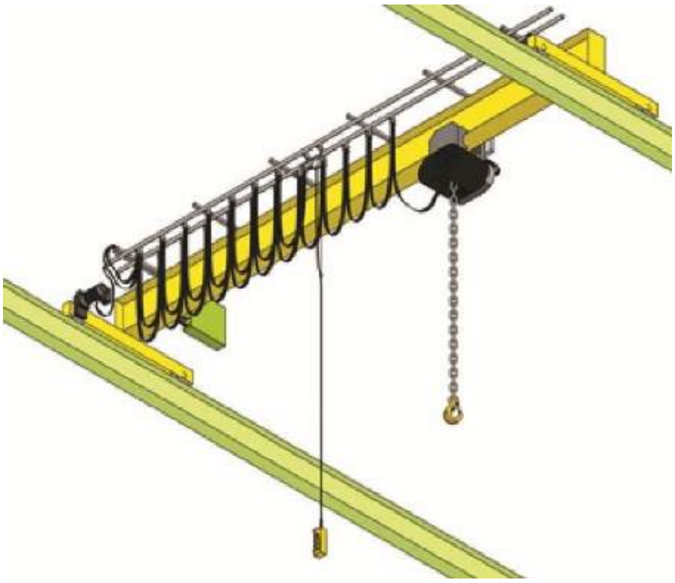
Examples of Cranes that require the Operator to hold a High-Risk Work Licence

Set out below is information about some of the kinds of cranes that require the operator to be experienced and hold a high-risk work licence.

Bridge and gantry cranes

A bridge crane:

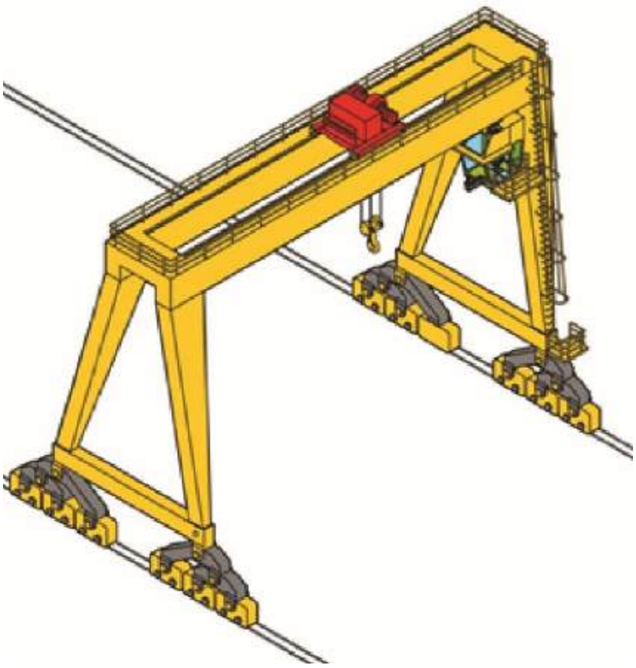
- consists of a bridge beam or beams that are mounted to end carriages at each end.
- is capable of travelling along elevated runways.
- has one or more hoisting mechanisms arranged to traverse across the bridge.



Example of a Bridge Crane

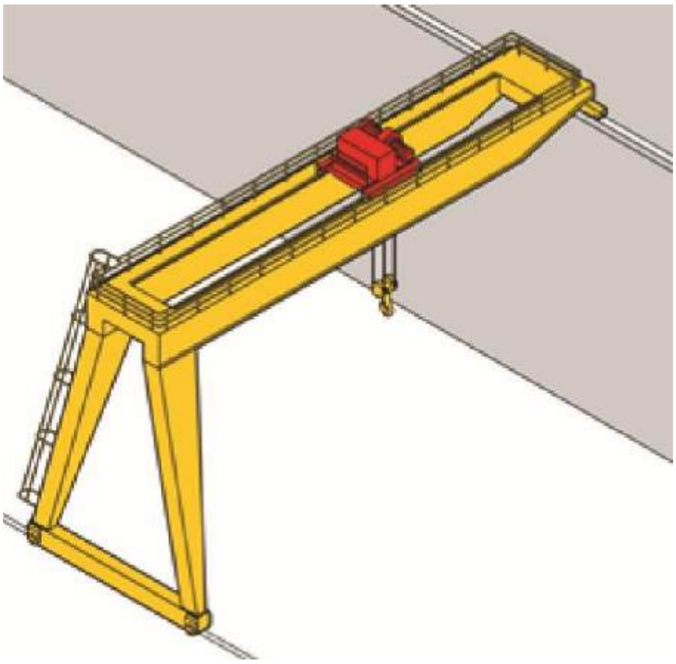
A gantry crane:

- consists of a bridge beam or beams supported at one or both ends by legs mounted to end carriages.
- is capable of travelling on supporting surfaces or deck levels, whether fixed or not.
- has a crab with one or more hoisting units arranged to travel across the bridge.



Example of a Gantry Crane

A gantry crane with a carriage that travels on an elevated runway on one side and a leg mounted to a carriage on the other side is sometimes referred to as a 'one-legged gantry crane', a 'combination crane' or a 'semi-gantry crane'.



Example of a One-Legged Gantry Crane

Vehicle loading cranes

A vehicle loading crane refers to one that is mounted on a vehicle to load and unload items off the vehicle.

With the introduction of larger capacity vehicle loading cranes and proportional control - that is the ability to operate multiple crane functions simultaneously - vehicle loading cranes may also be used for more traditional crane operations where the load is lifted:

- from the vehicle to an elevated area at a construction site, for example lifting packs of timber from the vehicle directly to a building floor.
- both to and from locations remote from the vehicle on which the crane is mounted.
- into place and held while it is connected to a structure, for example installing a sign.

Where a vehicle loading crane is used for a purpose other than loading and unloading the vehicle on which it is mounted, a slewing mobile crane high risk work licence may be required to operate the vehicle loading crane.

Unless a vehicle loading crane has been designed for pick-and-carry operations it must not be used in this way.

Example of a Vehicle Loading Crane

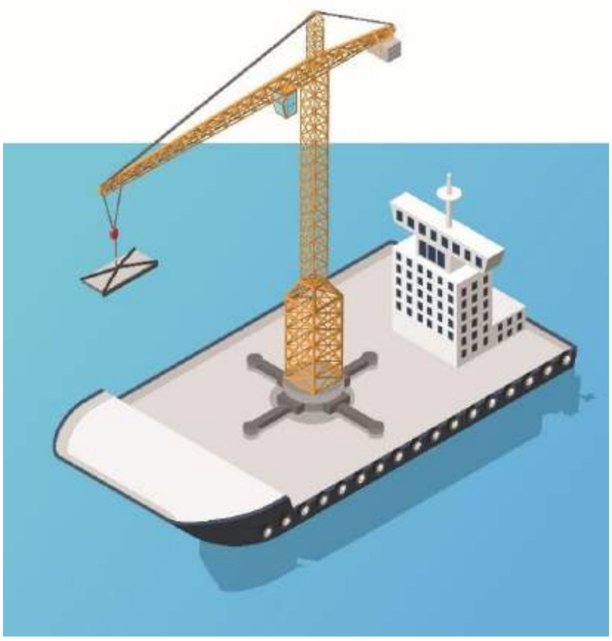
Vessel-mounted cranes

A vessel-mounted crane is a crane mounted on a vessel to lift loads. It may be permanently fixed to the vessel or a mobile crane temporarily positioned on the vessel.

Vessel-mounted cranes can be used for a range of tasks including:

- moving loads on and off or between vessels.
- suspending and holding loads in position.
- pile removal.
- grabbing.

A mobile crawler crane mounted on a barge



Example of a Vessel-Mounted Crane

Tower cranes

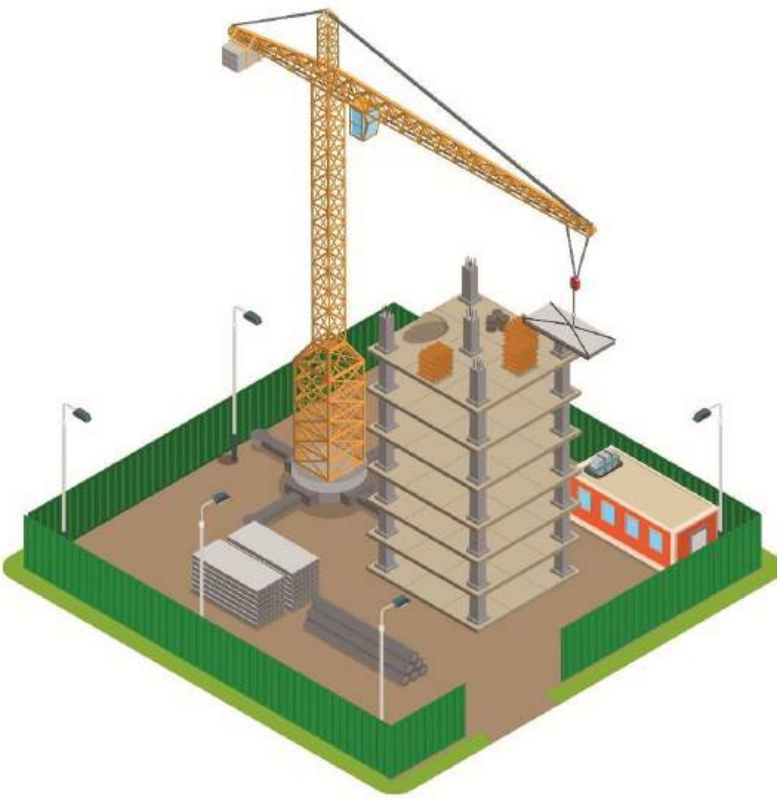
The three general types of tower cranes used:

- luffing.
- hammerhead (including topless).
- self-erecting.

Tower crane means one that has a boom, or a jib mounted on a tower structure.

- For high-risk work licensing purposes, a tower crane - if a jib crane - may be a horizontal or luffing jib type and the tower structure may be demountable or permanent, but 'tower crane' doesn't include a self-erecting tower crane.

A self-erecting tower crane is one that is not disassembled into a tower element and a boom or jib element in the normal course of use, and where erecting and dismantling processes are an inherent part of the crane's function.



Example of a Tower Crane

Mobile cranes

A mobile crane is capable of travelling over a supporting surface without the need for fixed runways and relying only on gravity for stability.

There are three general types of mobile cranes operating in Australia:

- hydraulic boom cranes.
- lattice boom cranes including crawler cranes.
- non-slewing (pick-up-and-carry) cranes.

A slewing mobile crane incorporates a boom or jib that can be slewed but does not include earth moving equipment such as a front-end loader, backhoe or excavator configured for crane operation.

A non-slewing mobile crane - also known as a pick-up-and-carry crane - is a mobile crane incorporating a boom or jib that cannot be slewed and includes:

- an articulated mobile crane.
- a locomotive crane.

A vehicle tow truck is not considered to be a non-slewing mobile crane.

A mobile crane can be set up in a range of locations and environmental conditions. Some mobile cranes, for example a non-slewing mobile crane, can also carry a load while moving (known as mobiling).

Example of a Mobile Crane

Using other powered mobile plant as a crane

Powered mobile plant may be used to lift, lower and transport freely suspended loads - that is the load is not pinned to the boom but is suspended by slings or chains from a purpose designed lifting point, jib attachment or quick-hitch.

- Powered mobile plant used in this way includes forklifts and earthmoving machinery like backhoes, front-end loaders and excavators.

These types of powered mobile plant do not generally provide the same level of safety found in common types of cranes for precision lifting and placement.

Using powered mobile plant as a crane for construction work is classified as high-risk construction work and a SWMS must be prepared before the work starts.

Quick hitches for earthmoving machinery

A quick hitch is a device that is fitted to an excavator or backhoe arm to quickly mount or dismount attachments. They are also known as ‘quick-couplers’.

There are a number of different types of quick hitches including half-hitch, mechanical, semi-automatic and automatic.

Quick hitches should have two mechanisms to engage the attachment - a primary retaining system and a backup safety system.

Operating and lifting procedures

Documenting operating and lifting procedures can help define responsibilities and manage crane activities in a logical and systematic way. This means the crane operation is more likely to be carried out safely. Lifting procedures should be prepared to suit the crane, the work and the working conditions. A SWMS will be required for crane work, including work defined as high-risk construction work.

Documented lifting procedures may include:

- hazards and risk controls to be applied e.g., for electric lines.
- the type of crane or cranes to be used.
- the loads to be lifted including the mass of the lifting equipment e.g., slings and spreader beams.
- verification that the crane standing will support the maximum ground bearing pressure to be imposed by the crane during operations.
- the position of the crane loads to be lifted and where e.g., a diagram showing a plan view of the site.
- the maximum wind speed for the crane and lower wind speeds for specified loads e.g., where the load has a large surface area, for example large pressure vessels and tanks.
- the load working radius range with confirmation the loads are within the crane’s capacity at the maximum radius.
- allowance for the factors that may require de-rating of the crane e.g., for multiple crane lifts, extra radius caused by tilting of tilt-up panels.
- when a spotter is needed e.g., to prevent a collision or contact with overhead electric lines - the tasks required, who is responsible for performing them and what communication system is to be used should also be documented.
- the slinging and lifting sequence, and
- the rigging requirements of the job.

Communication

Lack of reliable communication between a Crane Operator and dogger or rigger may lead to unsafe crane operations and contribute to injury to people from dropped loads and collision with other plant and structures.

Only one Dogger should give signals at a time. Signals may be visual, audible or a combination of both. When more than one dogger is involved in a lift, each Dogger should understand when responsibility for their part of the lifting operation should be handed over to another Dogger.

Effective communication is particularly important where the Crane Operator cannot:

- see the load, the load's landing area or the path of travel of the load or the crane.
- make an accurate judgement of distance, and
- see if the crane or the load may contact overhead electric lines or other obstacles.

People using radio equipment should be familiar with the manufacturer's operating instructions. A secure dedicated radio frequency should be selected for the duration of the crane operations to prevent interference with other radio equipment being used in the vicinity of the crane. A constant talk method should be used so the people involved are aware of the progress of the lifting operations. Work should stop immediately if there is a loss of radio communication.

Where radio communication cannot be used other ways to communicate including hand signals, bell, buzzer and whistle signals should be used. Mobile phones should not be used for directing mobile Crane Operations.

Lifting gear

Lifting gear should be checked before and after use and inspected regularly by a competent person to determine whether it is suitable to keep using. Checks should ensure:

- the lifting gear is tagged, and relevant information listed e.g., relevant information for a chain sling includes grade of chain, rated capacity, manufacturer, chain size and the relevant ISO or International Standard marking.
- lifting hooks are provided with operable safety latches unless a safety latch would increase the risk e.g., a hook on a tea pot ladle at a smelter.
- shackles used as terminal fittings are prevented from unscrewing e.g., mousing or similar.
- lifting eyes and inserts are compatible.
- lifting slings are not damaged e.g., excessive wear, damaged strands, cracks, deformation or severe corrosion, and
- the sling is suitable for the load being lifted including capacity and protection from sharp edges.

The manufacturer's requirements for lifting gear should be followed including using protective sleeves and corner pieces. Although the edges of the load may not appear sharp a sling may be damaged when it is placed under tension.

Lifting materials

Crane-lifted loads should be slung and secured so the load or part of it cannot fall. Tag lines or similar control devices should be used to control loads while being lifted or suspended. For example, Synthetic Lifting Slings without protection around a beam is not acceptable.

Material boxes

Material boxes should:

- have the tare mass and working load limit (WLL) clearly marked.
- be suitable for the material being lifted and be engineer-designed and certified.
- have four slings - one in each corner - attached during lifting.
- have enclosed sides or robust mesh with openings less than the minimum size of materials. being lifted (specifically designed material boxes should be used to lift smaller components).
- be inspected and maintained and inspection records kept.
- have loads secured against movement, and
- not have materials stacked higher than the side of the material box unless they are secured—but at no time should the material box become top heavy.

General lifting

The following principles should be observed when using cranes for general lifting work:

- Formwork frames should be either tied together, secured in a lifting frame, or lifting slings should be wrapped around the load.
- Loads of pipes, joists, timber or sheeting should be strapped together and lifted in a flat position to prevent individual items slipping.
- Sheets of plasterboard may be lifted in a specifically designed material box. If a material box is not used then the lifting system should:
    - be certified by an engineer or a person who holds an intermediate or advanced rigging licence.
    - specify the minimum and maximum number of sheets.
    - specify the number and locations of lifting slings, and
    - specify the capacity of lifting slings.
- Tag lines should be used as needed to control loads.
- Loads should be supported where possible with dunnage and with the load distributed over the supporting surface.
- Wherever basket hitches are used the sling needs to be positively restrained from sliding along the load.

Lifting people

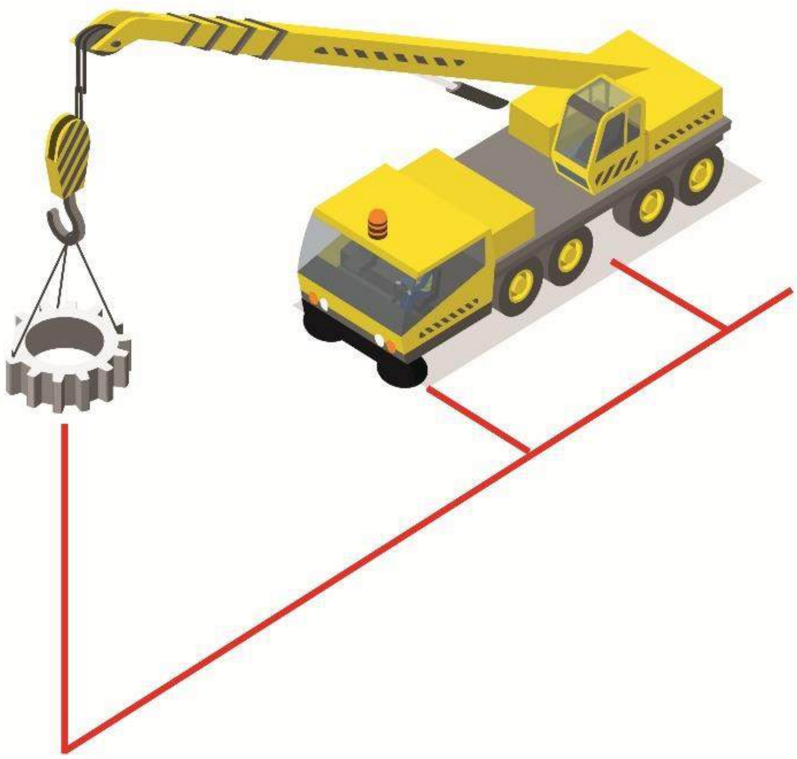
Except where exempted by the WHS Regulations, people should only be lifted by plant designed specifically to lift people, for example elevating work platforms. If it is not reasonably practicable to use plant specifically designed to lift people, a crane-lifted work box may be used to lift workers to perform minor work for a short amount of time in an elevated work area.

Crane overload

A crane should never be overloaded. The Crane Operator or Dogger should:

- verify if the marked load mass is correct and not lift a load in excess of the crane's rated capacity.
- verify the correct counterweight is correctly mounted and the outrigger settings are in accordance with the load chart being used, and
- control crane movement including mobiling to stop excessive load swing that may overload the crane.

Before lifting a load, the crane operator or dogger should check the hoist rope hangs vertically over the load. Care should be taken to stop the load swinging when lifting the load. The crane operator should always have the load under control when lowering loads or when the load is suspended.



Example of a load being too heavy and too far away from the counterweight

Falling objects

The risk of falling objects causing injury to workers and other people must be eliminated, or minimised, so far as reasonably practicable including preventing objects from falling freely or providing a system to arrest the fall of the object.

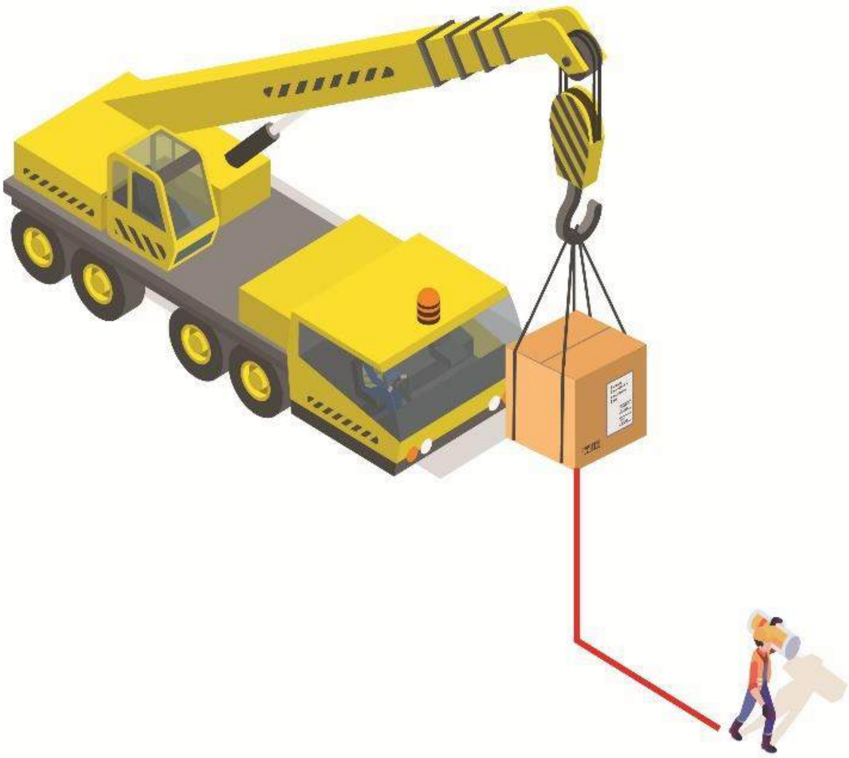
Loads should not be lifted over public access areas including footpaths, roads, highways, railways, waterways and buildings. If there is a risk of people being hit by falling objects control measures like exclusion zones or suitably designed gantries should be used to prevent people being hit by falling objects during lifting operations.

Where possible, site access should be restricted to people who are directly involved with crane activities. Movement of people and mobile plant at the construction site should be minimised while lifting is taking place.

- Never allow people to be below a suspended load at any time!

Never walk under a crane lifting a load

- One-to-One rule: All personnel should be 1 metre away from the load for every metre the load is above the floor.



The One-to-One Rule

- Only Essential personnel should be present during the lifting operation.
- Assess the risks of all lifting operations and develop standard operating procedures for all routine lifts.
- All Crane Operators must be issued with permits following successful completion of training.
- Produce and complete regular crane maintenance schedules.

Mobile crane setup tips

- Always establish the weight of the load, the length of the crane boom, and the angle of elevation before operation.
- Establish minimum clearing distances from obstructions such as power poles.
- Never move a mobile crane with a suspended load.

Exclusion zones

Exclusion zones should be established around cranes and adjoining areas to stop people entering the area and risk being injured by the crane or falling objects. The size of the exclusion zone should be based on a risk assessment.

Where the exclusion zone crosses a public footpath or roadway that needs to be closed or an overhead protective structure erected you should seek approval from the relevant authority. People should be safely directed to an alternative footpath. Lane closures and other operations requiring barricades and signs to be erected should meet local road authority, local government authorities and relevant building or local laws.

Exclusion zones should also be established for the lifting and landing areas and the load's travel path. When determining the size of exclusion zones, all risks arising in relation to the work should be taken into consideration, such as when lifting and manoeuvring loads of large dimensions in restricted areas, or near incomplete or temporarily braced structures.

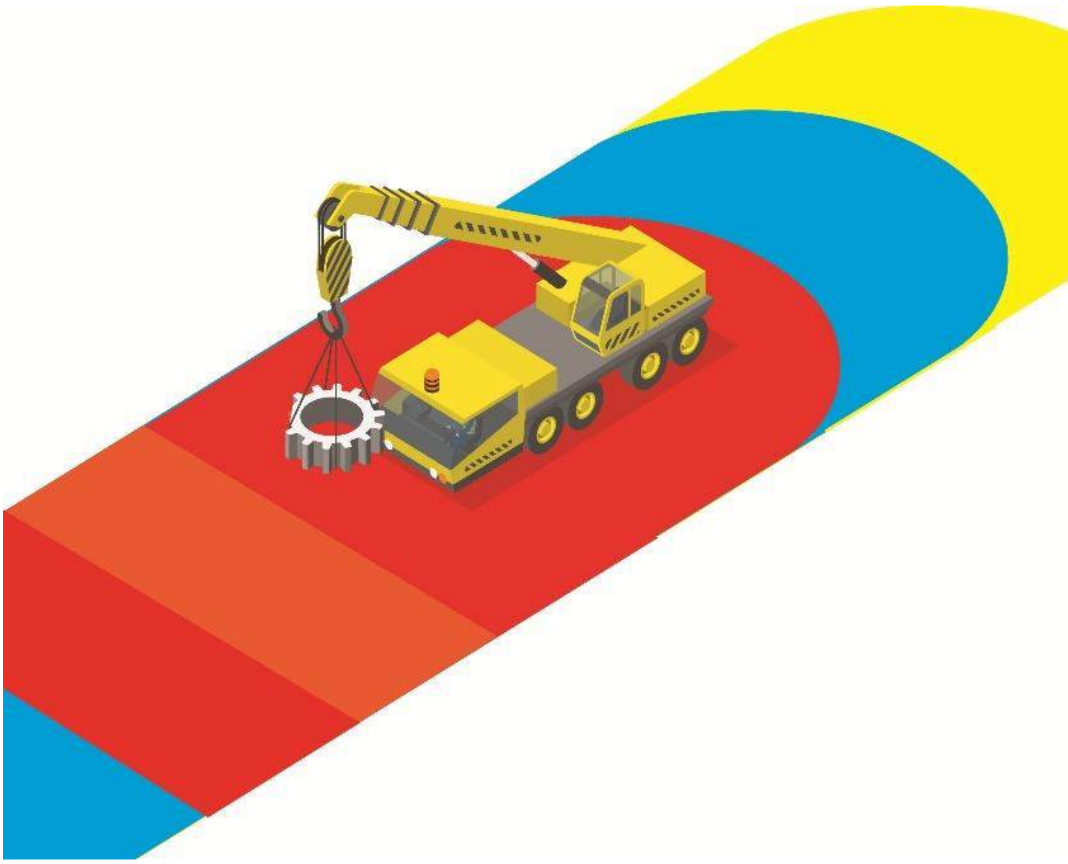
Designated lifting areas should be prepared to enable the crane to be set up as per the manufacturer's recommendations, for example, ensuring adequate space to set up the outriggers.

The below diagram shows exclusion zones depicted with colours:

Red: No-go zone

Orange and Yellow: Restricted zone

Blue: Approach zone



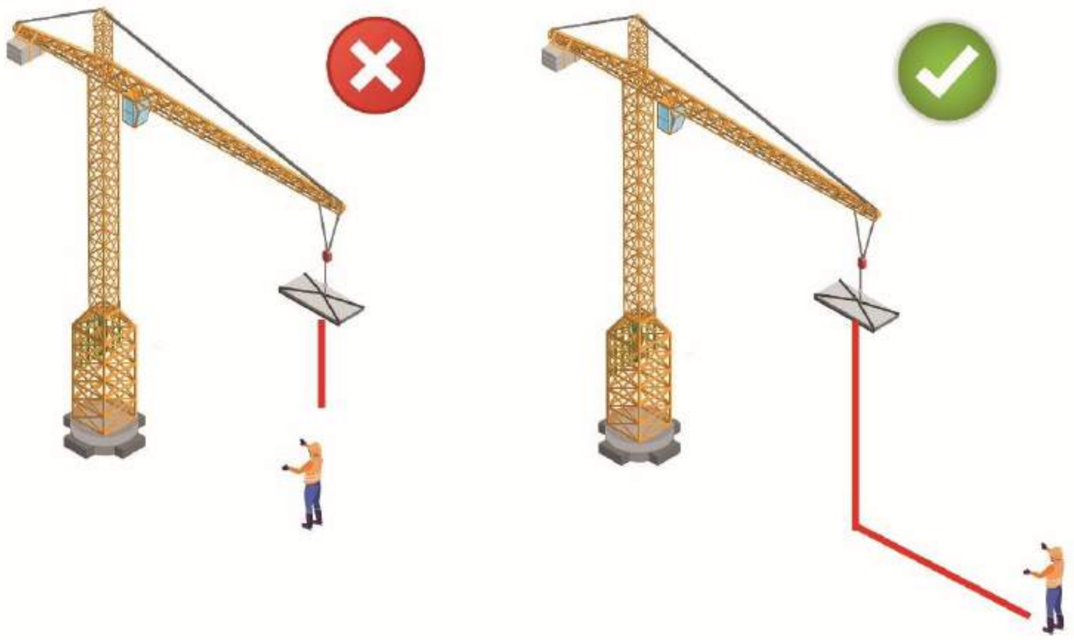
Exclusion and Restriction Zones for a Mobile Crane

Using a vehicle loading crane for deliveries on construction sites

Safety issues

Hazards that may pose a risk to worker health and safety when unloading deliveries with a vehicle loading crane include:

- lifting and manoeuvring loads of large dimensions in limited space.
- mobile plant or loads coming into contact with other objects including incomplete or temporarily braced structures.
- the operator of vehicle loading cranes being unable to see loads or people at all times.
- limited visibility of objects in the surrounding area, leading to potential collisions.



The right and wrong places to stand when directing a Crane Operator

Controlling risks

Unloading on a construction site

Operating a crane (or any other powered mobile plant) on a construction site, including the unloading of materials, is high risk construction work (HRCW). HRCW must not be performed unless a safe work method statement (SWMS) is prepared, and the work must be performed according to the SWMS. A SWMS must:

- identify work that is HRCW.
- state the hazards and risks of that work.
- describe control measures and how those measures are to be implemented.

- be set out and expressed in a way that is accessible and comprehensible to the persons who use it.

Principal Contractors must consult affected workers when identifying hazards and determining risk control measures and must ensure that workers are trained and provided with information and instruction in relation to the risk controls.

An untrained crane operator combined with careless workers is dangerous

Visual line of sight of a load

The Crane Operator should have clear line of sight of the load and travel path and ensure that the load is under control. Where a crane operator does not have line of sight or the load is not visible at any stage and the operator requires direction in the movement of the load then a dogger is required.

Training and licensing

The vehicle loading crane operator needs to be appropriately trained and competent for the type of plant being operated and, where required, hold the appropriate high-risk work licence. Vehicle loading cranes with the capacity of 10 metre tonnes or more usually require a high-risk work (HRW) licence. Other plant used on construction sites may also require a HRW licence.

Single crane multiple winch lifts

Some single cranes are designed to lift a load using both the main and auxiliary winches. Single crane multiple winch lifts can be undertaken on these cranes in accordance with the manufacturer's instructions. This can occur for example, to rotate a prefabricated concrete panel into its vertical position from a horizontal storage or transport position by using two hoist ropes. Even though the concrete panel will be suspended by two hoist ropes, each rope usually needs to support more than 50 per cent of the load during the rotation and one rope will have to support the full weight.

Therefore, unless each hoist is capable of supporting the full load it is important to use the main hoist to support the full load. The actual load to be carried by each winch and rope should be calculated and documented by a competent person before the lift commences. Where a single crane is used for mid-air rotation you should:

- use a crane designed and manufactured for simultaneous multiple winch use.
- follow the crane manufacturer's instructions.
- if needed, reconfigured the crane before it can be used in this way.
- make sure the main winch and auxiliary winch drives are independent.
- not exceed the rigging maximum design fleet angle.
- rotate as near as possible in line with the plane of the boom to prevent side loading the sheaves.
- monitor the load on the main and auxiliary winches separately and simultaneously to avoid overloading either rope or to make sure the combined load of both ropes does not exceed the rated capacity.
- not exceed by more than 10 degrees, or as determined by the manufacturer or a competent person, the included angle between the main hoist rope and auxiliary hoist rope unless otherwise specified by the manufacturer, and
- rotate with enough clearance to make sure the load does not strike the ground, crane or other objects.

A competent person, for example an engineer should confirm the minimum required capacity of each hoist rope, that is the maximum load placed on each rope during the rotation. Sometimes the auxiliary winch line passes over the 'rooster sheave' which is the name given to the sheave mounted on a short boom extension.

Do not overload the rooster sheave as some are not rated for the full line pull of the auxiliary winch and are not suitable for this purpose. Rooster sheaves and the associated rigging on the boom head should be designed and certified by an engineer.

Multiple crane lifts

Lifting a load with two or more cranes requires detailed planning and supervision because the movement of the load between the cranes may create extra loadings on the cranes, the load and the lifting gear. The design capacity of a crane will not be the maximum rated capacity but the de-rated capacity relevant to the multi-crane lift to be carried out. The cranes to be used in the lift will need to be de-rated.

No load should be lifted simultaneously by more than one crane unless a single crane lift is not practical and the multiple cranes lifting method ensures the load placed on each crane does not exceed its de-rated design capacity.

Where multi-crane lifts are carried out, a documented lift plan and procedure should be prepared by a competent person, for example an engineer, and followed. The crane de-ratings for each of the cranes used for the multi-crane lift should be identified in the plan.

Where it is necessary to lift a load using more than one crane the person in control of the lift must hold at least an intermediate rigging high risk work licence.

Cranes used for demolition

Cranes should not be used for demolition (or wrecking) ball work.

If a crane is used for demolition ball work it should be thoroughly inspected and verified by a competent person after the work is complete as being in a satisfactory condition before it is used for general lifting. The results of the inspection must be recorded in the crane's service logbook. Cranes used for demolition work must be fitted with suitable operator protective devices, for example a FOPS (Falling Object Protective Structures), to protect the crane operator.

The hoist rope should be prevented from leaving the boom point sheave. This may include fitting heavy duty rope guards to the sheave to control the slack rope condition that may occur as the ball falls—damage is likely where the demolition ball is attached to the hoist rope. Hoist ropes should not be fixed directly to the demolition ball. A length of chain should be used to join the hoist rope to the demolition ball. The chain should be at least 16 mm and at least 2 metres in length.

Cranes not in use

A crane may not be in use if it is unattended, parked or stored. You must make sure, so far as is reasonably practicable, a crane that is not in use is left in a state that does not create a risk to the health or safety of a person.
Except in an emergency due to fire or other life-threatening reason, the crane operator should never leave the crane cabin or controls while a load is suspended from the crane. A crane should not be left unattended unless:

- loads are removed from the hook or lifting device.
- the hook has been secured or raised to a position where it is clear of other operations.
- powered movements have been disabled, and
- the keys removed or the starting device locked out.

When leaving a mobile crane unattended for a period of time ensure the crane's boom is retracted and lowered as far as possible.

Where there is no risk of a tower crane boom contacting other structures, the crane should be left to weathervane when unattended according to the crane manufacturer's instructions.

Where it is necessary to restrict the movement of the boom of a tower crane the method of tethering, that is securing the boom to prevent slewing, should be according to the crane manufacturer's instructions or as determined by an engineer.

If a crane is to be stored it should be prepared to be left unattended and:

- the manufacturer's storage instructions followed.
- remote control equipment isolated.
- the power supply and controls isolated and locked off.
- storm anchors applied, if fitted, and
- doors and windows locked to prevent unauthorised access.

Decommissioning and dismantling

A crane must be decommissioned or dismantled by a competent person and inspections must be undertaken during the process. A crane should be decommissioned and dismantled according to the manufacturer's instructions or where not available, using recommendations prepared by a competent person.

GUIDE TO INSPECTING AND MAINTAINING CRANES

As a Principal Contractor, Construction Site Owner, or Crane Operator, you have obligations to ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety risks arising from the use of a crane. This includes making sure cranes at your construction sites are inspected and maintained.

A preventative inspection, maintenance and testing program will help ensure a crane is safe to use. Inspections and maintenance should be done in accordance with the manufacturer's instructions or, if these are not available, a competent person's specifications or according to relevant technical standards and engineering principles.

Pre-operational checks

Before operating a Crane, a pre-operational check should be completed by a competent person. An appropriate logbook should be used to record the condition of the crane.

Routine inspection and maintenance

Regular inspection, maintenance and repair are to be carried out in accordance with the manufacturer's instructions or those of a competent person. For inspections, if this is not practicable, they must be completed at least annually.

Cranes should be routinely inspected and tested even if they are not operated regularly. This is because the crane may have deteriorated through corrosion or be damaged.

Routine inspections can take place weekly, monthly or quarterly and should include an inspection of:

- crane functions and the controls for speed, smoothness of operation and limits of motion.
- emergency and safety switches and interlocks including limiting and indicating devices.
- lubrication of moving parts.
- verify accuracy of any load moment indicator (LMI) and rated capacity indicator (RCI) devices with a test lift using a certified test weight.

- filters and fluid levels and leaks.
- visual inspection and measurements as necessary of structural components and critical parts including brakes, gears, fasteners, pins, shafts, wire ropes, sheaves, locking devices and electrical contacts.
- signage including warning signs and control markings.
- wear on wheels and tyres, and
- extra items nominated in the crane manufacturer’s instructions.

A written report should be prepared when the inspection is finished. If replacement parts are needed as a result of the inspection, these parts should meet the original part’s specification. If a crane has been damaged and there are risks to health and safety, it should be immediately taken out of service and people prevented from operating the crane. If the crane needs to be operating during maintenance or cleaning, risk control measures must enable this to occur without risk to health and safety.

Annual inspection

Regular inspections must be carried out in accordance with the manufacturer’s instructions or those of a competent person or, if this is not reasonably practicable, annually.

An annual inspection may be less comprehensive than a major inspection. It should include every item specified by the crane manufacturer for annual inspection and every item included in the routine inspection and maintenance programs.

Annual inspections should include a detailed check of:

- functioning and calibration of limiting and indicating devices.
- structural and wear components.
- tolerances for wear limit.
- evidence of corrosion.
- critical areas for evidence of cracking, and
- for tower cranes, relevant items in the pre-erection inspection and tests that can be safely completed while the crane is erected.

Where a tower crane owner is aware a crane will be erected when the scheduled annual inspection falls due, the owner can choose to carry out an annual inspection before erecting the crane or during the pre-erection inspection.

Major inspections

A major inspection must be completed for registered mobile and tower cranes. Non-registrable mobile cranes and bridge and gantry cranes should have a regular ‘major’ inspection completed so that they continue to be safe to operate.

Major inspections must be carried out at the end of the crane’s design life, as determined by the manufacturer’s instructions, or if these are not available, as determined by a competent person to meet the same minimum requirements established by relevant technical standards.

If it is not reasonably practicable to inspect a crane according to either of these, you should inspect the crane at least every 10 years from the date the crane was first commissioned or registered, whichever was first. This must include inspection of the structure as well as mechanical components.

Major inspections must be carried out by, or under the supervision of, a competent person who:

- has acquired through training, qualifications or experience the knowledge and skills to carry out a major inspection of the plant and is registered under a law that provides for the registration of professional engineers, or
- is determined by the regulator to be a competent person.

Appendix A lists some items to be inspected during a major inspection for tower and mobile cranes. Some of the items may not apply, for example where the item does not exist on the crane. The full list of items to be inspected must be determined by a competent person.

Completion of a major inspection does not indicate that the components inspected will have a further 10-year life. It should not be assumed that the items included in the list only require inspection at 10 yearly intervals. Items will require some type of inspection and maintenance at more frequent intervals, for example at annual and other inspection intervals, according to the crane manufacturer's instructions.

Where there is documented evidence that inspection and testing has been carried out on certain items, for example slew ring bolts, drive systems and braking systems, within a reasonable preceding period (as determined by a competent person) the item may not have to be stripped down in the major inspection.

The competent person should still inspect the safe operation of the item to certify it is operating safely and document the reasons for the decision.

Record keeping

Crane records including maintenance logbooks of the significant events concerning the safety and operation of the crane must be kept and readily available. Records should be kept in a suitable format and must be transferred with ownership of the crane. Entries in the maintenance logbook should:

- clearly describe the work carried out and parts replaced.
- be dated.
- note the name of the person carrying out the work, and
- be signed by the person carrying out the work.

The checks, adjustments, replacement of parts, repairs, inspections performed and irregularities or damage concerning the unit's safe use must be recorded.

Inspection records should include a statement from a competent person confirming the item of plant has been inspected and is safe to operate.

Inspection records should include:

- What was looked at - component specification or areas of the plant inspected.
- What was looked for - signs of wear, damage, cracking or corrosion.
- What criteria were used - rejection criteria.
- How was it looked for - techniques used.
- What was found - test results, photographs or measurements.
- What was recommended - repairs required before continued use.
- What recommendations were actioned - recommendations acted upon and date tasks were completed.

Tower cranes

Pre-erection inspection and tests - on-ground inspection

Tower crane components should be inspected and tested by a competent person according to the manufacturer's instructions before being delivered to the construction site and before being erected.

Where a tower crane owner is aware a crane will be erected when the scheduled annual inspection is due, the owner may consider carrying out an annual inspection during the pre-erection inspection.

Crane owners should develop their own pre-erection inspection and test report that satisfies the requirements of the WHS Regulations and the manufacturer's instructions. The report should also reflect the specific type and model of crane and reference relevant design drawings and test certificates.

Commissioning inspection and tests

Commissioning inspections and test should be carried out by a competent person according to the manufacturer's instructions before a tower crane is put into service.

Non-destructive testing of tower crane components

Non-destructive testing (NDT) is the testing of materials to detect internal, surface and concealed defects, cracks, breaks or gaps using methods which do not damage or destroy the material being tested.

NDT must be carried out by a competent person having suitable knowledge and experience in NDT methods and being able to determine the appropriate NDT method for the component being tested.

When using magnetic particle NDT to detect cracks in metals remove the paint from the metal surface. This is not required for Eddy current NDT.

NDT of specific tower crane components should take place according to the manufacturer's instructions and at set intervals, for example pre-erection tests and major inspection. Table 1 indicates some common minimum frequencies of NDT for particular crane components.

Component tested	NDT description	NDT frequency
Boom clevises	Crack test	Pre-erection
Counterweight sheave bracket welds – moving counterweights only	Crack test	Pre-erection
Cruciform welds – luffing cranes only	Crack test	Pre-erection
Butt heal bosses – luffing cranes only	Crack test	Pre-erection
Band brake welds	Crack test	Pre-erection
Slew ring bolts – where slew ring has to be split at disassembly	Crack test minimum 10% bolts	Pre-erection
Tower bolts (where applicable)	Crack test minimum 10% bolts	Pre-erection
Boom lacing welds	Crack test minimum 10%	Pre-erection
Tower sections	Crack test minimum 10%	Pre-erection
Aluminium sheaves	Crack test	Pre-erection
Slew ring bolts – slew rings	Crack test bolts	5 years
Boom chord thickness	Material thickness testing	10 years
Slew ring	Crack test	10 years
Hydraulic luffing cylinder gland nut	Crack test	10 years
Hydraulic luffing cylinder and ram-rod ends and caps	Crack test	10 years
A-frame – connector welds on primary chords	Crack test	10 years
A-frame lacing welds	Crack test minimum 10%	10 years
Hook	Crack test	10 years
Welds on hook trolley	Crack test	10 years

Table 3: Frequencies of NDT for Cranes

Crack testing of booms and counterweight sheave bracket welds

Booms on non-self-erecting tower cranes are connected by pins passing through male and female clevises on the ends of each boom section. Every weld on male and female clevises on the ends of every boom section should undergo NDT before each crane erection for non-self-erecting cranes. Magnetic particle testing is the usual method used for performing these tests.

Counterweight sheave bracket welds, butt heal bosses and welds in cruciform area on luffing crane booms are known to crack and should also be crack tested by NDT before each crane erection.

Crack testing of band brakes

Older designs of luffing tower cranes use band brakes. On some of these cranes the steel band is welded to an end fitting that has a pin passing through it. These welds have been known to crack. You should crack test the weld between the band and the end fitting by NDT before each time a luffing tower crane fitted with band brakes is erected, keeping in mind there may not be a weld on some brake bands.

Crack testing of slew ring bolts

The integrity of slew ring bolts is critical for making sure both the machine deck and boom remain attached to the tower. Once removed, slew ring bolts should be replaced unless the manufacturer's instructions state they can be reused. If bolts can be reused they should be tested.

For tower cranes where the slew ring needs to be split each time the crane is moved, NDT 10 per cent of slew ring bolts is suggested. Bolts to be tested should be selected from the slew ring by a competent person. Complete removal of the bolts from the slew ring and use of magnetic particle testing is recommended. If cracks are detected, bolts should be discarded and replaced with new bolts.

Crack testing of tower bolts or pins

Tower bolts or pins are a critical part of the crane and permit the effective transfer of load from the crane boom to the crane base. Tower bolts or pins can become damaged and their effective life can be reduced if the bolts are either under or over-torqued. Some tower bolts are made from extremely high-grade steel and can be more susceptible to cracking.

Unless the manufacturer's instructions state tower bolts can be reused, they should be replaced. If bolts can be reused, crack test a minimum of 10 per cent of tower bolts by NDT before each crane erection.

If cracks are found, tower bolts should be discarded and replaced with new bolts. A system that makes sure tower bolts or pins are tested over time is preferred. However, a random system of testing can also be used. The tested bolts should be identified by a method that does not damage the bolt.

Chord thickness testing

Steel lattice-type tower crane booms can be prone to internal and external corrosion affecting the thickness of the boom. The thickness of the chord wall can be reduced through abrasive blasting of the boom.

Main chord sections on tower crane booms should undergo thickness testing at intervals not exceeding 10 years. Ultrasonic thickness testing is one method of verifying the strength in the chords of the boom. Review chord sections for structural adequacy when the thickness is shown by testing to be 90 per cent or less than 90 per cent of the original thickness.

Crane usage checklist examples

Major inspection
☐ Chassis including outriggers and boxes ☐ Drive train and suspension components ☐ Slew ring ☐ Slew ring bolts ☐ Hook rollers ☐ Drive systems including winches, hydraulic motors, gearboxes and drive-shafts ☐ Control systems ☐ Braking systems ☐ Electrical systems ☐ Hydraulic systems—cylinders including outrigger cylinders ☐ Booms ☐ Safety devices including rated capacity limiters and load indicators ☐ Outriggers ☐ Steel wire ropes, and ☐ Rope sheaves. ☐ Electrical systems—hazardous voltage ☐ Control systems—non-hazardous voltage ☐ Electric motors ☐ Hook assembly

Pre-erection inspections / tests	Commissioning inspections / tests	Major inspection
☐ NDT of welds on vital components including boom clevises, butt heel bosses and counterweight rope sheave brackets ☐ NDT of tower crane bolts ☐ NDT of slew ring bolts ☐ NDT of aluminium sheaves ☐ The condition of the power supply cable—where used ☐ The condition of motor brakes ☐ The condition of the slew ring gear and pinions ☐ Air controls and associated valves ☐ The condition of ropes and sheaves e.g. erecting, hoisting, counterweight and trolley, correct rope tracking and no signs of damage or excess wear ☐ The condition of limit switches and limiting	☐ Crane electricity supply—where used ☐ Crane base weights or ballast—where used ☐ Tower section identification and entry ☐ Tower bolts to correct tension ☐ Pins and fastenings ☐ Climbing frame and connection ☐ Jib connection pins and retainers ☐ A-frame connections and retainers—where applicable ☐ Jib and deck pendant pins and retainers—where used	☐ Slew Ring ☐ Hydraulic motors ☐ Hydraulic pumps ☐ Valve blocks (bodies) ☐ Hoist and luff drums ☐ Braking systems ☐ Rope sheaves ☐ Hydraulic luffing cylinder ☐ Gear boxes and drive shafts ☐ Boom ☐ A-frame ☐ Pins with moving

Pre-erection inspections / tests	Commissioning inspections / tests	Major inspection
devices ☐ The condition of counterweights ☐ The condition and fitment of machinery guarding ☐ Brake systems can be dismantled and inspected for wear and damage: ○ dry brakes—before each erection or more frequently if directed by the manufacturer ○ wet brakes—before each erection or after 5000 hours of crane operation or as directed by the manufacturer ☐ Normal service items including items supplied by the crane manufacturer e.g. temperature control units and seating being maintained in a serviceable condition according to the crane manufacturer's instructions, and ☐ Other tests as specified by the manufacturer. Once the tower crane components have been delivered to the construction site they should be inspected by a competent person for possible damage and wear that may have occurred during transport. Inspections should include: ☐ The crane base design and engineer's report ☐ Crane ties and structure to support them where used ☐ The power supply and earthing.	☐ Machinery guarding ☐ Leakage in lines, tanks, valves, pumps and other parts of air or hydraulic systems ☐ The condition of the ropes and sheaves e.g. erecting, hoisting, trolley and counterweight, and correct rope tracking ☐ Isolating switches ☐ The condition and phase of the power supply cable ☐ Verification of the crane wiring ☐ Effective operation of controls including interlocks ☐ Effective operation of indicating devices ☐ Effective operation of travel deceleration switches ☐ Effective operation of hoist upper and lower—where needed—working limit switches ☐ Effective operation of warning devices ☐ Effective operation of weather-vaning ☐ Effective operation of the hoist and travel brakes when the crane is laden to the maximum rated capacity ☐ Effective operation of the rescue controlled descent device ☐ Other tests specified by the crane manufacturer.	parts for example, boom heel pins and ram pins ☐ Static pins ☐ Steel wire ropes

CHAPTER 14

TRENCHING AND EXCAVATION SAFETY

This section covers Trenching and Excavation, and the importance of following safe procedures on any construction project when conducting trenching or excavation works.

Excavation work generally involves removing soil or rock to make a trench, tunnel or shaft, or filling or part filling a trench, tunnel or shaft. It does not include a mine, a bore or a trench to be used as a place of interment.

Trenches, tunnels and shafts are used for a wide variety of construction projects, including installing pipes and laying electricity and communications cables. Trenching is so critical to the construction industry, but like most construction work, trenching can be dangerous, and sometimes even fatal if they are not dug or installed in a correct and safe manner. That's why it's important to practice proper trenching practices to improve construction site safety.

The difference between excavating and trenching

Excavation is defined as any man-made cut in the Earth's surface. Excavating can be used as an umbrella term for any kind of cut or precision digging used in construction.

Trenching is a specific form of excavation work; it involves a precise, narrow excavation (in relation to its length) made below the surface. Generally speaking, the depth of the trench is bigger than its width, but the width doesn't exceed 4.5 metres.

Trenching can be some of the most hazardous work on a construction site. Learning proper trench safety can help keep you on track for your trenching project while providing the safest construction site possible. Anyone can suffer a serious injury if they're not careful.

An example of a common Trench

Risks associated with excavation

There are a range of health and safety risks associated with excavation work including:

- falls from one level to another.
- the fall or dislodgement of earth or rock.
- vibration and hazardous noise.
- exposure to an airborne contaminant.

There are significant risks associated with Excavation.

Risks associated with trenching

Trenching poses many dangers that can be outright fatal. Big machines, large holes and an assortment of potential hazards underground in different types of foundations can be a recipe for disaster.

Here's a list of things to look out for:

- Cave-ins.
- Falling debris or equipment.
- Workers slips, trips and falls.
- Flooding or water accumulation.
- Hazardous atmosphere exposure.
- Mobile equipment around the trench.

There are many risks associated with Trenching

Managing risks

Knowing about the dangers trenching and excavation can cause is just as important as preparing for them. Before any work begins for the day, you should make sure your workers are safe. You should try to eliminate or minimise risks associated with trenching and excavation work during the planning stage, before work starts.

- Risk management planning at the start of trenching and excavation work is critical to preventing deaths.

During the planning stage you need to identify hazards, assess risks and work out appropriate control measures in consultation with those relevant to the work. People you should consult are the principal contractor, demolition contractor, structural engineers and mobile plant operators.

You must also:

- Have regard to all relevant matters including the nature of the trenching or excavation, the nature of the work (including the range of possible methods for carrying it out), and the means of entry into and exit from the trench or excavation.
- Take all reasonable steps to obtain current underground essential services information about the part of the construction site where trenching or excavation work is being carried out, and any adjacent areas.
- Provide that information to subcontractors and make sure it is available for inspection for at least two years following a notifiable incident, if one occurs, or until the trench and excavation work is complete.

If the excavation work you plan to carry out includes digging a trench at least 1.5 m deep, you must ensure that the work area is secured from unauthorised access and take all reasonable steps to minimise the risk of the trench collapsing - unless you have written advice from a geotechnical engineer that all sides of the trench are safe from collapse.

Trenching safety checklist

Trenching and Excavation work needs to be carefully planned before work starts so it can be carried out in a way that is safe and without risks to health. Planning involves identifying hazards and risks, assessing risks where necessary, and determining appropriate risk controls. Before you start trenching or excavation on a construction site, you must follow this safety checklist.

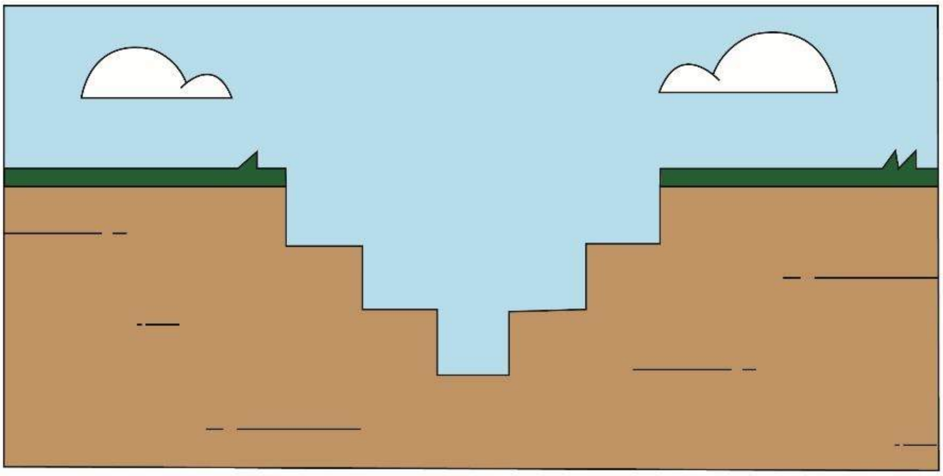
Before you begin the workday:

- A competent person must inspect excavation and adjacent areas.
- Hard hats, safety vests, and hi-visible clothing must be worn by employees.
- Warning systems are established and put into place.
- Protective systems are inspected and working as intended.
- Make sure nothing is near the excavation that shouldn't or doesn't have to be there

<u>The 10 trenching safety tips</u>

1. Install protective systems

Protective systems keep workers safe from cave-ins and deaths, in fact, preventing injury and death from cave-ins should be a priority for your construction site. A protective system must be put into place if the trench is deeper than 1.5 metres; if the trench is deeper than 6 metres, protective systems must be designed by a professional engineer.



There are many protective measures to ensure safety in a Trench

The most common protective systems to prevent cave-ins are:

Sloping and Benching

Sloping refers to cutting back the trench wall at an angle to create a slope. Benching is the act of creating steps (like long benches) to travel up and down the earthen wall. Both systems can be used by themselves or in conjunction with one another.

Shoring

Shoring means that a support system made of timber, mechanical parts or hydraulic systems that help prevent a cave-in are installed. They help keep the Earth in place and provide an extra layer of protection. It is purely meant to help prevent a collapse.

Trench shield

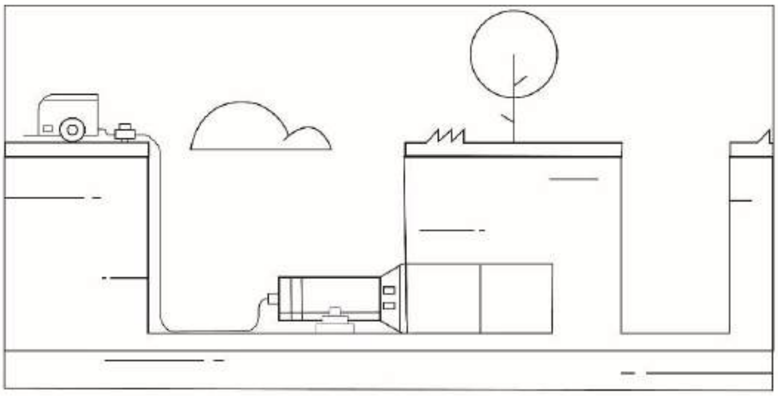
Unlike shoring, trench shields, also known trench boxes, aren't meant to prevent a cave-in or collapse, but rather protect the worker should one occur. Trench shields are great for continuous trenching, like pipe laying.

A few things to consider about trench shields:

- Always follow the manufacturer's warnings and labels.
- No one should be in the shield when it's being moved.
- Not all shields are designed to be stacked on top of one another.
- The empty spaces between the shield and the trench wall should be filled to prevent displacement.

2. Use alternative trenching methods

Since trenching is a necessary, but dangerous aspect of construction, you never want to do more than you need. Nevertheless, due to the dangers surrounding the method, it is recommended to use a different method of excavating instead of trenching for better safety.



Using machinery instead of workers can be a preventative measure to mitigate risk.

Here are the common alternative trenching methods:

Directional boring

Directional boring utilizes a boring machine that digs into the ground at an angle without disturbing much of the surface. First, a small pilot hole is created for direction; the bore (hole) is enlarged to the size that will fit the pipe. After that, the pipe is pulled through the hole.

Directional boring helps eliminate most of the dangers that are present with trenching.

Pipe ramming

Pipe ramming, also known as pipe jacking, is used in mainly horizontal projects; a pipe is hammered into the ground using a percussive instrument. This method works best with larger pipes and for surfaces that may have trouble settling when other trenchless methods are used.

Utility tunnelling

Utility tunnelling is similar to pipe jacking, except that linear plates are needed, and workers enter the borehole. The tunnelling process can either be done by hand or by a boring machine.

Utility tunnels are generally used for colder climates and on large industrial and commercial sites so as to not disrupt above-ground pedestrian or vehicular traffic. Regular inspection, maintenance and repair are needed.

3. Conduct atmospheric testing

Always check the atmospheric conditions in a Trench

Atmospheric testing is required whenever a trench or excavation goes deeper than 1 metre and it’s suspected hazardous atmosphere is present. This is due to the present danger of oxygen deficiency and the presence of dangerous gases, such as carbon dioxide and methane.

If a hazardous atmosphere is present, or it's reasonably suspected that it is, then the Principal Contractor must provide the workers with emergency rescue equipment, including a breathing apparatus and a basket stretcher.

4. Beware of falling loads

It is highly recommended that all workers need to be standing away from lifting or digging equipment that is being loaded or unloaded as they are at risk of being exposed to falling loads.

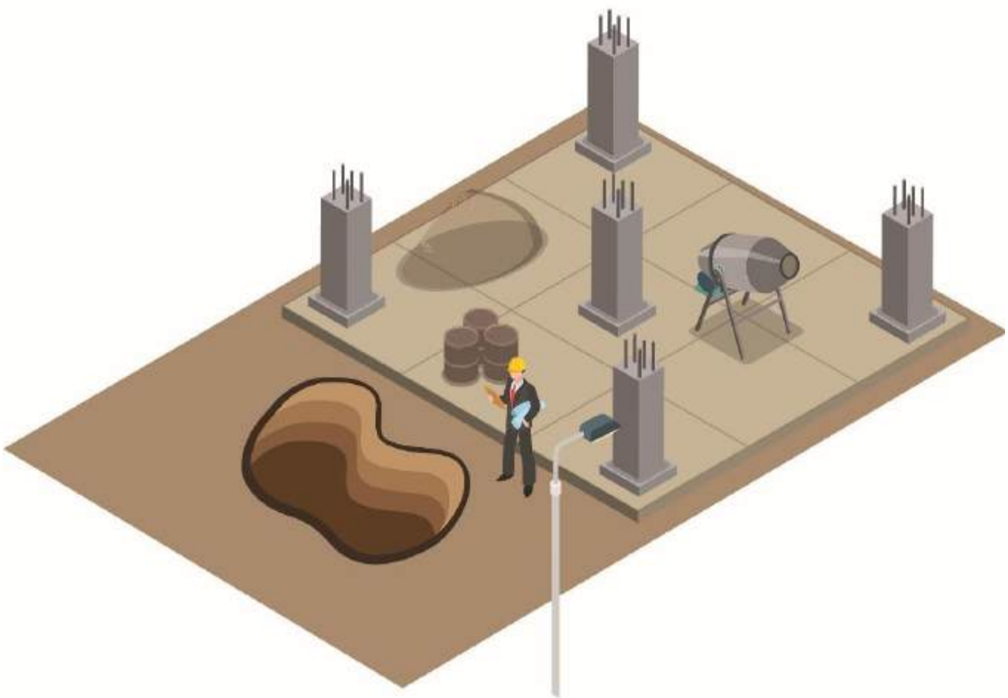
Likewise, no work should be done under suspended or raised loads due to the dangers of falling loads present. It is advised that construction site equipment be stored at least 0.5 metres away from the trenching edge.

Always use protective measures when lifting a load near a Trench

5. Routinely inspect trenches

A competent person must inspect the trenching site for any possibility of cave-ins or collapses daily. Inspections must begin before the start of work and as needed throughout the shift.

Inspections also have to happen after natural events, like a rainstorm, or other forms of work, like blasting work. If any unsafe conditions are found, all workers must be removed from the area until all safety precautions are met.



Routine Trench inspections will identity any potential risks and hazards

Creating a daily worksite checklist for trenching and excavation sites is important if you want to ensure that your workers remain safe. Below is an example of a daily checklist.

Yes	No	N/A	Excavation
			Trench box extends at least 18 inches above the vertical wall of the excavation and to within 2 feet of the bottom of the trench (or less if soil collapsing behind or below trench box).
			Trench box installed in accordance with manufacturers specific instructions and use limitations.
			Trench box inspected for damage or defects and pins and spreaders are securely installed
			If other soil protective systems are used, they are installed in accordance with manufacturer's instructions OR are approved by a Registered Professional Engineer.
			All workers at worksite trained in trenching safety procedures. Surface encumbrances such as utility poles, heavy equipment supported or removed. Heavy equipment safety zone at least 11⁄2 times depth of trench for if not supported. Workers protected from loose rock or soil.
			Spoils, materials, and equipment set back a minimum of 2' from edge of excavation.
			Walkways and bridges over excavations 6' or more in depth are at least 20 inches wide and are equipped with required guardrails.
			Ladders placed no more than 25 feet apart.
			Workers prohibited from working or walking under suspended loads
			Workers prohibited from working on faces of sloped or benched excavations above other workers.
			Warning system established and used when mobile equipment is operating near edge of excavation.
			Barriers provided if trench opening is not readily apparent. Barriers, fences available to secure area if left overnight.
			Personal Protective Equipment
			Hard hats worn by all workers.
			Work boots or safety shoes worn by all workers.

			Eye protection worn by all workers (if applicable). Hearing protection worn by all workers (if applicable).
			Warning vests, or other highly visible PPE provided and worn by all workers exposed to vehicular traffic.
			Utilities
			Utility companies contacted and/or utilities located.
			Exact location of utilities marked when near excavation.
			Underground installations protected, supported, or removed when excavation is open.
			Wet Conditions
			Precautions taken to protect workers from accumulation of water. Water removal equipment monitored by Competent Person.
			Surface water controlled or diverted. Inspection made after each rainstorm.
			Hazardous Atmosphere
			Atmosphere tested when there is a possibility of oxygen deficiency or build-up of hazardous gases.
			Oxygen content is between 19.5% and 21%.
			Flammable gas build-up to 20% of lower explosive limit (LEL).
			Toxic Levels of gases are below limits set on gas monitor
			Ventilation blowing into space and air intake placed away from vehicle exhaust.
			Program Manager contacted if atmosphere is above established limits. Source of contaminant to be determined and eliminated prior to entry or Program Manager will establish special procedures for entry.

6. Install safe access and egress points

Principal Contractors must provide easy modes of access and egress to the trench - such as ladders or ramps - for trenches deeper than 1 metre. The entrances and exits must also be at least within 7.5 metres of a worker at all times.

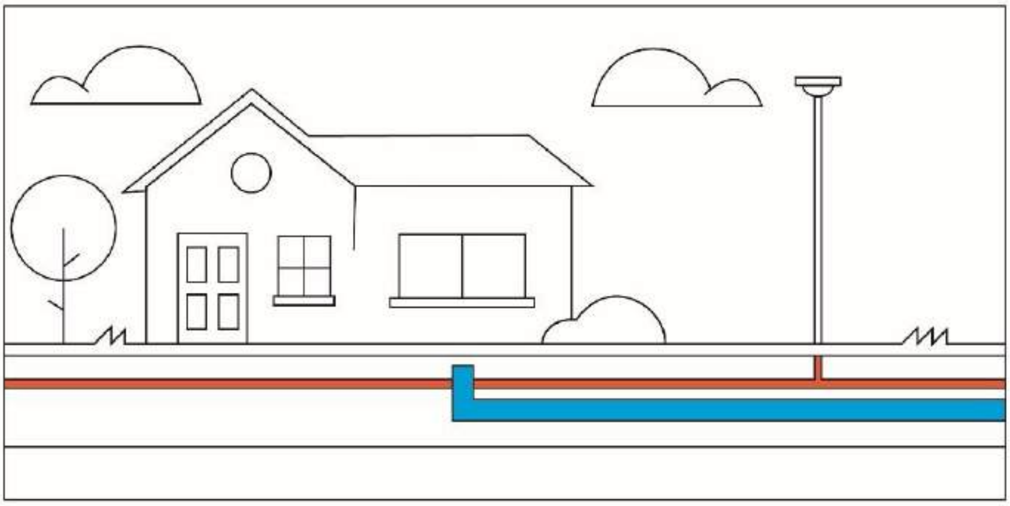
It is recommended to have separate entrance and exit points to a Trench

7. Locate utility lines before digging

Prior to any sort of digging, it is advised that excavators contact local utility companies and allow the local utility companies the time to mark their lines.

Underground utilities can pose an incredible amount of danger to workers. If workers don't know where they're digging, they can accidentally hit a gas, electrical, water, sewer or phone line. Doing so can result in catastrophic injury: striking a gas line can cause a dangerous gas leak.

Having all utility lines marked ensures that none of the lines will be struck by the digging equipment.



Always be aware of underground utilities before digging a Trench

8. Assign a competent person

A "competent person" is someone who has been designated by the Principal Contractor for the express purpose of designing, inspecting and supervising the trench.

This person must be a professional engineer and should be trained in:

- identifying possible and current dangers.
- dangerous and hazardous working conditions for workers.
- eliminating dangers promptly.

Trenching safety is reliant on these people due to the highly technical nature of trenching. Because of that, a high level of training and experience is needed for these appointed workers.

A ‘competent person’ should always be assigned to supervise

9. Install proper safety signs

Installing signs can play a huge role in preventing intense or fatal injuries. Adequate warning signs can alert workers entering the construction site along with any pedestrians who might accidentally wander by.

The truth of the matter is that not everyone is a trained construction worker: an everyday person may wander into the construction site and not know where they are going. Having a big and noticeable warning sign that says “DANGER: OPEN TRENCH” can make all the difference.

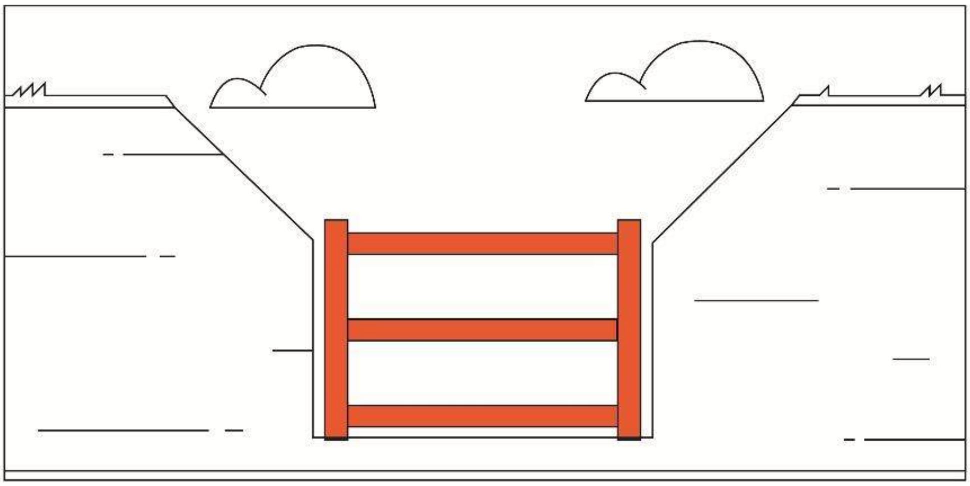
Make sure to erect relevant safety signs

10. Practice trenching and excavation safety

If someone isn't careful, trenches can cause a serious injury, whether on a job site or elsewhere. The same can be said about any type of excavation work.

The dangers they pose can be severe, if not fatal. Here are some trench and excavation safety guidelines to exercise:

- Never enter an unprotected trench.
- Trenches deeper than 1.5 metres need to have a protective system in place unless they are made of stable rock.
- Don't place any excavated soil/material within 0.5 metres of the trench edge.
- Don't stand near any vehicle being loaded or unloaded.
- Always wear proper safety equipment.
- Use a checklist to conduct safety inspections.



Any Trenches deeper than 1.5m require a protective system

Safe work method statements

If the excavation work is or involves high risk construction work, construction site owners must prepare a SWMS before the excavation work starts. The SWMS must:

- identify the type of excavation work being done.
- specify the health and safety hazards and risks arising from that work.
- describe how the risks will be controlled.
- describe how the control measures will be implemented, monitored and reviewed.
- be developed in consultation with workers and their representatives who are carrying out the high-risk excavation work.

In some circumstances one SWMS can be prepared to cover more than one excavation work activity being carried out at the worksite. For example, where there is:

- a risk of a person falling more than 2 metres into an excavation.
- a trench with an excavated depth greater than 1.5 metres.

In this case, construction site owners and workers can consult and cooperate to prepare one SWMS. Alternatively, they can prepare separate SWMS. If they choose to do this they must consult with each other to ensure all SWMS are consistent and they are not creating unintended additional risks at the workplace.

Using a competent person to assess soil and site structures

Trenching and excavation work presents serious hazards to all workers involved. Cave-ins pose the greatest risk and are more likely than some other excavation-related incidents to result in worker fatalities. One cubic metre of soil can weigh as much as a car. An unprotected trench can be extremely dangerous for workers. Principal Contractors must ensure that workers enter trenches only after adequate protections are in place to address cave-in hazards.

It is recommended that a qualified and competent engineer conduct regular assessments of soil composition in and around trenches as well as inspect all site structures used in supporting trenches.

How to determine the soil type for the best trenching method

Knowing what they are and how to evaluate and accommodate for them are critical to keeping workers safe.

Type A soils

Type A soils are unconfined and have a compressive strength of 1.5 tons per square foot or more. Things like clay, clay loam, sandy clay, or silty clay are examples of type A soil. It's not impervious to water conditions, so weather and running water need to be accommodated for when trenching in type A soils.

Type B soils

Type B soils are unconfined and have a strength of more than 0.5 but less than 1.5 per square foot. Examples of type B soils are silt loam and angular gravel. As they are more unstable than other types of soil, water and weather conditions definitely need to be factored in for safety.

Type C soils

Type C soils are unconfined soils that have the strength of less than 0.5 per square foot or less. They are gradual in nature and pose the biggest threat of danger in a trenching site. They are the most unstable, so if you are trenching in type C soils you will need to either dig deeper, slope horizontally or vertically, and anticipate weather or water changes

Essential services and other pipes or lines

Essential Services relevant to excavation work include:

- underground services such as gas, water, sewerage, telecommunications, electricity, chemicals, fuel and refrigerant in pipes or lines.
- overhead services such as power lines and ground mounted services such as transformers, gas and water pipes or mains.

An important element of pre-excavation planning is the identification, protection, relocation, flushing, de-energising, removal or decommissioning of all essential services and other pipes or lines.

It is important to verify that gas and electricity services that may be impacted by the excavation work are positively de-energised and disconnected and, where appropriate, purged.

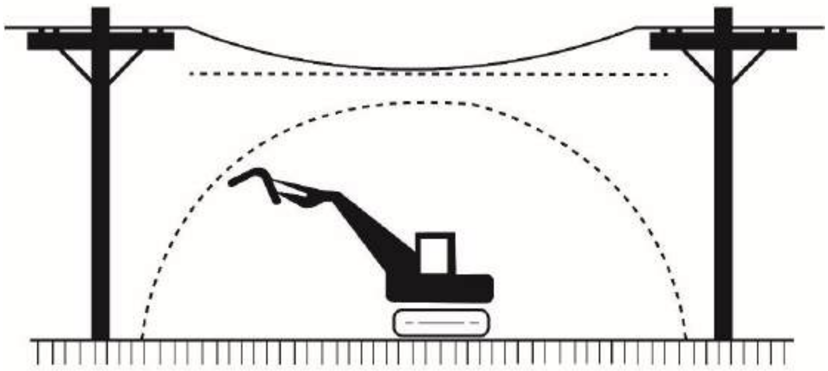
Check with local Gas and Electricity Authorities as to the location of pipes and lines.

Overhead power lines

Risk controls need to be implemented before using excavation machinery near overhead power lines.

The relevant authority should be consulted regarding approach distances and appropriate risk controls implemented to prevent any part of the machinery or any load carried on it from coming too close or contacting overhead power lines.

When operating powered mobile machinery near power lines, the SWMS needs to detail how this task will be done safely and the types of risk controls that have been put in place such as ‘no go zone’ rules.



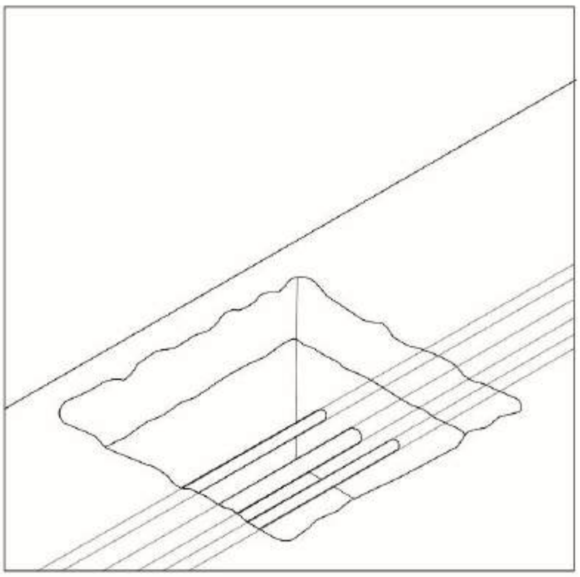
Always complete a SWMS before any work near power lines begins

Underground services

A Principal Contractor needs to ensure that underground services are identified before doing excavation work or ground penetration work.

Where there is limited information available on underground services, a Principal Contractor needs to seek advice from the relevant asset owners or another method needs to be used (for example, cable location device to identify the asset location). The Principal Contractor needs to ensure that hand digging, or non-destructive excavation is used to locate the asset before starting mechanical excavation (for example, sampling the area by exposing a short section of underground service usually using water pressure and a vacuum system or pothole the area).

Where underground services may be impacted, the Principal Contractor needs to ensure that the location of underground services are physically marked (for example, with signposts or spray paint) in a way that is conspicuous and not easily removed.



Digging Trenches can expose underground essential services

Adjacent buildings or structures

When planning excavation work (particularly bulk excavations), consideration needs to be given to adjacent buildings or structures. The excavation needs to be undertaken in a way that does not adversely affect the security or stability of any part of a building or structure at or adjacent to the location of the proposed excavation, as this could lead to structural failure or collapse.

Principal Contractors need to ensure that excavation work does not commence until steps are taken to prevent the collapse or partial collapse of any potentially affected building or structure.

A Principal Contractor needs to ensure that any excavation that is below the level of the footing of any structure (including retaining walls) that could affect the stability of the structure is assessed by a suitably qualified person (for example, a geotechnical engineer).

The excavation should be secured by a suitable ground support system designed by a suitably qualified person (for example, a structural or geotechnical engineer). Suitable supports to brace the structure may also be required.

It is also important that other buildings in and around the excavation site are not adversely affected by vibration or concussion during the excavation work. Special precautions should be taken in the vicinity of hospitals and other buildings containing equipment sensitive to shock and vibration.

Excavation work should be carried out in a way that does not cause flooding or water penetration to any adjacent building.

Excavated material and loads near excavations

Any material such as mechanical machinery, vehicles, or storage of materials (including excavated materials such as the spoil pile) will add further weight to the area where it is placed.

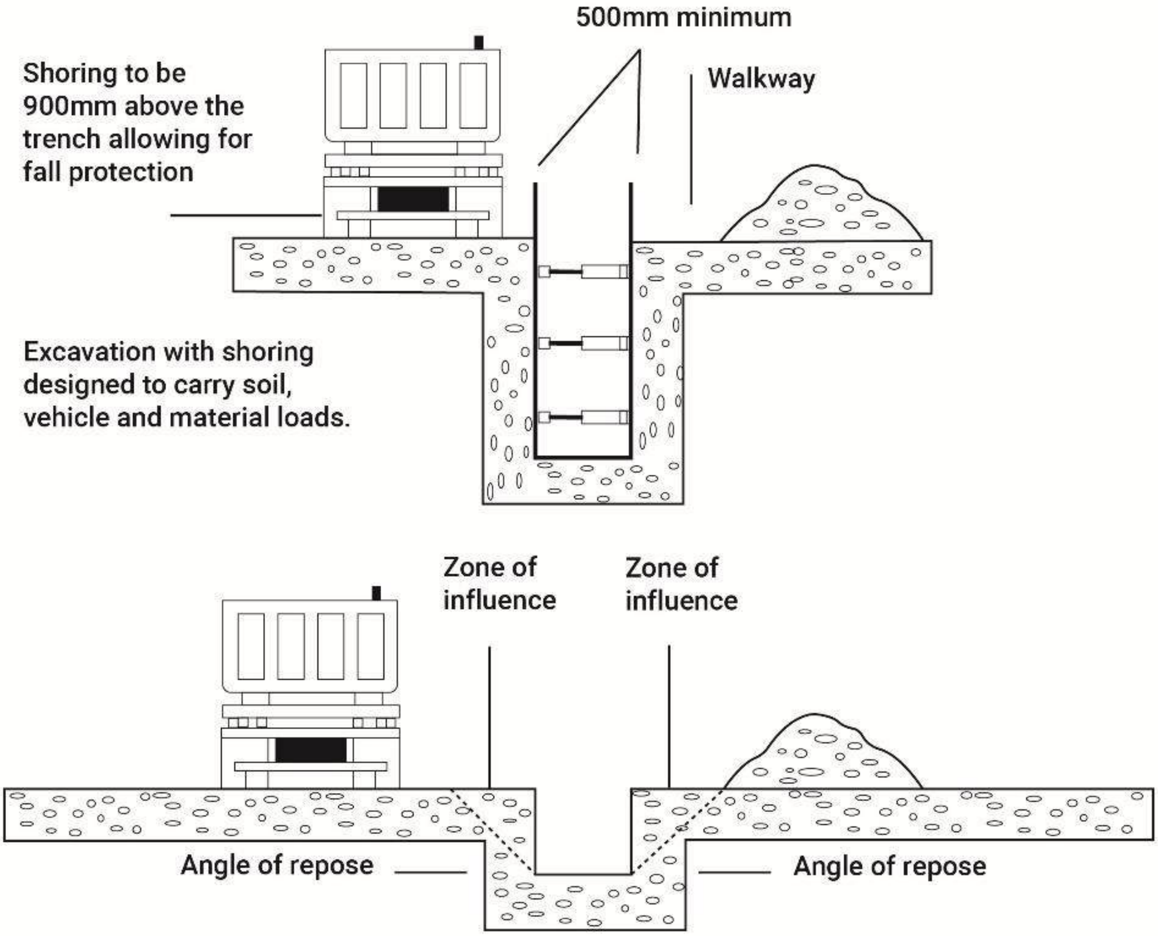
It is important that materials are not placed or stacked near the edge of the excavation or inside the ‘zone of influence’ unless the ground conditions allow for it or a ground support system has been installed which has been designed to carry such loads.

Placing materials in areas that cannot hold the weight puts people working in the excavation at increased risk as the extra load could cause the excavation to collapse.

The distance between the edge of the excavation and any excavated material should not generally be less than 500mm. How close a load can safely be located next to the edge of an excavation will depend on the ground conditions and the type of ground support in place. The design of a ground support system should specify the distance from the edge that materials can be placed or stacked.

The below figure shows an example of:

- an excavation with shoring that has been designed to carry vehicle and material loads - this may be required where there is limited space around the excavation for vehicle movement or material storage, and
- an excavation with no shoring, designed to carry soil loads only.



The zone of influence

The '**zone of influence**' is a theoretical zone in which the risk of ground collapse may increase if machinery or material is placed within that zone and is dependent on ground conditions. The figure above shows the relationship between the zone of influence and the angle of repose.

The angle of repose

The '**angle of repose**' is the slope at which dumped or excavated soil is naturally stable and does not fall away. This determines the angle of repose.

The angle of repose should not be greater than 45 degrees for the purpose of determining whether a ground support system is required. If it is proposed to have an angle higher than the angle of repose of the spoil pile, a geotechnical analysis needs to be undertaken before excavation work commences.

A Principal Contractor needs to ensure that pipes to be laid, and equipment for laying pipes (for example, excavators), are placed away from the top of the excavation to ensure they do not collapse or roll into the excavated area

Avoid using machinery on or near the zone of influence

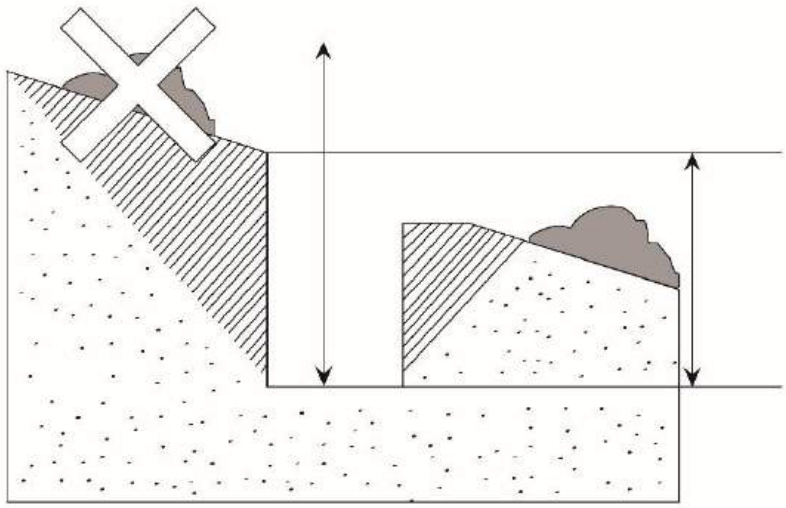
Always ensure the excavation or trench has adequate barrier protection

Placing excavated material

If excavating in sloping ground, the Principal Contractor needs to ensure that excavated material (for example, the spoil pile) is placed on the down- slope side of the excavation. In addition, the following need to be considered:

- ground conditions.
- changes to climate or weather conditions.
- access to the excavation.
- existing underground services.
- the need for earthmoving machinery or vehicles to work or move along beside the excavation.
- service installation and backfilling requirements, and
- any manual work being undertaken in the excavation.

Placing material of the up-slope side of the excavation increases the effective height (or depth) of the excavation. Placing material on the down-slope side of the excavation will avoid this and also assist in controlling the risk of material falling or being washed into the excavation.



Never place material above on the up-slope of the excavation

Material should not be placed on the high side of the excavation as this increases the risk of ground collapse or flooding. Excavated material should be placed so that it channels rainwater and other run-off water away from the excavation (for example, a small ditch or channel could be constructed to divert rainwater away to prevent flooding of excavations).

When a trench is being excavated beside an existing service line, the excavated material needs to be placed on the side opposite the existing service line to prevent excessive loading on previously disturbed ground.

To ensure safe access along all sides of an excavation, the toe of the excavated material needs to be at least 500mm from the edge of the excavation. If excavated material is placed close to an excavation due to obstructions such as fences, buildings or trees, the weight of the excavated material may overload the sides of an excavation.

In this case, the excavated material may be moved elsewhere, or the ground support system may need to be strengthened at these locations, and barriers such as toe boards need to be provided to prevent the material falling into the excavation.

Toe boards reduce the risk of excavated material sliding into the excavation. Retaining toe boards or trench shields need to protrude at least 300mm above the toe of the spoil pile.

Securing the work area

In securing the trench or excavation, Principal Contractors need to consider the risks arising from unauthorised access to the work area. To ensure the protection of workers and members of the public on or near the excavation site, it is important to restrict access to the excavation area.

Members of the public need to be prevented from entering the excavation site when it is unattended. Trenches should be covered to prevent unauthorized entry. Road plates, for example, can be used to cover an excavation on a roadway.

Safe entry and exit

If workers or other people are required to enter an excavation, the Principal Contractor or person with management or control of the construction site needs to ensure a safe method to enter and exit is provided. This may include a landing platform and a sufficiently long, secure internal ladder.

Additional access equipment maybe required to provide safe access to other locations in an excavation (for example, in order to connect or disconnect a sling from a trench shield). Adjustable walkways (see Figure 7), temporary platforms and other access equipment fitted with guardrails can provide safe access into and within, over or across the excavated site.

Principal Contractors must ensure that all trenches have a safe entry and exit

Plant and equipment

Principal Contractors and operators need to ensure that where machinery is used in trenching and excavation work:

- the machinery is appropriate for the trenching and excavation work and is maintained in good condition.
- the machinery is used and operated by a competent and, where required, licensed person.
- appropriate guards and operator protective devices are fitted.
- the safe working load (where applicable) is displayed, and any load measurement devices are operating correctly, and
- the machinery is maintained in accordance with the manufacturer's or supplier's instructions.

Powered mobile plant

Powered mobile machinery such as earthmoving machinery is frequently used for excavation work. To select machinery that is suitable for the task, a Principal Contractor needs to consider:

- site access and restrictions.
- site hazards such as overhead power lines and underground services.
- ground conditions.
- type and depth of excavation.
- volume of material to be excavated and the potential requirement for it to be placed offsite, and
- where the excavated material is to be located or stored.

Blind spots

Operators of powered mobile machinery may have restricted visibility of nearby workers or pedestrians, particularly those close to the machinery.

Operating near excavations

A Principal Contractor needs to ensure that powered mobile machinery, including earthmoving machinery such as bulldozers, does not operate or travel near the edge of an excavation unless the ground support system installed has been designed by a suitably qualified person (for example, a geotechnical engineer) to carry such loads.

Principal Contractors need to control risks associated with job layout, haul roads, vehicle pathways and traffic management. Temporary haul roads need to be well constructed and maintained to enable plant operators to complete the work safely.

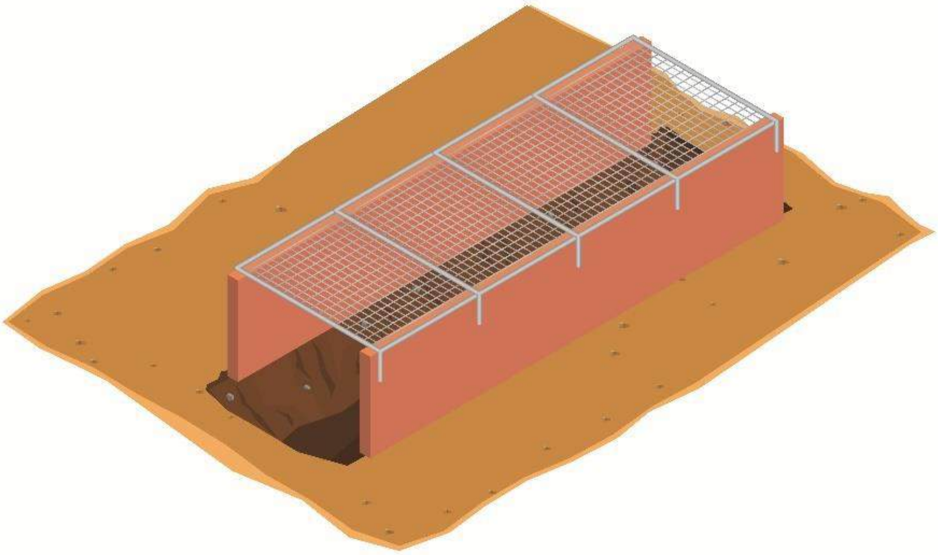
A Principal Contractor needs to ensure that machinery always approach embankments or trenches from across the line of a trench rather than parallel to it.

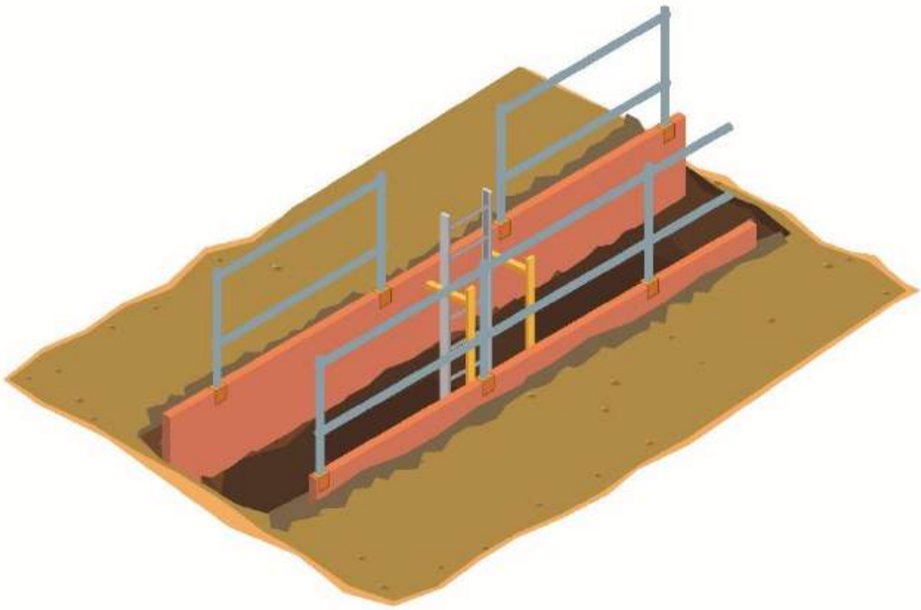
Falls prevention

A Principal Contractor has a general duty to control risks associated with falls from any height, including falls into an excavation.

Risk controls for falls into an excavation include:

- the support system itself (for example, using trench box extensions or trench sheets with a height greater than the trench depth).
- installing guard rails or covers on trench shields; where possible, guard railing needs to be fitted before installing the trench shields or form part of the shield.
- inserting guard rails and toe boards into the ground immediately next to the supported excavation side.
- installing landing platforms or access structures such as scaffold towers inside deep excavations.
- securing ladders to trench shields.
- installing effective barriers or barricades.
- providing clearly defined pedestrian detours.
- provision of alternative entry and exit points to the excavation for emergency use.
- backfilling the excavation as work progresses.
- fencing around excavations or trench shields which extend at least 900mm above ground, thus providing appropriate edge protection.
- bridge units that span wider trenches and incorporate ladder points to enable entry and exit from trench shields.
- where an excavation is being worked on in an unpopulated area (for example, a greenfield estate), barricades set back an appropriate distance (for example, two to three metres) and signage may be an appropriate means of preventing persons from approaching live edges.





Use safety control measures to prevent workers falling into trenches

Falling objects

A Principal Contractor must provide appropriate personal protective equipment to persons at risk from construction work. Principal Contractors need to ensure that workers doing excavation work wear safety helmets.

Helmets need to be worn by anyone entering an excavation site, whether they are involved in the work directly, inspecting the excavation or simply touring the area.

Eye protection should be worn to reduce the risk of eye injury which may result from small materials or soil rolling into the excavated area.

Where loads are to be suspended via lifting hooks (e.g., trench shields, road plates, pit or pipe sections) the hooks need to be attached to purpose designed lifting points in a manner that requires a deliberate action to release the connection (e.g., a self-locking hook or hook with latch).

Connections that rely on gravity alone (i.e., open hooks) should be avoided as they may dislodge due to the movement of the lifting equipment or load.

Always wear the correct PPE when working in trenches

Using explosives

Construction work that involves the use of explosives is HRCW and a SWMS must be prepared before this work commences.

The use of explosives as an excavation method should only be considered when it is not reasonably practicable to undertake the excavation by any other method.

A person must be licensed by the Cambodia Government to use blasting explosives. If explosives are used in excavation work, a licensed person must develop a blast management plan and be responsible for all aspects of the use of explosives in the excavation.

A blast management plan must include a plan for dealing with any misfire. It must also be commensurate with the size, location, nature and complexity of the blasting operation to be undertaken.

A suitably qualified person (for example, a person licensed and experienced in the controlled application of explosives for excavation purposes) should be consulted before deciding whether explosives may be used for the excavation.

Atmospheric conditions and ventilation

The risk of contamination through a build-up of gases and fumes needs to be controlled in excavation work.

Gases and fumes heavier than air can accumulate in trenches, tunnels and excavations (e.g., gases such as sulphur dioxide, engine fumes such as carbon monoxide and carbon dioxide, leakage from gas bottles, fuel tanks, sewers, drains, gas pipes, and LPG tanks).

Make sure tunnels are well ventilated

Manual work

Manual excavation methods are generally used for small, shallow excavations in soft soils.

When working in close proximity, the Principal Contractor needs to provide and maintain a system of work to keep workers sufficiently far apart to prevent injury from the use of picks or other hand tools. This applies particularly to work in trenches and small excavations.

Using hand tools and working in cramped conditions (for example, trenches) increases the risk of musculoskeletal injury from twisting and bending or from being struck by other workers.

Preparatory drilling activity and the use of hand drills may increase the risk of musculoskeletal disorders from exposure to vibration and twisting.

Make sure workers are at a safe distance from each other when using potentially dangerous equipment and machinery

Emergency works

Emergency works on an underground essential services asset (such as repairing a damaged gas or water pipe) may require excavation work. The urgent nature of the works does not exempt a duty holder from safety obligations.

Hazards and risks associated with excavation work when carrying out emergency works on essential services may include:

- leaking gas when excavating to repair a damaged gas pipe.
- water escaping from a broken water main, affecting the stability of the excavation.
- disturbed ground conditions.

Careful planning of the excavation works, and risk management needs to be undertaken despite the time dependent nature of the work.

If emergency works involve HRCW, and there is a risk to the health and safety of any person arising from that work, a Principal Contractor must ensure that a SWMS is prepared before the work starts, and the work is performed in accordance with the SWMS.

If there is a risk of ground collapse, appropriate ground collapse risk controls need to be used to protect workers who need to enter the excavation to carry out emergency repair works.

Tunnelling

A tunnel is an underground passage or opening in an approximate horizontal plane and which begins at the surface or from an excavation of any sort.

The nature of tunnelling work is complex and highly specialised, and requires engineering expertise during the planning, investigation, design and construction stages.

Design of tunnel

Engineering investigations and the anticipated excavation methods need to be considered in preparing a tunnel design. The design needs to include:

- details on the tunnel dimensions and allowable unsupported excavation tolerances.
- temporary and final support and lining requirements for each location within the tunnel.
- ventilation requirements either natural or mechanical.
- details of expected tunnel drive lengths and location of shafts.
- any other requirements for the finished tunnel.

The design should also include information on the excavation methods, ground conditions and methods of ground support which have been considered in the design.

The design needs to take into account the construction methods that may be used to construct the tunnel so that a safe design for construction purposes is achieved.

Tunnelling hazards and risks

Common hazards and risks during tunnel construction, in addition to above ground construction hazards, include:

- tunnel stability - rock or earth falls and rock bursts.
- changing ground conditions - strata and stress fluctuations.
- limited space and access, with possible confined spaces involved.
- ventilation taking into consideration the potential for air contamination or oxygen depletion.
- fire or explosion.
- the use of fixed and powered mobile machinery.
    - the interaction of people with powered mobile machinery.
- temporary electrical supplies and circuits, including loss of power for lighting, ventilation and pumping.
- compressed air use and high-pressure hydraulics.
- large scale materials and equipment handling.
- influxes of water, overhead seepage, ground and process water.
- uneven, wet or slippery surfaces.
- falling objects.
- contaminated groundwater.
- noise.
- vibration.

- heat and humidity.
- use of explosives.

Risk controls include:

- ground support (e.g., pre-formed tunnel lining segments, tunnel support sets, mesh, rock bolts, and shotcrete).
- appropriate controls associated with falls from heights (for example elevating work platforms in larger tunnels).
- plant and vehicular traffic management systems.
- regular plant maintenance.
- pumps or dewatering systems to remove ground water.
- mechanical ventilation to control airborne contaminants and air temperature or humidity.
- dust extraction.
- plant fitted with water scrubbers.
- plant fitted with catalytic converters.
- provision of breathing equipment and training in its correct use when a hazardous atmosphere is present.

Shafts

A shaft is a vertical or inclined way or opening from the surface downwards or from any underground working and the dimensions of which (excluding the perimeter) are less than its depth.

Shafts are often constructed to provide access or ventilation to a tunnel. Shafts can also be sunk for geological investigating, constructing foundations, dewatering, and providing access to infrastructure or providing openings to underground facilities.

Shafts vary greatly in design and construction, depending on their purpose and the local conditions. They may be vertical or inclined, lined or unlined, various shapes, and excavated using various techniques.

Shaft sinking involves excavating a shaft from the top, with access and spoil removal from the top. Other construction methods include raise-boring, which is a method of constructing a shaft (or raise) where underground access has already been established.

Raise-bored shafts can be from the surface or from one underground horizon to another. The method is remotely executed and does not require people to enter the shaft during operation.

Advice on the design and construction of shafts should be obtained from a suitably qualified person (e.g., an engineer) before excavation and installation. In some cases, ventilation facilities may be required. Common hazards in shaft construction include:

- shaft dimensions limiting workspace, possibly including confined space work.
- underground essential services.
- the potential for ground instability.

- falls and falling objects (e.g., rock falls and water from the shaft wall).
- use of hoisting equipment (e.g., winch, ropes and hooks).
- water inflow or inrush and dewatering.
- airborne contaminants and ventilation.
- hazardous manual handling.
- hazardous materials.
- fire or explosion.
- inadequate communication systems.
- mobile machinery.
- noise.

Risk controls include:

- stabilising the ground at the head of the shaft and placement of excavated material away from the top of the shaft.
- continuously lining or supporting the shaft.
- providing appropriate fall protection (for example, guard rails).
- providing and maintaining appropriate hoisting equipment.
- installing dewatering systems.
- installing mechanical ventilation to control airborne contaminants and air temperature or humidity.
- isolating access to moving parts of plant and equipment.
- managing the working areas and temporary material placement in the bottom of the shaft.
- avoiding overfilling material kibbles before lifting.
- closing shaft doors before tipping.
- cleaning the spillage off doors, stage and any steelwork.

Access to shaft openings needs to be controlled by using a secure cover that is lockable and accessible only by an authorised person.

Bulk excavations

Bulk excavations are often undertaken when construction projects are required to make provision for large spaces (e.g., underground parking, basements, wetlands, or retaining basins).

Common hazards involved in undertaking bulk excavation work include:

- being buried from ground collapse.
- undermining the structural integrity of neighbouring structures, buildings footpaths and roadways.
- damage to buried essential services (for example, gas and sewerage pipes).

- falling into the excavation or piling holes, both people and plant.
- drowning if the excavation floods from rain or damaged water or sewer pipes.

Before commencing bulk excavation work a Principal Contractor should engage a suitably qualified person (e.g., a geotechnical engineer or civil engineer) to determine:

- ground conditions.
- the appropriate ground support or retention system for the site.
- suitable systems of work for the installation of the ground support system.

When excavating, the Principal Contractor needs to ensure:

- a competent person supervises the work.
- the engineer's ground support design and systems of work is followed.
- SWMS are developed and followed for the excavation and ground support works where the work includes HRCW.
- workers never work ahead of the support or remove it prematurely if ground support is being progressively installed.
- workers are trained and are aware of the SWMS and emergency response procedures.
- the public is prevented from accessing the edge of the excavation or the site.

While the excavation remains open the excavation and site security should be inspected regularly by a suitably qualified person and as soon as possible after any event that could affect the safety of the excavation (for example, inclement weather or a ground slip).

Ground collapse is one of the primary risks to be controlled in excavation work. Ground collapse can occur quickly and without warning, giving workers virtually no time to escape, especially if the collapse is extensive.

Where it is determined that there is a risk of ground collapse, or where there is a possibility of the sides of the excavation becoming unstable, the excavation needs to be supported irrespective of the depth.

The figure below shows a typical example of ground failure where material collapses onto a worker pinning them against the wall of a trench. This can cause suffocation, internal organ damage, back injury or broken bones and these injures may be fatal.

When planning the work and selecting appropriate excavation methods and risk controls, the Principal Contractor needs to consider the following:

- the type and strength of the material to be excavated (for example, the depth of the excavation and whether the ground is self-supporting or has been previously backfilled).
- the moisture content of the soil.
- the ground is level or sloping.
- if groundwater is present.

- if there is jointing or faults in the strata.
- if there are any other nearby water courses, drains or run-off that might affect the stability of the excavation.
- the work area and any access or operational limitations.
- the planned height of the excavated face.
- vehicular traffic or powered mobile plant will operate near the excavation.
- if there will be other construction activity nearby that may cause vibration.
- any other loads adjacent to the planned excavation (e.g., buildings, tanks, retaining walls, trees).
- whether the need for persons to enter the excavation can be eliminated.
- any underground essential services (e.g., gas, water, sewage and electrical services).

Falling ground can easily trap unsuspecting workers

Ground conditions

The ground conditions may have a significant impact on the selection of an excavation method and the risk controls required.

In their natural condition, soils have varying degrees of cohesive strength and frictional resistance. Examples of materials with virtually no cohesive strength are dry sand, saturated sand and gravels with minimal clay content.

Ground encountered in excavations can generally be categorised as follows:

- Rock.
- Hard, compact soil.
- Dry soil liable to crack or crumble.

- Loose or running material.

Hard compact soil is the type that can cause the most trouble because the face 'looks good' and this often leads to risks being taken. Loose or running material is often the safest, because the need for safety precautions is obvious from the start.

A Principal Contractor needs to give careful consideration to soil liable to crack or crumble or sandy conditions before determining appropriate risk controls. With the right amount of moisture ground conditions can look safe and solid. The loss of a small amount of water can make the soil crumble or an increase in water content can make the soil or sand slump.

The following examples can increase oil stresses in an excavation and may lead to failure under adverse weather conditions, additional load or vibration:

- excavation, by removal of support previously provided for the excavated material.
- loads on the ground surface near the top of the excavation, such as excavated material, digging equipment or other construction plant and material.
- shock and vibration, which could be caused by, digging equipment, passing loads or vibration producing plant (for example, compactors).
- water pressure from ground water flow, which fills cracks in the soil, increases horizontal stresses and increase the possibility of slumping.
- saturation of soil, which increases the weight and in some cases the volume of the soil.

The following examples may reduce soil stability:

- excess water pressure in sandy soil may saturate the soil and increase its plasticity.
- dryness of the soil may reduce cohesion in sandy soil and soils high in organic content which then may crumble.
- prolonged stress may cause plastic deformation (for example, by squeezing).
- prolonged inactivity at an excavation site. An evaluation of the soil should be undertaken before work recommences.

Before commencing work, a Principal Contractor needs to obtain as much information as possible about the ground conditions. Natural features such as rock outcrops, water courses, creeks and swamps should be inspected. The surface drainage system should also be studied in relation to the line of the proposed excavation.

Information on ground conditions may be available from nearby works such as existing railway cuttings, roadways and foundation works. Results of test bores are usually available from relevant authorities. When test bores are not available, unsupported test excavations using a backhoe should be dug in areas where ground conditions are unclear.

The ground conditions should then be assessed to determine suitable ground supports.

Additional care needs to be taken where disturbed ground may exist due to previously worked trenches or shafts. In such cases, it is essential to increase the excavation ground supports or use a correctly designed and fabricated trench shields.

Controlling the risk of ground collapse

There are three main types of ground collapse risk controls that can be used where ground collapse may occur:

- trench shields.
- benching or battering.
- positive ground support (for example, shoring).

A Principal Contractor needs to ensure that the selected method of ground support is installed safely and as soon as possible after the ground has been excavated.

There is a difference between a ground support system and a shield. A ground support system supports the sides of an excavation, preventing collapse and ensuring the safety of workers. Unless backfilled between the trench wall and the shield, a shield will not support the ground, but does protect the people inside the shield if the wall collapses.

A Principal Contractor needs to ensure that all ground support systems, including shoring and trench shields, are regularly inspected. This is particularly important when an excavation enters different ground conditions or is subject to heavy rains or flooding. Ground supports need to be inspected, repaired and reinforced as necessary.

Some specific areas of the excavation may not require shoring, benching or battering if written analysis is received from a suitably qualified person (e.g., a geotechnical engineer) that identifies which specific sections of the excavation are safe from collapse. Any analysis should state the period of time to which it applies and should identify which occurrences may create a risk of ground collapse (e.g., rain, increase loads for plant or spoil piles, vibration).

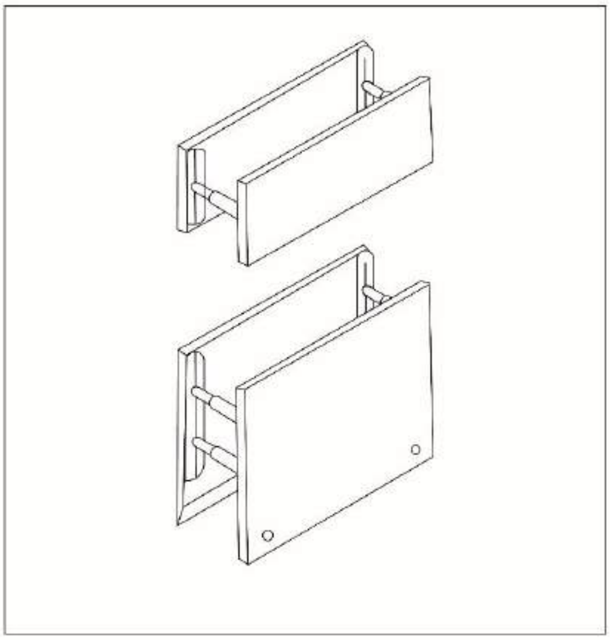
If excavation work is planned to be carried out without positive ground support, the continuing safety of the excavation will depend on the conditions arising during construction.

If the conditions during construction are not as expected, or if conditions change during the course of the work (e.g., different soils, heavy rain or flooding) a Principal Contractor needs to ensure that action is taken immediately to protect workers and other people by implementing appropriate risk controls, such as suspending work until the ground is stable or by installing a positive ground support system.

Trench shields

Trench shields are commonly used during trenching works to protect workers from being engulfed by a ground collapse. Trench shields come in a variety of shapes and sizes and generally consist of steel or aluminium panels.

The panels are held apart by struts at both ends and secured into position by pins and clips or welded. Trench shields are designed to be repositioned as the trench work progresses and the finished section of trench is back filled. The figure below shows a typical trench shield.



Trench shields are vital to prevent collapse

Trench shields are designed and constructed to withstand impact from ground collapse or the earth pressures if the ground becomes unstable. They incorporate certified lifting points for installation and removal.

The trench shield needs to also be firmly wedged into the ground to prevent it from moving if struck by collapsing ground or the area between the shield and trench wall needs to be backfilled with suitable material. A Principal Contractor needs to ensure that the design of trench shields is carried out by a suitably qualified person (for example, engineers experienced in trench shield design). A trench shield may be pre-manufactured to job specific dimensions.

Trench shields are mainly used in open areas where access is available for an excavator or backhoe to lower and raise the trench shields into and out of a trench. They are generally not suitable where access is difficult and ground conditions prevent the use of lifting equipment.

Trench shields can be used as ground support systems if they are of a similar width to the excavator bucket and can be placed in the excavation and pressed down. This ensures that the trench shields provide firm support to the trench wall. In the absence of ground support, the only safe area in the trench is that which is actually protected by the shield.

When selecting the correct trench shield, the conditions of the environment in which the equipment is to be used need to be considered, including:

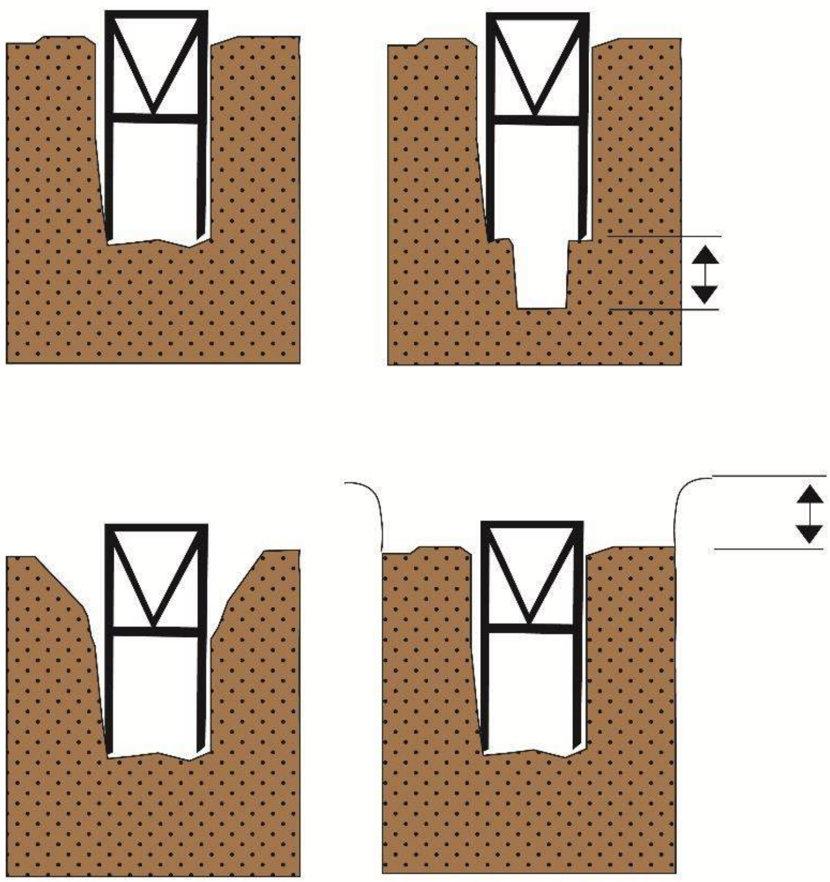
- the nature of the soil, including the type, moisture content and water table (for example, the level below which the ground is saturated with water).
- ground stability and any anticipated ground vibration (for example, from nearby machinery or road traffic).
- expected ground pressures, including the location of the spoil pile and equipment to be used.
- the size of the trench or excavation (for example, the depth, width and length).

- any space constraints.
- the existence or proximity of underground services.
- the type of road traffic and plant near the site, and
- the system of work to be used with equipment.

When trench shields are used as the only means of ensuring safety in the trench, a Principal Contractor needs to ensure that workers do not:

- enter the excavation prior to installation of the shield.
- work inside a trench outside the protection of a shield.
- enter the excavation after the trench shields have been removed.
- enter a shield other than by a suitably designed means (for example, a trench bridge with ladder mounting point should be considered where appropriate).

The ideal placement for a trench shield is when it rests on the bottom of the excavation and extends above the surface by at least 900mm, as it also provides fall protection (see figure below). An alternative method is narrowing the bottom of the trench and having the trench shield supported. When this method is used the trench shield needs to be tightly wedged into the trench.



Example of trench shields that do not exceed the top and bottom of the trench by 900mm

Trench shields should not be subjected to loads exceeding those for which the system was designed to withstand. Earth pressures are reduced when correct benching and battering practices are used. The figures above provide an example of a trench shield placed in a slope battered trench and as an example of a trench shield placed in a step battered trench.

In some circumstances (for example, when digging in rocky ground) it may be difficult to excavate smooth sided trench walls that allows for the trench shield to fit tightly. This can result in the creation of large voids between the trench shield and the trench wall, which allows sections of the trench wall behind the shield to collapse. This additional risk can be controlled by excavating the trench with walls closer to vertical or pushing trench spoil or backfill material into the void area.

Trench shields are often lifted, lowered, extracted and moved around a construction site using earth moving equipment. If a suspended load is not controlled there may be a risk of a load falling from height or swinging unexpectedly.

Where trench shields are to be suspended by chains or wire rope slings, the Principal Contractor needs to ensure that sling hooks are attached to purpose-designed lifting points in a manner that requires a deliberate action to release the connection (for example, a self-locking hook or hook with latch). Connections that rely on gravity alone (i.e., open hooks) should be avoided as they may dislodge due to the movement of the lifting equipment or load.

A Principal Contractor needs to ensure that trench shields are controlled at all times while being lifted or suspended. The installation and removal of trench shields needs to be undertaken by an appropriately qualified plant operator and, where appropriate, a licensed dogger or rigger.

Trench shields are often assembled and dismantled on site. If the process is not undertaken correctly the trench shield components may become unstable and collapse, placing workers at risk of being struck by the collapsing shield. Prior to undertaking assembly or dismantling activities, the Principal Contractor needs to ensure that a safe system of work is developed in accordance with the manufacturer’s instructions.

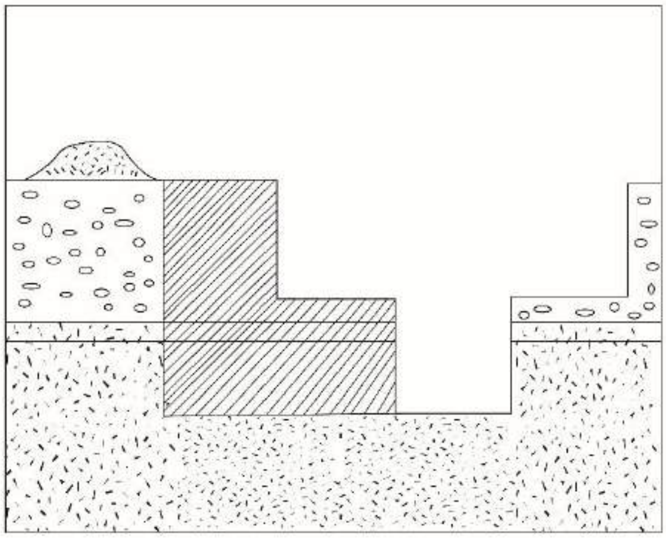
The use of trench shields provides a means of safely accessing the trench when joining pipes or traversing disturbed or unstable ground.

Trench shields should be stored and transported in accordance with the manufacturer’s instructions. Large dimensional trench shields may require disassembly prior to transport.

Benching and battering

Benching or battering creates excavated steps or slopes which should provide appropriate control from ground collapse. That is, the steps or slope will not slump when left for a considerable period, there will be no movement of material down the slope and the toe of the slope will remain stable.

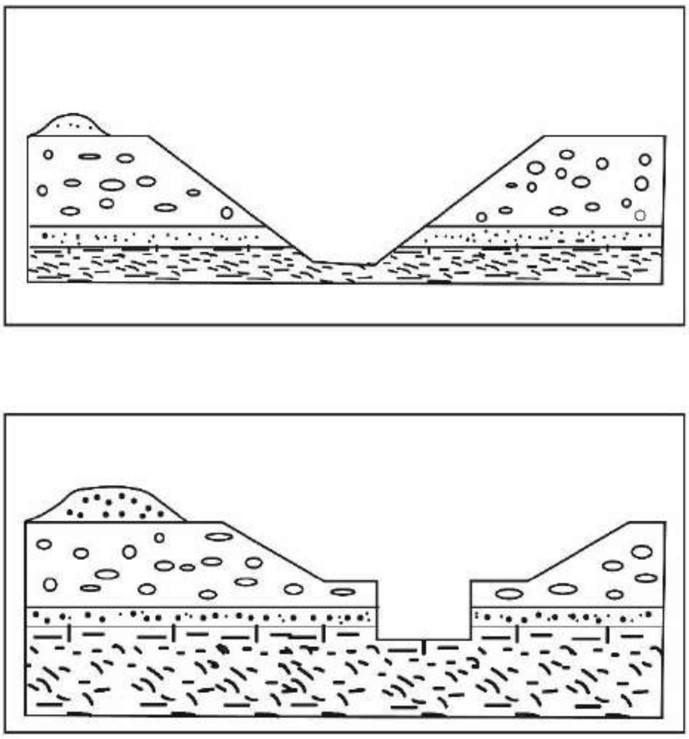
Benching is the creation of a series of steps in the vertical wall of an excavation to reduce the wall height and improves stability. Benching is a method aimed at reducing the risk of ground collapse by excavating the sides of an excavation to form one or more horizontal levels or steps with vertical surfaces between levels.



An example of benching

Battering is where the wall of an excavation is sloped back to a predetermined angle to improve stability. Battering reduces the risk of ground collapse by cutting the excavated face back to a safe slope. Battering needs to commence from the bottom of the excavation.

In some circumstances it may be appropriate to use a combination of benching and battering on an excavation. The angle of repose needs to take into consideration all inclement weather.



An example of benching

Benching and battering of excavation walls can minimise the risk of soil or rock slipping into the excavation.

A Principal Contractor needs to ensure that risk controls are designed by a suitably qualified person (for example, a geotechnical engineer) and be relative to the soil type, the moisture content of the soil, the planned height of the excavated face and any additional loads acting on the excavated face.

It may not be necessary to bench or batter the face of excavations which a geotechnical engineer determines are in stable rock or has assessed that there is no risk of collapse. The geotechnical engineer should provide the assessment or determination in writing.

Sides of the excavated face should be battered to the angle of repose of the soil pile. If it is proposed to have a battered angle higher than the angle of repose of the spoil pile, a geotechnical analysis needs to be undertaken and documented before excavation work commences.

Benches need to be wide enough to stabilise the slopes and to prevent material from the top falling into the working area.

The size and type of any earth moving machinery to be used and any related haulage removal routes need to be considered when designing the batters and widths of benches.

Shoring

Shoring is a positive ground support system that can be used when the ground conditions, location or depth of an excavation makes battering or benching impracticable (for example, unstable ground conditions such as excavating sand, silt or clay).

It provides support for excavated faces, preventing movement of the excavation sides that can lead to ground collapse. Shoring needs to be designed by a structural or geotechnical engineer for the specific construction site ground conditions.

Some common types of shoring are:

- closed sheeting.
- plywood panels (sandwich sheets), and
- soldier sets (hydraulic and timber).

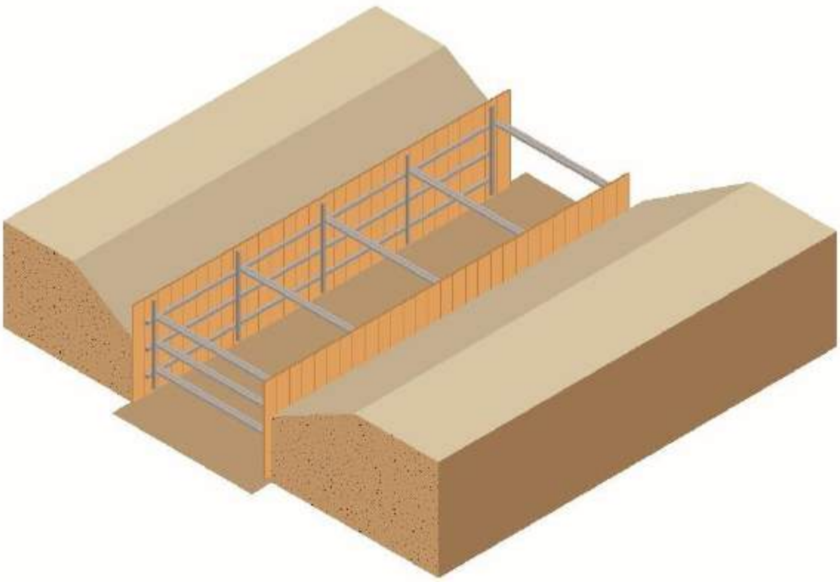
The use of metal shoring has largely replaced timber shoring because of its ability to ensure even distribution of pressure along an excavation line and it is easily adapted to various depths and excavation widths.

Stabilising the face of an excavation should progress as the excavation work progresses. If any part of the excavation is left unstable or unsupported, the principal contractor needs to ensure that appropriate risk controls are put in place to prevent workers or others entering the area.

An example of a trench with no shoring and the spoil pile being to close the zone of influence

Closed sheeting

Closed sheeting (see figure below) is a continuous frame where vertical timber or metal sheathing planks are placed side by side to form a continuous retaining wall to fully cover and support an excavated wall. The closed sheet may also be supported by the other members of the ground support system such as toms and walers.



An example of Closed Sheeting

This method of ground support is used when unstable ground conditions (such as sand) are encountered (for example, when there is a danger of the ground running or collapsing). A Principal Contractor needs to ensure that walers and toms are installed as soon as reasonably practicable during the excavation process, followed by the insertion of the closed sheeting.

When using this method of excavation, capping over the toms needs to extend the full width of the excavation, as they support the timber toms on the waling.

Bearers are used to support the collar set of toms and walers. To ensure that the walers are correctly located, timbers called 'lacing' need to be secured to the walers.

Shoring terms:

Tom is a structural member used to hold soldiers against an excavation wall or to press walers apart when closed sheeting or panels are used.

Waler is a horizontal steel or timber element which supports vertical elements such as soldiers, sheeting and panels.

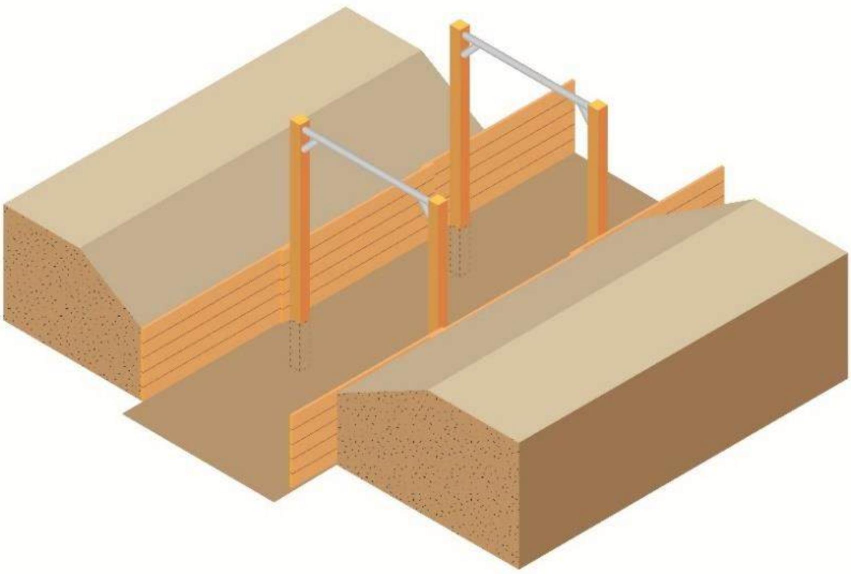
Soldier is a vertical upright timber or steel element used for supporting an excavation wall.

Strut or screw jack is a timber or steel member (usually horizontal) in compression, resisting thrust of pressure from the face or faces of an excavation. Screw jack struts are adjustable

Side lacing

Side lacing is a form of closed sheeting used primarily to ensure safety by preventing soil from slipping by the placement of fill behind timber boards or steel plates. Side lacing is used in all types of ground and is particularly useful where long or large diameter pipes are to be installed and in variable ground conditions where steel or timber supports are difficult to install.

Side lacing needs to be firmly wedged into the ground to prevent it from moving when fill is placed against it.



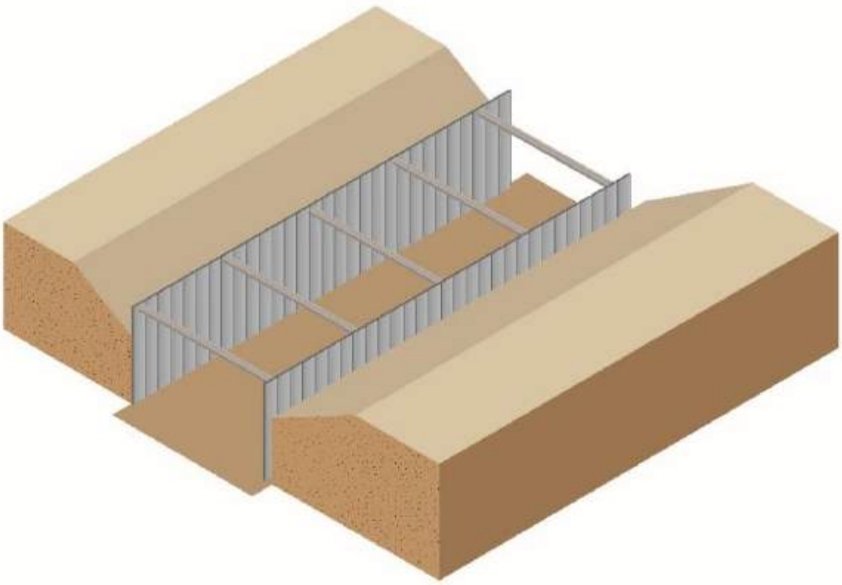
An example of side lacing

When closed sheeting or side lacing is used to prevent ground collapse, a Principal Contractor needs to ensure that workers do not:

- enter the excavation prior to the installation of the sheeting or lacing.
- work inside an excavation, outside the protection of sheeting or lacing.
- enter the excavation after sheeting has been removed.
- enter an area where there is sheeting or lacing, other than by a ladder.

Steel sheet piling

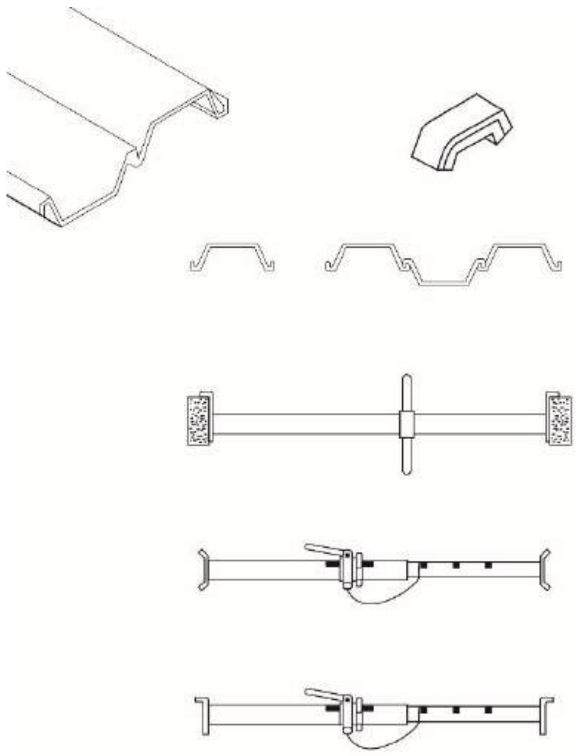
Steel sheet piling is a form of closed sheeting which generally used on major excavations such as large building foundations or where large embankments are to be held back and can be installed prior to excavation work commencing. It is also used where an excavation is in close proximity to adjoining buildings.



An example of Steel Sheet Piling

Steel sheet piling should be used when the ground is so unstable that side wall collapse is likely to occur during excavation (for example, in loose and running sand). In such cases, a Principal Contractor needs to ensure that sheet piling is installed before excavation commences.

It is positioned and mechanically driven into final depth. Toms and waling's are placed into position as the soil is excavated. Although timber can be used, it is more efficient to use adjustable jacks or struts (see figure below).



An example of using adjustable jacks or struts

Steel sheet piling is heavier weight than closed sheeting and in some circumstances, may be driven by hand-held pneumatic hammers or electrically operated vibrating hammers.

Any hazardous manual handling arising from these tasks needs to be controlled. Any projections on the underside of the anvil of jack hammers need to be removed to prevent damage to the driving cap and potential injury to the operator.

Workers may be exposed to noise levels in excess of the noise exposure standard due to driving operation, so the Principal Contractor needs to ensure risks associated with exposure to noise are controlled.

Plywood panels (sandwich sheets)

Plywood panels (sandwich sheets) should be used in variable ground conditions. In unstable ground, the panelling needs to be continuous (closed sheeting). The panelling and soldiers need to be pressed firmly against the excavation sides by either expanding the steel jacks or cutting toms of appropriate length and forcing them in place.

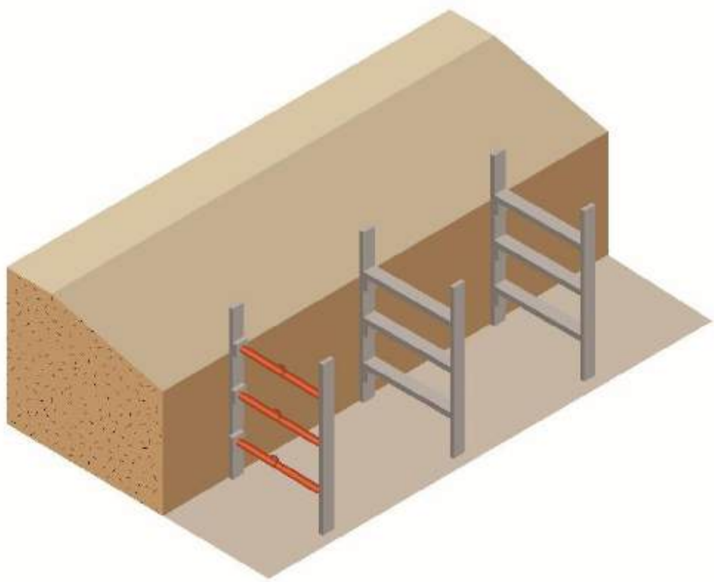
Timber tongs are used to lower the tom into the excavation with the lower end of the tom being placed on top of the far side bottom cleat. The upper end of the tom is then placed against the opposite soldier, above the near side bottom cleat. This upper end is finally driven down onto the bottom cleat causing the lower section of the two soldiers to press against the excavation.

Soldier set systems

The soldier set system is a simple form of excavation support which can be formed with steel or timber. This system is mostly used in rock, stiff clays and in other soil types with similar self-supporting properties.

Unlike closed sheeting, soldier sets retain the earth and may be increased in an area where there is a fault in the embankment. Soldier sets only provide ground support at regular intervals and do not provide positive ground support between the sets. Open soldier sets should only be used in stable soil types.

The figure below shows the minimum support required for a trench being driven through ground of compact, stiff clays, or other sediments. These support dimensions need to be increased in trenches wider than one metre, or where the supports show signs of being overloaded, or where there is evidence or a likelihood of the trench becoming unstable between sets.



An example of a soldier set system

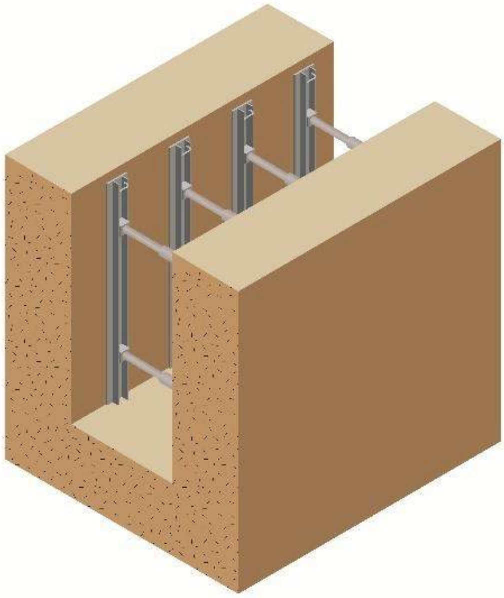
Hydraulic systems

Hydraulic support systems are mainly used to provide temporary or mobile ground support while other ground supports are being installed.

A Principal Contractor needs to consider ground pressures prior to installing hydraulic supports. The hydraulic support system needs to be designed by a geotechnical engineer. The hydraulic capacity of the ground support system needs to be designed to resist the expected ground pressures and potential for collapse.

Hydraulic support systems may become unreliable or rupture if not properly maintained and properly used. Frequent inspections of pressure hoses and rams are necessary by appropriately qualified persons to detect abrasion, fatigue or damage such as bent or notched rams. Hydraulic systems need to incorporate hose burst protection.

A Principal Contractor needs to ensure that, upon removal from the excavation, hydraulic supports are inspected, repaired if necessary and carefully stored prior to re-use.



An example of a hydraulic support system

Installing and removing ground support systems

An excavated area is most insecure when the ground supports are being installed or removed. A Principal Contractor needs to ensure that all support systems are installed and removed in a manner that protects workers from ground collapse, structural collapse or being struck by structural members. Before installation or removal begins, temporary structural supports should be installed to ensure work can be done safely.

Work should not proceed in potentially unstable, unsupported ground. Work can only proceed in potentially unstable ground if appropriate stabilising and supporting structures are correctly implemented. Working without installing supports may hasten the excavation process, but a substantial ground collapse may delay operations.

Installing ground support systems

During the erection of support systems, as more material is excavated the ability of the walls to support the load may decrease.

If workers are required to enter an excavated area before permanent supports have been correctly installed (for example, to drill and place explosives), the Principal Contractor needs to ensure that temporary protection in the form of timber supports or trench shields is used to protect the workers from ground collapse or falling rocks.

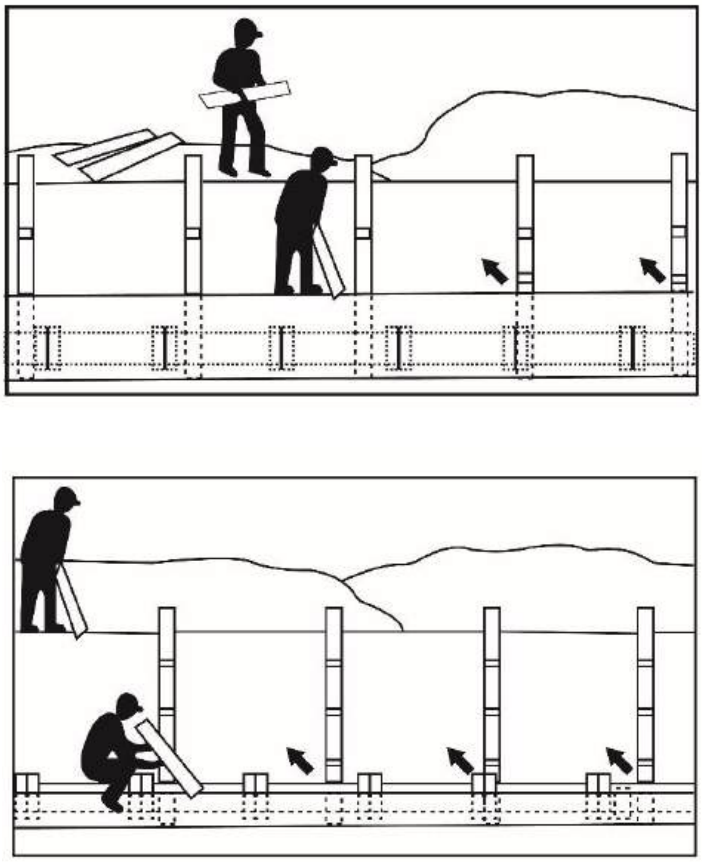
Removing ground support systems

A Principal Contractor needs to ensure that ground support is not removed from the section of an excavation where workers are working. Ground support systems should only be removed using a predetermined safe method under the direction of a person with the appropriate expertise. The support material should be left in place if its removal is dangerous.

When a ground support system is being dismantled and the excavation has not been properly backfilled, the excavated area may not withstand the increase side pressure that was previously borne by the ground supports. This may cause the excavated area to collapse.

Removal of the soldier sets needs to be done from the surface or from a supported area of the excavated area. There are two recommended methods of removal, both of which require workers to be in the excavated area during dismantling. Consideration should be given to compaction of backfill material as the work progresses.

Method 1 – This is the preferred method. Soil needs to be replaced back into the excavated area along the entire length so that it is level with the bottom set of toms prior to workers entering the excavation. Once this is complete workers can then enter the excavated area and remove all the bottom toms. Once this is complete workers need to leave the excavation so it can be back filled to the next level of toms. The next level of toms then needs to be removed in the same way. This is repeated until all the toms have been recovered, after which it is safe to remove the soldier sets by means of back-hoe and chains or lifting lug. Backfilling is then completed.

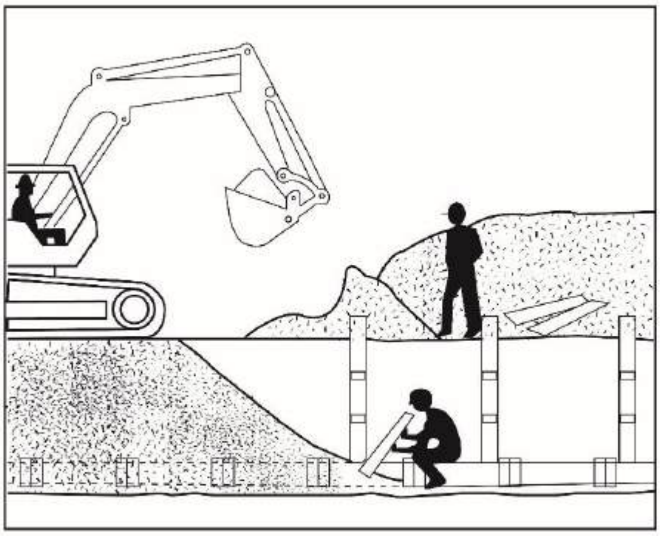


Method 1 of ground support dismantling and removal

Method 2 – With this method, backfilling progresses from one end of the excavation to the other. This is useful practice when the excavation has restricted access.

Backfill is placed in the excavation until it begins to run over the bottom tom of the first soldier set. A worker then removes the bottom tom. Once this is complete the worker needs to leave the excavation or go behind a complete soldier set. This is because if ground does fall it may collapse back to the last complete set. More back fill is then added until it reaches the next tom in the set being recovered. This is repeated until all toms in the soldier set are removed.

The two soldier sets are then removed, and the excavation is backfilled until the fill reaches the bottom tom of the next set. The process is repeated along the whole length of the excavation.



Method 2 of ground support dismantling and removal

Soldier sets should not be used to enter or leave an excavated area. Ladders or other appropriately designed means need to be used. A Principal Contractor needs to ensure safe access is provided in all excavation where work is being undertaken.

Using toms as a ladder is unsafe as the excavation wall may have shifted, thereby loosening the top tom, or the soldier set may have been erected incorrectly. Soldier sets could become damaged and weakened if used as a ladder which may cause the soldier set to fail and the excavation to collapse.

<u>**Emergency procedures**</u>

What is engulfment?

Engulfment happens when a person is partially or fully enveloped by soil or other material.

Requirements for establishing emergency procedures

A Principal Contractor must establish emergency procedures before construction work is undertaken if there is a risk of a person becoming engulfed by soil or other material when the work is performed (subject to limited exceptions). The Principal Contractor must ensure that the emergency procedures, so far as is reasonably practicable, enable,

- the rescue of a person in the event that the person becomes engulfed by soil or other material.

- the provision of first aid to a person who has become engulfed.

The Principal Contractor must ensure that the emergency procedures can be, and are, carried out immediately after a person becomes, or is likely to become, engulfed.

Documenting emergency procedures

Principal Contractors have duties to provide the necessary information, instruction and training to workers, including on the emergency procedures and how to implement them safely.

These emergency procedures should be easy for users to understand, onsite and readily available.

It is recommended that Principal Contractors maintain records of the training and instruction provided to workers.

In an engulfment situation, people working onsite need the necessary information, instruction and training to make informed decisions about how to safely rescue an engulfed person. By making uninformed or impulsive decisions, they can place themselves or others at risk, which increases the possibility of multiple injuries or fatalities.

For construction work that requires a safe work method statement (SWMS), the SWMS must describe how risk control measures are to be implemented. This should include the engulfment emergency procedures, which can be documented or referenced in the SWMS. For example, Engulfment - implement documented emergency procedures.

Planning for engulfment

Principal Contractors or self-employed persons should know how to deal with engulfment by:

- consulting with workers during the planning process.
- identifying the likely engulfment scenarios associated with their work and developing. emergency procedures for those scenarios. For example, a ground slip.
- including a contingency plan where emergency services are unable or unavailable to attend, for example when working in remote areas.
- identifying equipment required to be onsite to allow implementation of the emergency procedures.
- training nominated persons in emergency procedures.
- instructing all workers involved about the emergency procedures.
- identifying appropriate post-incident support services (for example counselling) that might be required.

Before starting the construction work

Where relevant, the site's general inductions should address emergency procedures for engulfment incidents. Once onsite and before starting construction work, the engulfment emergency procedures should be reviewed and modified as necessary. The review should take site-specific conditions into account, such as:

- The name of the person managing emergency procedures onsite. If that person is likely to be at risk of engulfment, include the name of an alternative person.
- The accurate location of the construction site, so that directions can be given to emergency services.
- Consideration of weather forecasts affecting the work environment, especially if this will affect emergency procedures. For example, how emergency services will access the site.
- Checking that telephone services are available to contact emergency services.
- Determining the quickest way to contact emergency services, especially if a telephone service is unavailable
- Checking that the emergency equipment detailed in the emergency procedures is available onsite and relevant persons are competent in its use.

When the procedures have been reviewed and modified for site conditions, the Principal Contractor or self-employed person should coordinate with the site's principal contractor, when needed, to include engulfment emergency procedures into the principal contractor's emergency procedures and the overall site Emergency Response Plan.

All persons who will be involved in the construction work should be inducted into the emergency procedures.

What to do if engulfment happens

A site's emergency procedures should be used immediately if an engulfment happens.

The nominated person should take control of the site. If the nominated person is unavailable, another person, such as the alternative person nominated, should take charge.

People working onsite should avoid trying to immediately rescue the engulfed person. Impulsive actions can put rescuers at risk of engulfment, worsen the situation of the engulfed person, and delay emergency procedures, such as contacting emergency services.

What to do after the site is under control

Once the site is under control, assess the person's condition, degree of engulfment and any risk of further engulfment. Work out if the person is:

- fully engulfed.
- partially engulfed, above or below waist.
- able to help rescue themselves, for example their arms are free.
- conscious or unconscious.
- able to communicate if they have any injuries.

Other things to consider are:

- the stability of the ground or material.
- the likelihood of the person being further engulfed.

- if people helping also risk being engulfed.

What to do when contacting emergency services

Contact emergency services as soon as possible and explain:

- the engulfment situation and the person's condition.
- how to locate the site.
- who and where emergency services will be met, for example on big sites where there are multiple works, to guide them to the location.

What to do while waiting for emergency services

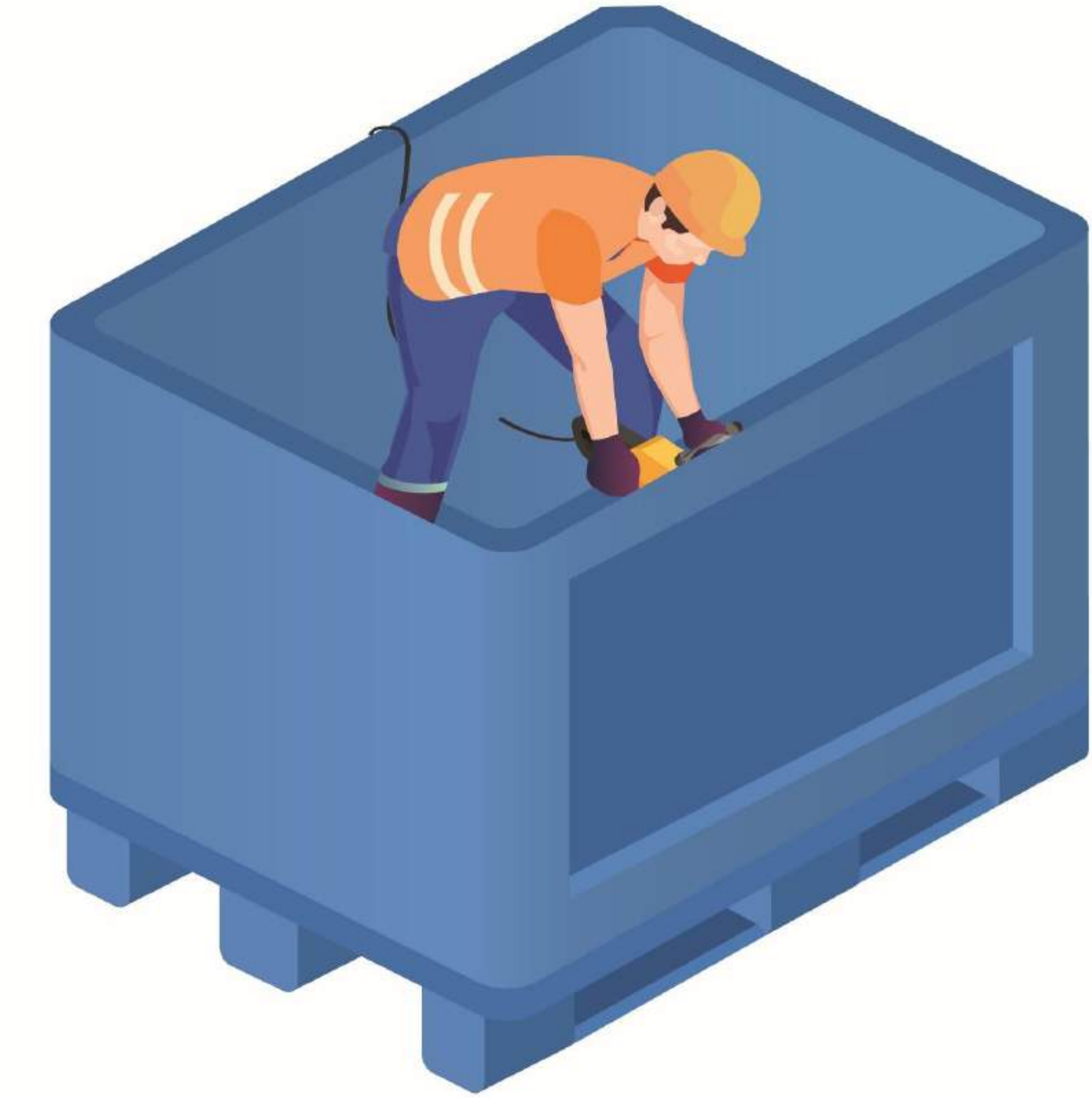
While waiting for emergency services, work out how to provide practical help to the engulfed person. This could include:

- providing structural support to prevent further engulfment, for example, lowering a trench shield over the person, bench or batter back walls if it's safe.
- trying to relieve pressure on the person's body, for example, manually removing material around the person or providing hand tools to the person if their arms are free, to help them dig material away from their body.
- providing water or other fluids to keep the person hydrated.
- providing shelter to shade the person from sun.
- preventing the risk of flooding by using a pump or other effective method to remove any accumulating water.
- providing first aid and arranging transport to hospital if the engulfed person is able to get themselves out.

Once emergency services are onsite they will take charge of the emergency procedures and undertake the rescue of the engulfed person. Emergency services might ask people on site to help with the rescue.

CHAPTER 15

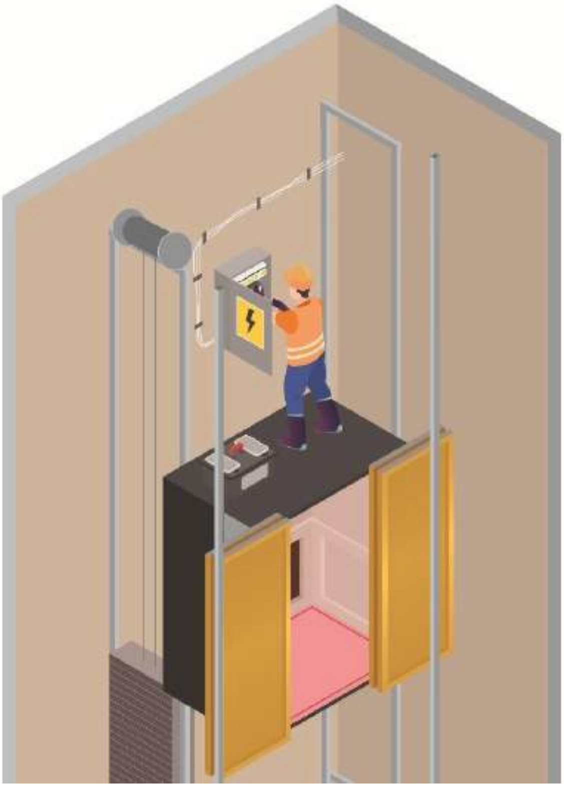
SAFE WORK IN CONFINED SPACES



Confined spaces are common in many industries and involve significant risks for workers who need to work inside them.

Limited means of entry and exit, poor ventilation, and the presence of toxic gases and vapours in confined spaces pose serious risks to workers.

People have also been killed as a result of being suffocated or crushed by materials stored in the space.



Confined Spaces pose a number of dangers for workers

This section will help you understand the risks and will explain what you need to do to make your construction site safe.

What is a confined space?

A confined space is any enclosed or partially enclosed structure that is intended or likely to be entered by any person, has limited or restricted entry or exit access and contains a potentially harmful atmosphere. Examples include tanks, pits, chimneys, silos, underground sewers, tunnels and wells.

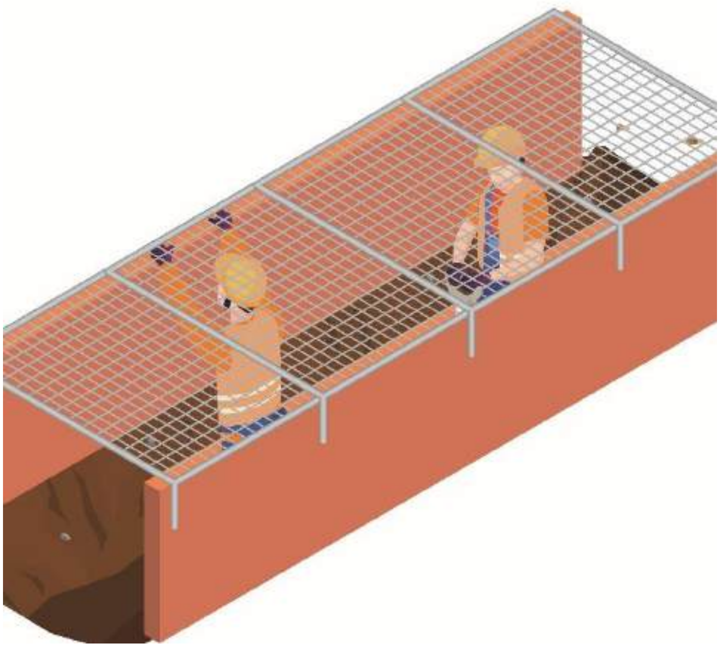
A confined space may contain a harmful atmosphere, dangerous vapours, flammable gases, reduced or unsafe oxygen levels or stored substances that might collapse and engulf a person.

In many instances, people killed in confined spaces die trying to rescue someone already overcome by a harmful atmosphere. Rescues should never be attempted without proper emergency management procedures and appropriate safety equipment such as air-supplied respiratory protective equipment.

A ‘confined space’ means an enclosed or partially enclosed space that:

- is not designed or intended to be occupied by a person.
- is, or is designed or intended to be, at normal atmospheric pressure while any person is in the space; and
- is or is likely to be a risk to health and safety from an atmosphere that does not have a safe oxygen level, or
- has contaminants, including airborne gases, vapours and dusts, that may cause injury from fire or explosion, or
- has harmful concentrations of any airborne contaminants, or engulfment.

Entry into a confined space means a person’s head or upper body is in the confined space or within the boundary of the confined space.



As soon as your head or upper body is in a small, enclosed space, it is considered an entrance into a confined space

Risks of working in confined spaces

There are serious health and safety risks working in confined spaces. For example:

- loss of consciousness, injury or death from contaminants in the air.
- a fire or explosion that kills or seriously injures.
- suffocation from oxygen deficiency.
- crushing or suffocation from something like grain, sand, flour or fertiliser if you fall into it.

Incidents in confined spaces have sometimes involved multiple deaths. Other workers enter a space to rescue a victim, unaware of the risks. But they can also be overcome by toxic fumes or gases.

Always take precautions when working in confined spaces

Managing safety in confined spaces

Consult

Involving your workers in health and safety issues can result in a safer construction site. That's why consultation is an important part of risk management. In certain situations, Construction Site Owners and Principal Contractors must consult about health and safety issues with workers and health and safety representatives (HSRs) if they have them.

Most confined space work requires consultation between Principal Contractor and Worker

Find the hazards

If you have a confined space, you must identify all the hazards associated with work in that space. This might include things like ignition hazards from open flames, and environmental hazards like heat or damp.

Assess the risks

Once you have identified the hazards, you must assess the risks associated with the hazards. Testing the atmosphere helps you know what hazards are present so you can control the risks in the confined space. It tells you oxygen levels, and if there are air contaminants, flammable gases or vapours. Testing is important because many toxic gases can't be seen or smelled.

Control the risks

The best solution is to eliminate the risk by finding a way to do the work without entering the space. For example, you might be able to clean a tank with a high-pressure hose through the hatch.
If it's not possible to do the work from outside, look at ways to reduce the risk. For example, you could scrape the surface of a tank instead of using chemicals or replace a flammable solvent with a non-flammable one.

Review risk controls

Review your risk controls to make sure they are working properly. You must review and, if needed revise them if, for example:

- a notifiable incident occurs.
- the risk controls do not control the risk effectively.
- an HSR requests.

How to determine whether a space is a confined space

A confined space is determined by its structure and a specific set of circumstances. This may include restricted entry or exit, hazardous atmospheres or risk of engulfment. When work is performed in an enclosed small space it does not necessarily mean it is a confined space.

Use the questions in the flow chart below to determine whether a space is a 'confined space' for the purposes of the OHS Regulations.

Flow Chart – Is the space a confined space?

Is the Space **enclosed** or **partially enclosed**?
The size of the space is not a factor when classifying a confined space

→ No

Yes ↓

Is the space **intended** or **likely to be entered by a person and is it at normal atmospheric pressure?**

Entry into a confined space occurs when the head or upper body enters the space and there is a risk the person may be overcome or incapacitated by the conditions within the space.

→ No

Yes ↓

Does the space have **limited** or **restricted entry or exit?**

The entry or exit to the space may be restricted buy the size of the opening or its location. Consideration needs to be given to whether the space is physically difficult to get in or out of and whether it would be difficult to remove and injured or unconscious person from the space.

→ No → **Not a Confined Space**

Yes ↓

Does the space **contain, is it likely to contain or is it intended to contain** one or more of the following:

- An atmosphere that has a harmful level of containment (e.g. a level in excess of the relevant exposure standard or, if the contaminant does not have an exposure standard, the level where the containment is likely to have an adverse health effect)
- An atmosphere that does not have a safe oxygen level (a safe oxygen level is defined as an oxygen content in air of between 19.5% and 23.5% under normal atmospheric pressure)
- Any stored substance (other than liquids) that could cause engulfment (e.g. solids such as fly ash, grain, animal feed, sawdust, and sand, that can flow and can form a temporary cavity or bridge, which may collapse and surround a person cutting off their air supply)?

→ No

Yes ↓

Confined Space

Hazard identification

A Principal Contractor, so far as is reasonably practicable, identify all hazards associated with work in a confined space. All hazards, including those associated with entry or exit, need to be identified before anyone enters the space.

The types of substances previously stored in the confined space (for any length of time) will indicate the sorts of hazards that may be present, such as a lack of oxygen, atmospheric contaminants or flammable atmospheres. Other hazards may arise from processes, products, by-products, waste and work activities in or around the confined space.

Generic hazard identification

Where the Principal Contractor is responsible for similar confined spaces in a number of different work areas or construction sites, a single (or generic) hazard identification may be undertaken for a class of confined spaces rather than each individual confined space if:

- all the confined spaces in the class are similar; and
- the identification carried out for the class of confined spaces does not result in any workers being subject to any greater, additional or different risk to health or safety than if the identification were carried out for each individual confined space.

Restricted means of entry or exit

Small entrances and exits make it very difficult to rescue injured persons or to get equipment (such as respirators needed in spaces with hazardous atmospheres) in or out of a confined space. In some cases, entrances and exits may be very large but difficult to access. For example, access to pits or openings high up in silos may require the use of ladders, hoists or other devices and therefore escape or rescue operations from such spaces may be very difficult in emergency situations. Consideration should be given to the:

- size, location and access to entrances and exits.
- nature of work and equipment required.
- physical environment, including obstructions and fittings.
- equipment used to assist with safe entry and exit.
- emergency and rescue requirements, including whether entrances and exits are adequate to enable workers to be rescued quickly.

Ensure there is a rescue plan in place for workers injured in a confined space

Harmful atmospheric contaminants

The following table provides some examples of harmful atmospheres that may be present in a confined space, and how they may be created.

Some confined space work can produce harmful vapours

Non-toxic chemicals can turn toxic if left covered for a long time

Unsafe oxygen level

Under normal atmospheric pressure, air usually contains 21 per cent oxygen. However, oxygen levels between 19.5 per cent and 23.5 per cent by volume are considered to be safe.

Some situations can cause the level of oxygen to dramatically decrease, leading to an oxygen deficient atmosphere and possible asphyxiation. For example, this may occur if oxygen in the atmosphere is:

- displaced by gases produced during biological processes, such as methane in a sewer.
- displaced during purging with an inert gas to remove flammable or toxic fumes.
- depleted inside metal tanks and vessels through surface oxidation (for example, when rust forms).
- consumed during combustion of flammable substances.
- absorbed or reacts with grains, chemicals or soils in sealed silos.

Too much oxygen can increase the risk of fire or explosion. Oxygen-enriched atmospheres may occur if:

- chemical reactions cause the production of oxygen (for example, certain reactions with hydrogen peroxide).
- there is a leak of oxygen from poorly designed or maintained oxygen storage equipment.

Oxygen storage rooms/areas should always be maintained

Other hazards associated with confined spaces

Uncontrolled introduction of substances

The uncontrolled introduction of substances (e.g., steam, water or other liquids, gases or solids) may result in drowning, being overcome by fumes or other harm, depending on the nature of the substance.

Machinery such as vehicles and LPG-forklifts operating close to the opening of a confined space can cause a build-up of exhaust gases, such as carbon monoxide, in the space.

Fire and explosion

A fire or explosion requires the presence of three elements: an ignition source, air, and a fuel (e.g., gas or vapour) capable of igniting. An atmosphere in which a flammable gas or vapour is likely to exceed five per cent of its Lower Explosive Limit (LEL) is considered to be a hazardous atmosphere.

An LEL is the lowest concentration of a gas or vapour that will burn in air. A Principal Contractor must ensure that during work in a confined space, so far as is reasonably practicable, the concentration of any flammable gas or vapour in the atmosphere of the space is below five per cent of its LEL.

If there is a likelihood of fire or explosion in a confined space, a Principal Contractor must ensure that no source of ignition is introduced to the space, whether introduced from within or outside the space.

For example, potential ignition sources inside and outside the space may include:

- open flames and hot surfaces.
- electrical equipment.

- internal combustion engines.
- metal tools striking metal surfaces.
- spark-producing equipment such as grinding wheels.
- static electricity.

Flammable atmospheres in confined spaces may result from the evaporation of a flammable residue, flammable materials used in the space, a chemical reaction (for example, the formation of methane in sewers), or from the presence of combustible dust (for example, in flour silos).

If an ignition source, (for example, a sparking or electrical tool) is introduced into a space containing a flammable atmosphere, an explosion is likely to result.

Biological hazards

Contact with micro-organisms (e.g., viruses, bacteria or fungi) may result in infectious diseases, dermatitis or lung conditions such as hypersensitivity pneumonitis. Sewers, grain silos and manure pits are examples of confined spaces where biological hazards may be present.

Mechanical hazards

Exposure to mechanical hazards associated with plant may result in entanglement, crushing, cutting or piercing injuries. Sources of mechanical hazards include machinery such as augers, agitators, blenders, mixers and stirrers.

Confined spaces can put workers close to dangerous machinery

Skin contacts with hazardous substances

The nature of a confined space can increase the likelihood of skin contact with surface contaminants. Skin contact with hazardous substances may result in immediate health effects (e.g., burns, irritation or allergic dermatitis) or longer-term systemic effects.

Confined spaces can contain hazardous substances

Noise

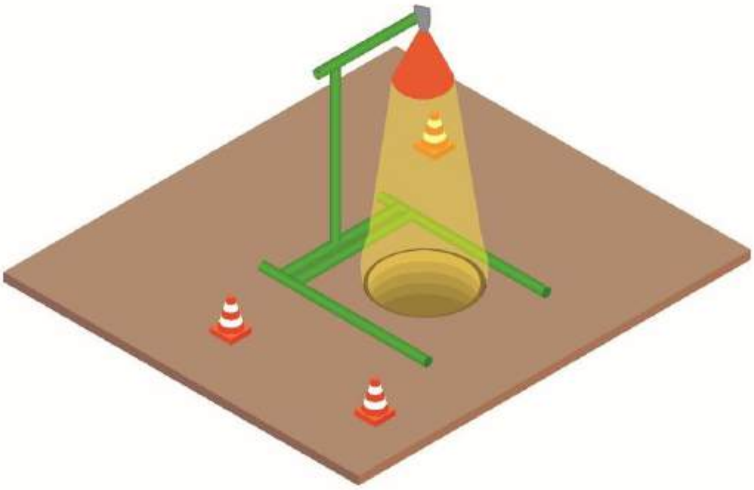
Noise generated in a confined space from the use of plant, the work method or process may be amplified due to reflections off hard surfaces. Exposure to excessive noise may result in hearing loss, tinnitus and other non- auditory health effects. Excessive noise may also prevent workers from hearing warning signals and distract them from their work.

Loud noises are amplified in confined spaces

Environmental hazards

Environmental hazards associated with work in a confined space may cause or contribute to harm. Examples of environmental hazards include:

- heat or cold stress arising from the work process or conditions.
- slips, trips and falls arising from slippery surfaces or obstacles.
- inadequate lighting.



Ensure the confined space has adequate lighting

Hazards outside the confined space

Where the confined space has a vertical opening, there is a risk a person could fall in. People at risk include those assisting the confined space entry (for example, the standby person or spotter) and, in certain circumstances, pedestrians.

Ensure adequate warning and protective measures are taken to protect the public

Traffic hazards are a concern where confined space entrances or exits are located on footpaths or roads. There is the potential for workers entering or exiting the space to be struck and injured by vehicle traffic.

Additional physiological and psychological demands of working in a confined space

Working in a confined space may impose additional physiological and psychological demands over and above those encountered in a normal working environment. Consideration should be given to a worker's:

- physical ability.
- ability to work in a restrictive space (for example, claustrophobia).
- ability to wear the personal protective equipment required to do the work (for example, respirators).

Testing the atmosphere

To effectively control the atmospheric hazards associated with work in a confined space, it is necessary to quantify the level of oxygen, any atmospheric contaminants and any flammable gas or vapour present in the space. Testing the atmosphere in a confined space needs to be a routine part of determining appropriate risk controls.

Testing needs to be carried out by a suitably qualified or competent person, using an appropriate and correctly calibrated gas detector that meets or exceeds international standards. Where relevant, the atmosphere in a confined space should be tested for:

- oxygen content.
- airborne concentration of flammable contaminants.
- airborne concentration of potentially harmful contaminants (e.g., hydrogen sulphide, carbon monoxide and methylene chloride).

A person's senses should never be used to determine if the air in a confined space is safe. Many toxic or flammable gases cannot be detected by sight or smell and the level of oxygen in the air cannot be determined by using the senses.

Where to test

Initial testing needs to be done from outside the confined space, by inserting a sample probe into appropriately selected access holes, nozzles or openings. Contaminants can settle at different levels in a confined space, so the top, middle and bottom areas of the space need to be tested.

Some gases (for example, hydrogen sulphide) are heavier than air and in unventilated areas typically settle to the bottom of the space, while other gases (for example, methane) are lighter than air and typically collect at the top of the space. Tests need to be made at a sufficient number of points to accurately reflect areas of the space that are likely to be accessed.

If it is necessary to enter the space to test remote regions away from entrances or access holes, then air-supplied respiratory protection equipment needs to be worn.

Atmospheric testing of remote sections and different levels within a confined space

When to test

Testing needs to be done before entry to a confined space is permitted and at other times as necessary. Re- testing and continuous monitoring of the atmosphere needs to be undertaken if it has been identified (for example, through a risk assessment) that conditions may change due to the work being done or the disturbance of hazardous material in the confined space. Alternatively, the results of the testing may indicate a requirement to purge or ventilate the space and re-test prior to entry.

Where the concentration of flammable gas or vapour in the space is equal to or greater than five per cent but less than 10 per cent of its LEL, the space must be continually monitored during occupancy. For example, by using a suitably calibrated, continuous- monitoring flammable gas detector that meets or exceeds international standards.

Ensuring a safe atmosphere

During work in a confined space, Principal Contractors must ensure, so far as is reasonably practicable, that the atmosphere in the space has a safe oxygen level and does not expose workers to an atmospheric concentration of a contaminant above the exposure standard

A safe atmosphere in a confined space is one that:

- has a safe oxygen level.
- is free of atmospheric contaminants or contains atmospheric contaminants below their exposure standard (if any).
- has a concentration of any flammable gas or vapour below five per cent of its LEL.

A safe atmosphere can be achieved within a confined space by using methods such as cleaning, purging and ventilation. In relation to work in a confined space, a Principal Contractor must ensure, so far as is reasonably practicable, that purging or ventilation of any contaminant in the atmosphere of the space is carried out.

Incorrect and correct usage of ventilation when there are harmful contaminants in the air

Purging

Purging means the method by which any contaminant is displaced from a confined space. Purging can be done using an inert gas, such as nitrogen, to clear any contaminant in the atmosphere, including flammable gases or vapours, before work in a confined space begins.

After purging, the confined space needs to be adequately ventilated with sufficient fresh air to ensure that the inert gas is removed. Purging needs to be done in a way that ensures any contaminants removed from the confined space are expelled to a location where they present no further risk. Atmospheric testing needs to be carried out before entry into the confined space to check that the ventilation has been effective.

When any contaminant is required to be purged, purging and ventilation equipment designed for use in hazardous areas should be used. A hazardous area is an area in which an explosive atmosphere is present, or may be expected to be present, in quantities that require special precautions for the construction, installation and use of potential ignition sources.

Ventilation

Ventilation is the act of ensuring that adequate air flow is maintained within a confined space. Ventilation of a confined space with fresh air, by natural, forced or mechanical means, may be necessary to establish and maintain a safe atmosphere and temperature during work in the confined space.

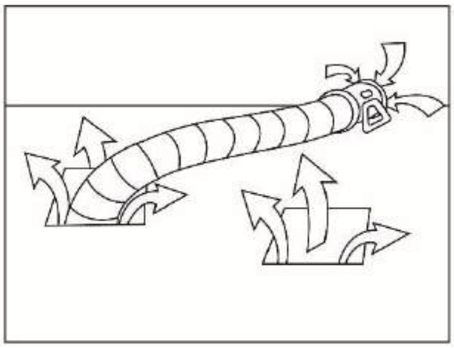
If the confined space has sufficient openings natural ventilation may be adequate, but in most cases mechanical ventilation is likely to be needed. Consideration needs to be given to where the fresh air is drawn from and where the exhaust air is vented to, so that the fresh air is not contaminated either by exhaust air or by other pollutants, and the exhaust air does not cause other risks.

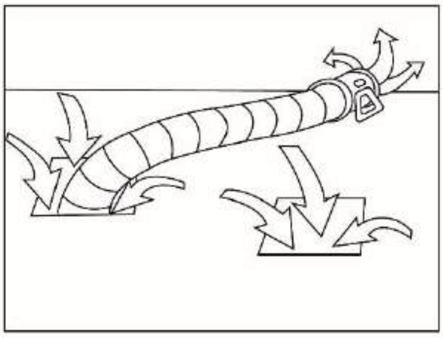
Mechanical ventilation may be either local exhaust ventilation (LEV) or dilution ventilation (see Figures below). LEV is effective where the source of contaminant generation is localised, the extraction point can be located close to the source and adequate make-up air is available (for example, the capture or extraction of welding fumes).

Where dilution ventilation is used air needs to be introduced in a way that will ensure effective circulation throughout the confined space, taking account of the configuration of the space, the position of the openings and the properties of any contaminants.

During operations likely to generate contaminants, mechanical ventilation equipment may not be adequate or sufficiently reliable to maintain contaminants at acceptable levels or to ensure a safe oxygen level. Where mechanical ventilation equipment is likely to be necessary to maintain acceptable contaminant levels in a confined space, the equipment should:

- be monitored to ensure continuous operation while the confined space is occupied.
- have the controls (including any remote power supply) clearly identified, tagged and protected to guard against unauthorised interference.





Dilution ventilation

Local exhaust ventilation

Respiratory protective equipment

Principal Contractors must ensure, during work in a confined space, that the space has a safe oxygen level. If it is not reasonably practicable to ensure a confined space contains a safe oxygen level, a Principal Contractor must provide workers with air- supplied respiratory protective equipment.

Where any atmospheric contaminant in the space has an exposure standard, and it is not reasonably practicable to ensure workers are not exposed to the contaminant above its exposure standard (if any), a Principal Contractor must provide workers with air- supplied respiratory protective equipment or other appropriate respiratory protective equipment.

Principal Contractors must ensure that workers use personal protective equipment when it is supplied. They also need to ensure that it is correctly fitted and maintained.

Respiratory protective equipment includes a range of air-supplied and air-purifying equipment. Whenever there is any doubt about the type of respiratory protective equipment required, air-supplied equipment needs to be used, as it provides a higher level of protection.

Where there is uncertainty about the concentration of atmospheric contaminants (due to inaccessibility, no appropriate testing methodology or where the work activity generates atmospheric contaminants, such as cleaning processes), a Principal Contractor needs to ensure that air- supplied respiratory protective equipment is used. For more information see Chapter 4 Use of PPE

Signage

A Construction Site Owner must erect signs that identify the confined space and notify workers that they must not enter unless they have a confined space entry permit.

Signage must be clear and prominently positioned next to each entry point to the confined space. It must be in place while work is performed in the confined space, or work is being performed in preparation for, or in completion of, work in the confined space.

A Construction Site Owner needs to take all reasonable steps to prevent unauthorised entry to a confined space by, for example, using fixed barriers, locks or other suitable security devices. Signposting alone should not be relied on to prevent unauthorised entry into a confined space.

A typical Confined Space warning sign

Confined space entry permits

It is advised that all construction sites that require workers to work in confined spaces, adopt a confined space entry permit system, ensuring that a worker does not enter a confined space unless they have been issued with a confined space entry permit for the space to which the permit applies.

A confined space entry permit provides a formal check to ensure all elements of a safe system of work are in place before a worker is allowed to enter the confined space.

It also provides a means of communication between site management, supervisors and those carrying out the work, and ensures that the Principal Contractor has checked and authorised the entry to the confined space and it is safe to proceed.

Principal Contractor must ensure that a confined space entry permit is issued for each confined space. The entry permit must only apply to one confined space and may allow one or more persons to enter that space.

The confined space entry permit must list:

- the confined space to which the permit applies:
    - the permit form should be designed and completed to enable clear identification and recording of the space that each permit form applies to.
    - a single permit can be used for multiple entries into a space and can be used where there is more than one access point into a single space.

- the measures to control the risk:
    - list the control measures to be implemented before work commences. These should include the isolation of plant and services, purging, ventilation, atmospheric testing, cleaning and signage.
    - list the control measures to be implemented or continued while work is being done in the space. These should include ventilation, continuous monitoring, respiratory protective equipment and personal protective equipment.
    - list any equipment to be taken into the confined space, including any exclusions such as ignition sources.
    - list any specialist emergency rescue equipment required.

- the name of any workers permitted to enter the space.
- the name of any standby person assigned to the space.
- the period of time that the permit is in operation:
    - generally, a permit will only apply for the work shift for which it is issued. The permit needs to be re-validated if the person with direct control of work in the space changes, a break in work continuity occurs (for example, a shift change), changes are made to the work that introduce hazards not addressed by the current permit or new risk controls are required.

The entry permit should be displayed in a prominent place to facilitate signing and clearance. A copy of the entry permit should be displayed at the entry point where the standby person is stationed.

A Principal Contractor must keep each confined space entry permit they issue until work in the confined space is completed, or for two years from the date of completion if a notifiable incident occurs (for example, an injury requiring immediate inpatient treatment).

Communication and initiation of emergency procedures

A Principal Contractor must ensure that when a worker is working in a confined space there is continuous communication from outside the confined space between the Principal Contractor, or a person assigned by the Principal Contractor, and the workers in the confined space.

Principal Contractors must also ensure that when a worker is working in a confined space, emergency procedures can be initiated from outside the confined space.

Continuous communication is necessary to:

- monitor the status of any worker who has entered a confined space under an entry permit.
- alert any person in the confined space if evacuation is required.
- initiate emergency procedures in a timely manner.

One way a Principal Contractor can ensure continuous communication is by assigning an appropriately trained person to act as a standby person. A standby person needs to continuously monitor the wellbeing of any person inside a confined space and initiate appropriate emergency procedures when necessary.

Depending on the conditions in the confined space, communication can be achieved by voice, radio, hand signals or other appropriate means.

The standby person should:

- understand the nature of the hazards inside the confined space and be able to recognise signs and symptoms that a worker in the confined space may experience.
- be trained and rehearsed in all aspects of emergency procedures (including how, when and what procedures will be initiated).
- remain outside the confined space and ensure any person inside a confined space is monitored at all times.
- have all required rescue equipment (e.g., safety harnesses, lifting equipment, a lifeline) immediately available.
- where necessary, be able to operate and monitor plant used to control risk (e.g., atmospheric monitoring equipment, ventilation devices, respiratory protective equipment).
- have the authority to order any workers to exit the confined space if a hazardous situation is identified.
- never enter the space to attempt rescue.

Never attempt to rescue an injured person until relevant personnel arrive

Emergency procedures

If things go wrong in relation to work in a confined space, people may be exposed to serious and immediate danger. Effective arrangements for raising an alarm and carrying out rescue operations in an emergency are therefore essential.

Suitable emergency procedures will depend on the nature of the confined space, the risks identified and the likely nature of an emergency rescue.

Planning and establishment of emergency, rescue and first aid procedures

Construction Site Owners and Principal Contractors must establish procedures for the control and management of an emergency in a confined space, including procedures for:

- the rescue of any person from the confined space.
- first aid to be provided to any person in the confined space and after rescue from the confined space.

Construction Site Owners and Principal Contractors must ensure that the emergency procedures take into account:

- the nature of the confined space.
- any hazards associated with the level of oxygen or atmospheric contaminants in the confined space.

- the work to be done in the confined space (including the range of possible work methods and the work method chosen).
- any work done outside the confined space that may be associated with a hazard.
- the means of entry to and exit from the confined space.
- the method of continuous communication between people inside and outside the confined space and whether that method will enable communication in an emergency.
- how emergency procedures can be initiated from outside the confined space.
- the procedure in place which indicates that a worker has entered a confined space.

The Table below provides further questions that Construction Site Owners and Principal Contractors should consider when developing emergency procedures.

Relevant Considerations	Questions
Location of the confined space	What is the geographic location of this space, how accessible is it in an emergency and how far away is it from appropriate medical facilities? Planning needs to ensure that rescue and emergency personnel can access the construction site during nights, weekends and holiday periods.
Rescue and resuscitation equipment	What kinds of emergencies may occur? The provision of suitable rescue and resuscitation equipment will depend on the potential emergencies identified. Training in the correct operation of emergency equipment is essential. Selected rescue equipment needs to be in close proximity to confined space and able to be used immediately.
Capabilities of rescuers	Are rescuers properly trained, sufficiently fit to carry out their task and capable of using any equipment provided for rescue (e.g. breathing apparatus, lifelines, and firefighting equipment)? How will rescuers be protected during the rescue operation?
First Aid	Is appropriate first aid available for immediate use? Are trained first aiders available to make proper use of any necessary first aid equipment provided?
Local emergency services (if they are to be relied upon for rescue)	How will the local emergency services (for example, fire brigade) be notified of an incident? What information about the particular dangers in the confined space be given to them on their arrival? Have prior arrangements been made with local emergency services to ensure they are able to respond in a reasonable time, and is the specialist confined space rescue retrieval equipment readily available?

CHAPTER 16

SAFE WORK IN HOT, HUMID CONDITIONS

This section provides practical advice for dealing with heat illness and related health & safety problems at construction sites in Cambodia. It contains recommended actions and measures to prevent or minimise the likelihood of heat illness and outlines how Workers of construction sites can prevent workers from getting heat related illness whilst working on a construction site.

What is heat-related illness?

Heat illness occurs when the body cannot sufficiently cool itself. Prolonged or intense exposure to high or humid temperatures can lead to heat-related illnesses such as heat exhaustion, heat cramps, dehydration, fainting and heat stroke. Heat-related illness occurs when your body is no longer able to maintain a healthy body temperature.

People who are most at risk of heat related illness are young (under 25) and older workers, pregnant women, people with physical illness such as heart disease and workers who are not acclimatised to working in heat.

Heat-related illness is progressive and can be life threatening if left untreated. Factors that contribute to heat related illness are:

- temperature.
- humidity.
- amount of air movement.
- radiant temperature of surroundings.
- clothing.
- physical activity (metabolic heat load).

Heat related illnesses should be taken very seriously

Heat illness covers a range of medical conditions that can arise when the body is unable to properly cope with working in heat. These conditions include:

- heat stroke - a life threatening condition that requires immediate first aid and medical attention.
- fainting.
- heat exhaustion.
- heat cramps.
- rashes (also called prickly heat).
- heat fatigue.
- worsening of pre-existing illnesses and conditions.

Signs and symptoms of heat illness include feeling sick, nausea, dizziness or becoming weak. Clumsiness, collapse and convulsions may also be experienced as a result of heat illness. Workers with these signs or symptoms need to seek immediate medical attention.

Workplace health and safety laws in Cambodia require Workers to ensure that the working environment on a construction site is safe and without risks to health and safety, so far as is reasonably practicable. This includes ensuring that workers are not subjected to unnecessary and excessive hot and humid conditions.

Workers, Construction Site Owners, and Principal Contractors should use this guideline to assist them in understanding and being more aware of.

- the signs and symptoms of heat illness.
- the factors that increase the risk of heat illness.
- how to control the risk of heat illness.
- how to prevent heat illness.
- other problems that working in hot conditions may cause.
- what heat discomfort is, and how to manage it.

Identifying heat illness hazards

Air temperature alone cannot be used to determine whether there is a risk of heat illness. The key risk factors that need to be taken into account are:

- air temperature.
- humidity (in the environment or hot construction sites).
- radiant heat (from the sun or other sources like heat producing machinery).
- air movement or wind speed.
- workload (nature of the work and duration).
- physical fitness of the worker (including acclimatisation and any pre-existing conditions e.g., overweight, heart/ circulatory diseases, skin diseases or use of certain medicines).

- clothing (including protective clothing such as overalls, coveralls and suits worn during insecticide spraying).

If workers are working in the sun, ensure they take regular breaks, so no overheating occurs

Preventing heat illness

The risk of heat illness can be minimised by modifying workload. This may include:

- rescheduling work so the hot tasks are performed during the cooler part of the day.
- doing the work at a different location.
- wearing light clothing that still provides adequate protection.
- reducing the time spent doing hot tasks (e.g., job rotation).
- arranging for more workers to do the job.
- providing extra rest breaks in a cool area.
- using mechanical aids to reduce physical exertion.

If workers are required to work in the sun for long periods, Principal Contractors should provide shade cover

Other measures for preventing heat illness include:

- keeping people away from hot processes.
- allowing workers to acclimatise.
- providing cool drinking water near the work site. During hot weather, workers should be encouraged to drink a cup of water (about 200 mL) every 15 to 20 minutes, and not rely solely on soft drinks or caffeinated drinks.
- providing personal protective equipment (PPE) such as reflective aprons and face shields for reducing exposure to radiant heat. Outdoor workers should be provided with protection against ultraviolet exposure, such as wide brim hat, loose fitting, long-sleeved collared (preferably cotton) shirt and long pants, sunglasses and sunscreen.
- providing workers with information, instruction and training on recognising heat-related illness and on first aid. Adequate supervision of workers is also required.
- providing first aid facilities and access to medical help.

Always keep hydrated when working in hot humid conditions

Using engineering controls to prevent or minimise heat illness.

Workers can utilise equipment and machinery to minimise the risk of heat exposure and illness to workers. Examples include:

- increasing air movement using fans.
- installing shade cloth to reduce radiant heat from the sun.
- installing shields or barriers to reduce radiant heat from sources such as furnaces.
- removing heated air or steam from hot processes using local exhaust ventilation.
- installing air conditioners or coolers to reduce air temperature and generate air movement.
- locating hot processes away from people.
- insulating/enclosing hot processes or plant.
- isolating workers from the hot process by locating them in air-conditioned control rooms.

Related health and safety problems

Apart from heat illness, hot working conditions may either contribute to or cause other health and safety problems:

- loss of grip while handling tools, objects and controls due to sweaty hands.
- slips, trips and falls due to fainting or fatigue.
- errors/mistakes due to heat fatigue.
- not following safe work procedures or cutting corners due to fatigue and/or discomfort.

- not using PPE due to discomfort.
- burns from contact with hot surfaces or substances.

Heat discomfort

Heat discomfort is what many people feel when it is hot. It is not a medical condition like heat illness and therefore is not considered a risk to health.

People who work in office type environments and who do very little physical work are unlikely to be at risk of suffering heat illness. What they experience as a result of higher temperature and increased humidity is likely to be heat discomfort.

Heat discomfort can generally be managed by:

- increasing air movement.
- providing air conditioning (if practical).
- providing access to cool water.
- wearing suitable light, loose fitting clothing.

Thermal comfort is subjective, but generally, conditions considered comfortable for people working indoors and doing light work are:

- air temperature (dry bulb temperature) 23 to 26 degrees C.
- relative humidity 30 to 60 per cent.

Medical Attention

- If symptoms occur, workers need to rest in a cool, well- ventilated area and drink cool fluids. If symptoms do not improve quickly, or skin is very hot and dry to touch, seek urgent medical help.
- Plan ahead and ensure all necessary measures for preventing heat illness can be implemented when hot weather is predicted.

CHAPTER 17

FIRE SAFETY

Construction sites are one of the highest risk places for a fire to start, so fire prevention must be a top priority when planning and managing construction work.

The risk of fire occurring on construction sites increases due to a variety of factors:

- The presence of flammable waste materials.
- The use of flammable and explosive substances like gases and solvents.
- The type of work activities including hot works processes and incomplete electrical systems.
- The nature of the unfinished building.
- The storage of (often flammable) building materials on the site increases the damage caused once a fire does take hold and can also pose increased risks to fire and rescue teams.

There are several common causes of fire on construction sites:

Hot work

Hot work operations pose a significant risk because they can introduce ignition sources into many areas of the work site. Even many hours after welding, soldering, grinding or other hot work has been completed, a spark can smoulder and ignite combustibles, sometimes after workers have left for the evening.

Implementing a hot work permit system, with a dedicated fire watch, minimum 30-minute cool-down period, and assigning a fire prevention Program Manager to oversee operations can help avoid fires.

Sparks and flames can cause fires long after you have finished working

Smoking

Smoking presents a serious fire risk to any construction site. A strict "no smoking" policy that is clearly communicated to all Workers, and providing a designated safe smoking area, help prevent the risks of fire due to ash or carelessly discarded cigarettes.

Smoking during construction work should be prohibited and only permitted in designated smoking safe areas

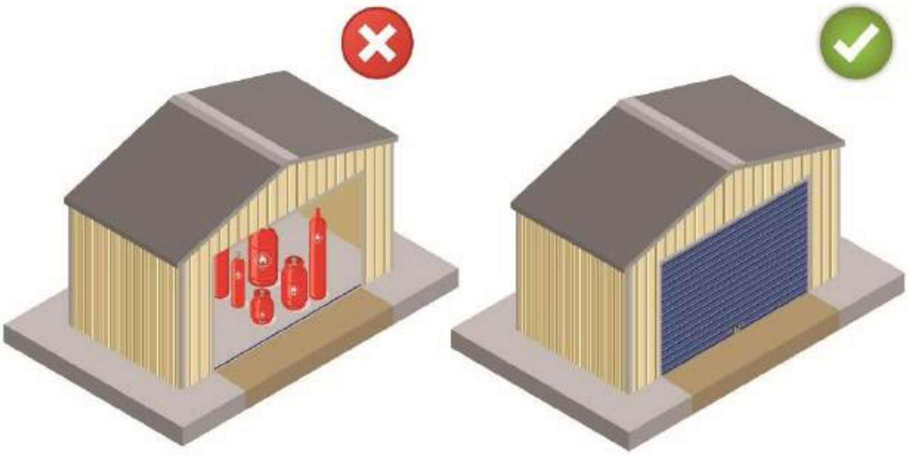
Flammable and combustible materials

All flammable and combustible liquids and gases should be used and stored so that they do not present a fire hazard to the site. Limit the amount of flammable and combustible materials inside the building under construction and designate safe storage locations.

Cooking

While having a break area on-site is acceptable, workers should not be allowed to start a fire to cook food on a construction site or bring any cooking equipment, such as grills or hot plates, to the construction site.

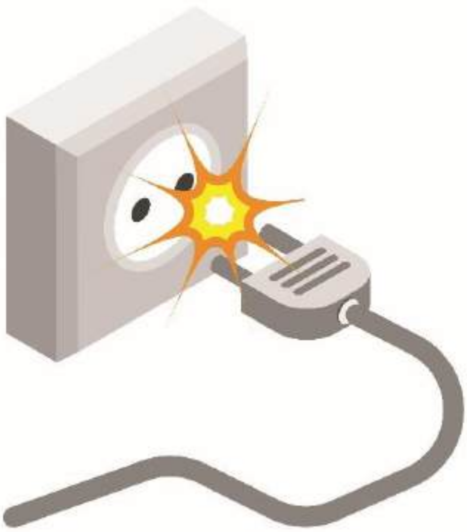
Cooking on a construction site can be dangerous and should be prohibited



Store flammable liquids and gases in a safe and secure area

Electrical cabling and temporary lighting

All electrical cabling, including temporary lighting must be installed by a competent and qualified electrician and installed in accordance with National regulations and standards. Systems and lighting should be maintained and regularly inspected by an approved electrical contractor.



Using cables and lights that are not installed correctly can cause fire

Rechargeable lithium-ion batteries

Cordless tools and other battery-run equipment present risks of overheating and igniting fires. Charging stations should be outside the building under construction and stored in a safe location.

Lack of protection

Until fire sprinklers and fire warning systems are installed and activated, having filled and serviced fire extinguishers distributed throughout the construction site, will allow workers to respond quickly to a fire before it gets out of control and minimize damage. Where installed, automatic sprinklers should be activated as soon as practical as construction progresses.

All construction sites must have fire extinguishers placed around the site and have workers trained in how to use them

Below are 12 tips that construction site managers should implement to prevent a fire occurring on your site.

1. **No fires permitted on site** - stop workers lighting fires on a construction site.
2. **Keep the construction site clear of waste** - always clean up your construction site and remove items that can burn easily like empty packaging, wooden pallets and offcuts of timber. Don't let waste materials build up around the site.
3. **Plan for waste** - Plan designated areas for waste with fire and emergency procedures in place to confine and deal with a fire should it break out. Never attempt to dispose of rubbish by burning it.
4. **Ensure safe electrics** - electrical systems including temporary supplies must only be installed by a competent electrician and must be regularly maintained. Portable electrical equipment must be inspected for damage and faults before use.
5. **Regularly check the construction site** - the entire construction site, including temporary offices, change rooms and toilets should be inspected regularly particularly before leaving a construction site if it is unmanned.
6. **Install industry standard lighting** - lights produce heat and can act as an ignition source, especially high intensity flood lights, which should never be covered or placed near combustible material. They must be securely fixed to prevent them from falling over.
7. **Prohibit smoking** - many fires can start accidentally by something as simple as a discarded cigarette butt. Smoking on site should be carefully controlled and confined to a designated area, on or off site. Do not smoke in areas of high fire risk or outside the designated fire smoking areas.
8. **Permits for hot works** - hot works are a big fire risk. Control all hot works by a permit to work system to ensure that risk is adequately controlled. Before starting hot works ensure the area is free from combustible material. Non removeable items must be covered with heatproof blankets. Don't under-estimate how far radiant heat and sparks can travel.
9. **Conduct fire checks** - smouldering materials, hot equipment and stary sparks can start a fire after hot works has finished. Stop hot works at least 1 hour before the end of the shift, with fire checks conducted at 30-minute intervals and up to and including 1 hour after completion of work.
10. **Install fire extinguishers** - used correctly, a fire extinguisher can put out a small fire, stop it spreading, growing and becoming a major emergency on your construction site. Always have numerous fire extinguishers readily available through the construction site and make sure you have the right types of extinguishers for the class of fire that may occur. Making sure that enough of your workers on site are trained in how to use a fire extinguisher correctly is important.
11. **Plan for fire** - put a fire and emergency plan in place for your construction site. Make sure this forms part of the safety induction procedure for all workers, so people know what to do. Ensure everyone knows their part in a fire safety plan, where extinguishers are and how to use them, the evacuation procedure and escape routes and the rules in place to prevent fires.
12. **Have a fire prevention focus** - cover fire safety and prevention at induction and run regular fire trainings during the duration of your construction project. This is especially important if you notice fire safety standards slipping. Talking about fire safety with your workers will raise awareness and increase compliance with fire prevention rules.

Construction site - fire safety plan

Most construction site fires have simple causes and can be prevented with by simple precautions. It is important that construction site managers conduct routine fire risk assessments to minimise the risk of fire and ensure that the construction site has adequate fire safety measures in place: Your risk assessment plan should:

- identify all fire risks at the construction site.
- consider who will be affected in the event of a fire.
- assess the extent of the risks and list them in priority.
- identify safety measures to reduce or remove the risk of fire.
- put in place the fire safety measures.
- provide training to workers and visitors on fire safety measures.

Fire safety assessments should be conducted routinely by a competent person.

As with all construction site hazards, fire should be dealt with in this way:

- Identification of the hazard.
- Assessment of the risk.
- Control: Elimination or reduction of the risk.
- Review and evaluation of any control strategies.

Identification of fire hazards

- Ensure you look for fire hazards as part of your regular construction site inspections. Use checklists to identify fire hazards and to check the effectiveness of warning systems and emergency procedures.
- Develop specific checklists to enable the process of identification to be carried out. These checklists should be developed in coordination with other competent workers. An example of a simple checklist can be seen at the end of this chapter.
- Ensure you have all the relevant information to identify and assess any hazards. This includes Material Safety Data Sheets for all substances used and stored at the construction site, properties of building materials, etc.
- Discuss the issue of fire hazards with members of your designated work group.
- Ensure that all incidents are recorded.

Assessment of the risk

- Check all MSDS to ensure that flammable substances are used and stored correctly.
- Check any past incidents on the construction site.

Control: elimination/reduction of risk

As with other hazards, the preferred order of control should be followed - start by trying to eliminate the hazard at the design stage. Sometimes a combination of control methods should be used.

Consider the following:

Design

- Has the site manager or safety officer been given access to all relevant publications such as Codes of Practice, Acts, Regulations, and Industry Standards?
- Has the construction site been designed to eliminate or minimise the risk of fire?
- Can ignition sources (sparks, flames, and heat sources) be eliminated from the construction site?
- Can inflammable materials be eliminated from the construction site?
- Have work practices been designed to eliminate or minimise the risks associated with fire?
- Can construction site practices be changed to eliminate fire risks?
- Has the construction site been designed to facilitate firefighting and emergency procedures in the case of fire?
- Has the construction site owner, site manager or safety officer contacted the Fire Department for advice on fire prevention?
- Have the Workers been asked for suggestions and recommendations for improvements in the area of fire safety?
- Have arrangements been made so that all new Workers receive induction training? This must include fire procedure training.

Substitution

- Can fire resistant furnishings and furniture minimise fire risks?
- Can fewer flammable materials be used in the construction site?
- Can the quantities be reduced and/or the form be changed?

Engineering

- Can inflammable materials and ignition sources be isolated from each other and from workers? Isolation may mean isolation by distance, or by barriers.
- Can ventilation/exhaust fans etc, prevent the build-up of inflammable or explosive gases?
- What warning systems can be installed to signal hazardous pre-fire situations or actual outbreaks in the early stages?
- Can the construction site layout be changed to facilitate firefighting and emergency procedures?
- Can heat-producing equipment be kept away from the walls to enable air circulation?
- Can fire doors, fire windows and shutters be installed to delay the spread of fire?
- Can additional storage facilities be installed to reduce the fire risk?
- Are the means of access and exit adequately sign-posted and readily accessible?

Administrative measures

- Has a housekeeping program been implemented to minimise the fire risk? Is it being practised?
- Is there a maintenance system to prevent fires? (e.g., maintenance of electrical equipment, removal of refuse, etc.).
- Is there a maintenance system to ensure that warning systems and firefighting equipment are in working order?
- Are extinguishers appropriate for the type of fire risk?
- Is there a system to ensure emergency procedures will work? (e.g., to ensure that exits are not blocked or locked?).
- Are signs adequate for fire prevention and for emergency procedures?
- Is all staff suitably trained in fire prevention and emergency procedures? In some cases, the training may need to be in different languages.
- Are all emergency response teams trained in the case of a fire situation?

Personal protective clothing

- Will the protective clothing and equipment issued minimise burns or other harm such as smoke inhalation suffered by a worker in the event of fire?
- Is breathing apparatus required/supplied/available?
- Are fire blankets provided?

Emergency plans

It is important that your construction site has a simple plan to respond to fire and emergencies. This will reduce the potential for injury and illness and avoid panic.

The construction site owner, site manager or assigned safety officer should develop the plan in consultation with all Workers. All Workers should receive a copy of the plan, which should also be posted on notice boards on the construction site. It is vital that all Workers are trained in the emergency procedures outlined in the plan.

The emergency plan should cover:

- immediate action to stop or minimise the hazard (e.g., use of fire extinguishers if trained).
- the need to stay calm.
- who to call to raise the alarm.
- how to notify emergency personnel (ambulance, fire brigade, electricity, police, local government).
- how, when and where to evacuate.
- names of the key leaders responsible for making decisions during the emergency (and their duties e.g., a warden).
- how to establish and use a fail-safe communications system.

Fire warning systems

A fire warning system will alert people to a fire on the construction site, allowing them to exit safely and quickly. Construction site managers should look to install a fire alarm or PA system that alerts workers to a fire. The responsibility of operating a warning system in the event of as fire and testing the fire warning system should be allocated to a responsible person (s) on your construction site. Fire warning systems should be tested at least once a month to ensure they are operating.

A fire warning system will give people on your site ample time to exit in the event of a fire.

Firefighting equipment

Carrying out a risk assessment on the site will identify the hazards and the type of equipment required. On a small or low-risk construction site, fire extinguishers and/or fire blankets may be sufficient. On a large or high-risk construction site, it may be necessary to install a fixed system such as fire sprinklers or fire hose system as well as have fire extinguishers and fire blankets available around the construction site.

Whatever the equipment needed on the site; it is important that:

- fire equipment is located close to work areas and is easily accessible.
- the correct extinguishers are chosen.
- extinguishers are serviced and in good working order.
- everyone on the site is trained in basic firefighting techniques.

Fire extinguishers

At a minimum on any construction site, fire extinguishers must be installed at your site. There are several different kinds of fire extinguishers available and most of them have a specific function.

- Water extinguishers are ideal for rubbish fires.
- Electronic fires are dealt with using a carbon dioxide type.
- Foam extinguishers are used to fires with flammable liquids.
- Powder extinguishers are used for a variety of materials and fire types.
- If there aren't enough extinguishers available or the appropriate type isn't available the site manager or safety specialist should be contacted.

There are two important notes to remember:

- Fire extinguishers will be effective in the event of small fires and when it’s in the initial stage.
- Second, regularly inspect fire extinguishers (ideally at least every 6 months) to make sure they are in proper condition and working. A fire extinguisher is no good if it doesn’t work when you need it.

DRY POWDER	FIRE HOSE REEL	FOAM SPRAY	WATER	CO^2
USE ON: Wood, paper & Textiles	USE ON: Wood, paper & Textiles	USE ON: Wood, paper & Textiles	USE ON: Wood, paper & Textiles	USE ON: Flammable Liquids
USE ON: Flammable Liquids	DO NOT USE ON: Live Electrical Equipment	USE ON: Flammable Liquids	DO NOT USE ON: Live Electrical Equipment	USE ON: Live Electrical Equipment
USE ON: Gaseous Fires	DO NOT USE ON: Flammable Liquids	DO NOT USE ON: Live Electrical Equipment	DO NOT USE ON: Flammable Liquids	DO NOT USE ON: Wood, paper & Textiles
USE ON: Live Electrical Equipment	DO NOT USE ON: Flammable Metal Fires	DO NOT USE ON: Flammable Metal Fires	DO NOT USE ON: Flammable Metal Fires	DO NOT: Hold horn when operating

Use this chart to understand classes of fire and what fire extinguisher to use

Fire blankets

Fire blankets are known as the first line of defence from fire. They are designed to extinguish incipient (starting) fires or control small fires. Fire blankets are made of a highly flame-resistant blanket. You can use them to cover a burning material. They can also be wrapped around a person to cut off the oxygen supply to the fire.

Fire blankets are an effective response to small fires

Fire safety & emergency signs

It is important to install Fire Safety and Emergency signs around your construction site to assist workers as well as visitors in knowing where fire hazards may be, where fire-fighting equipment is located and where emergency exits points are when and evacuation is required.

You should install fire safety and emergency signs that are readily recognisable, understandable and durable.

Fire Safety signs should be:

- in a format appropriate for the intended audience (e.g., may be pictorial rather than written if the intended audience has a low level of English literacy or understanding).
- visible against background structures, and
- easily interpreted in the conditions that may prevail (e.g., low light).

Ensure the work site has adequate fire safety signage

Fire safety training

Proper fire safety training and having the correct procedures in place are essential for all workers on your construction site so they can assist in preventing and responding to a fire.

Workers on your construction site should be provided with training that includes:

- basic fire prevention.
- good housekeeping.
- risk awareness.
- your smoking policy.
- your emergency plans.
- the terms, conditions and restrictions of any licence, certificate or registration for the premises.

Training is crucial if you want your workers to assist in preventing and responding to a fire

Basic Fire Safety Checklist

	Yes	No	Score
Items blocking passageway and exits?	❑	❑	❑
Items blocking access to fire extinguishers?	❑	❑	❑
Exit lights and emergency lights working and tested?	❑	❑	❑
All emergency signs visible?	❑	❑	❑
Workers/Contractors adhere to health and safety policy?	❑	❑	❑
Gas cylinders stored in holders or trolley and fittings in safe working order?	❑	❑	❑
All smoke doors functioning and not wedged open?	❑	❑	❑
All fire extinguishers present, full, on wall brackets, signposted and test tags up to date?	❑	❑	❑
All hose reels present, signposted and test tags up to date?	❑	❑	❑
All emergency equipment in safe working order?	❑	❑	❑
Emergency manual in a prominent location for staff reference?	❑	❑	❑
Manual rotated amongst staff for staff awareness of immediate actions in an emergency?	❑	❑	❑
New staff trained and familiar with procedures?	❑	❑	❑

All areas free of non-essential items and rubbish?	❑	❑	❑
No smoking policy strictly supervised?	❑	❑	❑
Flammable goods correctly stored?	❑	❑	❑
Electrical equipment in safe working order? (eg No worn wiring, cracked casing, etc)	❑	❑	❑
All electrical appliances turned off when not in use?	❑	❑	❑
Other	❑	❑	❑

CHAPTER 18

SAFE USE OF MACHINERY AND EQUIPMENT




Ask yourself this question - Could the people around me or can I get injured when operating machinery or equipment on my construction site?

Every year many Workers in Cambodia suffer life-changing injuries and/or lose their lives whilst operating or working close to equipment & machinery on construction sites.

Lack of controlling risks on the construction site, lack of maintenance of equipment and machinery, lack of training, and improper use of equipment and machinery are the frequent causes of fatalities, amputations, manual handling injuries, crush injuries, burns and fractures to the fingers, hands and arms.

But all these injuries are preventable! This section will help Construction Site Owners and Principal Contractors and Workers understand hazards and risks relating to machinery and equipment use and provide information on how to reduce those risks and make the construction site safe.

Everyone must take all practicable steps to make sure machinery and equipment that is used in the construction site, is designed safely, installed correctly, is operated by competent people and is adequately guarded to reduce the risk of injuries or harm to all people entering a construction site.

You can be injured or killed when you operate machines or equipment if:

- your hands, feet, hair and other parts of your body can reach hazardous moving parts of the machine.
- you are required to make adjustments whilst the machine is moving.
- you are required to clear away product, waste or scrap whilst the machine is moving.
- you are exposed to noise, dust, fumes or radiation.
- you access confined or difficult to reach spaces, or you work at heights on a machine. without fall prevention.
- you are manually transferring materials, for example, heavy items or awkward postures.
- you are exposed to chemicals while using or cleaning machines.
- water could enter the electrical parts of machines, for example, cleaning or other purpose.

Always take relevant precautions when using dangerous machinery

Suppliers of machinery to Construction sites

Companies or individuals who supply, lease, rent to construction sites and/or install machinery and equipment on constructions sites, must take all practicable steps to make sure the machinery & equipment is designed, manufactured, installed and tested so it will not harm anyone during:

- installation.
- use.
- repair.
- dismantling.
- cleaning.

Machinery information provided to construction sites

Construction Site Owners must ensure that thorough and easy-to-understand instructions on how to use machinery and equipment safely, are provided by any person who supplies machinery or equipment for use on a construction site, upon delivery and/or installation of the machinery or equipment.

Any instructions must be available to operators of any machinery and equipment and must explain:

- hazards linked to the machine.
- how to install the machine safely.
- how to operate the machine safely.
- safe ways to clean and adjust the machine.
- how to maintain and repair the machine.
- regular replacement of parts of the machine that wear.
- how to safely take the machine out of service and take it apart.
- any other relevant matters.

Always read the manufacturers instruction manual before using machinery and equipment

Use of machinery – the Construction Site Owner and Principal Contractor

Construction Site Owners and Principal Contractors are responsible for the health and safety of their Workers and any other person who can be harmed by the actions or inactions of their Workers whilst operating machinery and equipment on a construction site. Construction Site Owners and Principal Contractors must, as far as practicable:

- keep Workers and site visitors safe from hazards at the construction site by identifying and managing hazards.
- make sure work done is safely.
- provide protective clothing and equipment to all Workers and visitors to the construction site.
- train and supervise Workers so they can work safely.
- provide an accident reporting system and follow up on any accidents, injuries or near misses that occur on the construction site.
- develop procedures for dealing with emergencies.
- eliminate the hazard or reduce the risk of it occurring when hazards are identified.

If a Construction Site Owners and Principal Contractors can only minimise a hazard, they must monitor the environment and the health of Workers.

Training and supervision of machinery operators

The Construction Site Owners and Principal Contractors or person in control of a construction site must not let anyone use a machine or equipment unless they have had training on:

- the actual and potential hazards of the machinery and equipment.
- all the precautions to be taken when operating machinery and equipment.
- how to operate the machinery or equipment safely.

When training people on how to use machinery and equipment on the construction site, a trainer must explain:

- how to check and adjust the machine or equipment before starting it.
- how to stop and start the machine or equipment.
- how the machine or equipment works.
- what the machine or equipment does.
- location and operation of other controls.
- actual and potential hazards and appropriate ways to control them.
- purpose of guards and other safety devices and correct use and adjustment of guards.
- correct work methods to be used.
- how to recognise faults that could cause harm.

- limitations and capabilities of the machine emergency procedures.

Construction Site Owners and Principal Contractors should take manufacturer's instructions into consideration when developing training programmes for machinery and equipment operators.

Consult the manufacturer's instructions when developing training programs for Workers

Inspection and maintenance

Construction Site Owners and Principal Contractors must have an inspection and maintenance program in place for all machinery and equipment on a construction site. This program must ensure a competent person regularly inspects, tests and maintains the machinery and equipment, checking safety guards and safety control systems. This ensures the safety system's reliability and integrity. When developing maintenance and repair programmes, refer to the manufacturer's instructions.

Maintenance and repair programs should specify:

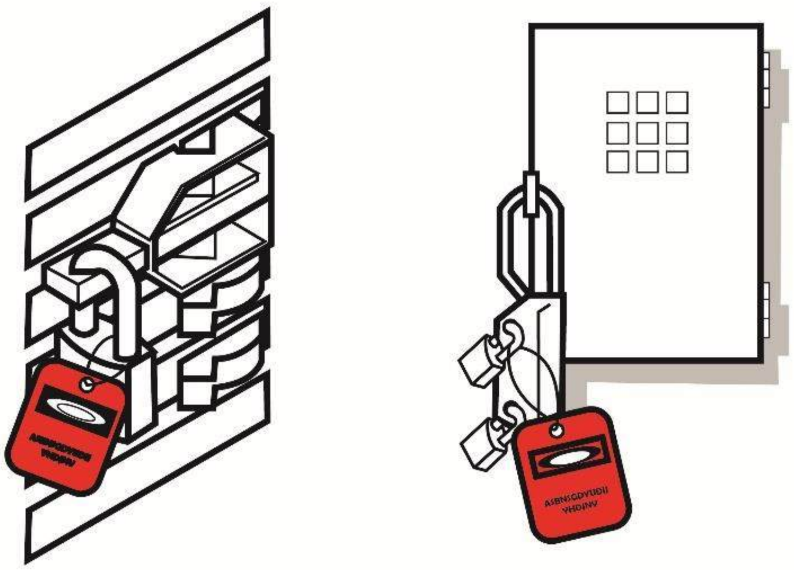
- where servicing is needed.
- how much servicing is needed.
- what type of servicing is needed.
- how often it needs to be serviced.
- who is responsible for maintaining repair and maintenance programs.
- how defects will be fixed.
- what standards are used for performance testing and evaluation.

Programs should be reviewed regularly to ensure their effectiveness. Develop, implement and maintain an accurate record of maintenance done and maintenance programs.

Cleaning and maintenance of machinery

Construction Site Owners and Principal Contractors should take all practicable steps to make sure any hazardous machinery or equipment on a construction site has stopped before any cleaning or maintenance is done. Construction Site Owners and Principal Contractors must make sure machinery and equipment is safe to clean, maintain and repair. Procedures must be put in place for these activities to be performed safely and Workers must be trained to follow them.

Isolation tag-out cards and lock-out devices should also be used on all machinery and equipment to minimise the risk of accidental machinery and equipment start-up during cleaning and maintenance.



Always use lockout tags on machinery to prevent accidental machinery start-up

If it is essential for the cleaning, maintenance or repair procedure that the machinery or equipment stays in operation, then Construction Site Owners and Principal Contractors should:

- only have power going to the part of the machine that must be in motion.
- adequately train anyone working in this hazardous situation.
- establish and follow a safe work system.
- regularly review any safe work systems.
- reduce the speed of any dangerous parts to as slow as practical with reduced power/force, or step-by-step operation with a limited movement control device.
- restrict access to and control of danger areas to one person.
- have emergency stop controls within immediate reach.
- use a portable inching control with E-stop or local inching allowing full sight of controlled elements and danger area.

Mid-position pendants are better than jogging or inching machinery using a hold-to-run control. The machine should run at the slowest practical operating speed for cleaning, loading and setting up. The inching control should be a hold-to-run type, so the machine stops immediately when the control is released.

Construction Site Owners and Principal Contractors should maintain and keep machinery and equipment in sound operating condition at all times. They can manage the maintenance using:

- preventive maintenance schedules.
- regular inspections.
- unsafe condition reports.
- ask for Worker feedback.

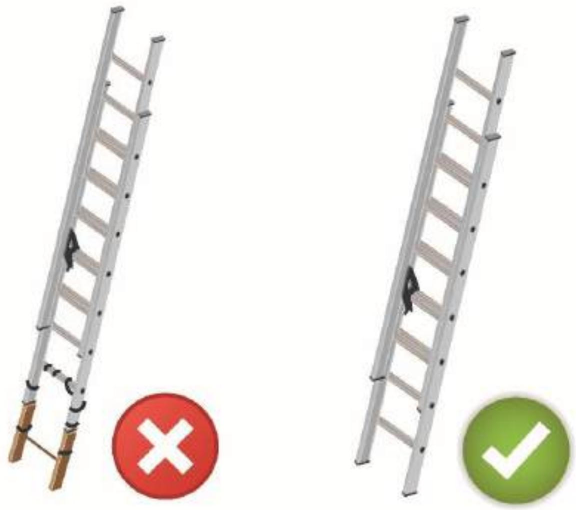
Make sure all equipment is regularly cleaned, as dirty equipment can malfunction and cause fires and electric shocks

Modifying machinery and equipment

If any modifications must be made to machinery or equipment on a construction site, it is important that Construction Site Owners and Principal Contractors ensure that the manufacturer's and designer's instructions are referred to before any modification is made.

Modifications should only be completed by a competent person who has knowledge and experience of the type of machinery or equipment being modified.

Any modifications must be validated and ensure that the modifications do not change, reduce or remove any safety features that the machinery or equipment has.



Never modify machinery or equipment to increase or decrease its functionality

Decommissioning machinery or equipment

Any decommissioning and dismantling of machinery and equipment on a construction site must be undertaken as per the manufacturer's instructions and completed by a competent person. Workers with no training or experience must not decommissions or dismantle machinery or equipment.

Use of machinery – the worker

Construction Site Owners and Principal Contractors are not the only people responsible for safety when it comes to machinery and equipment on the construction site. When using machinery and equipment, a Worker is responsible for:

- their own health and safety.
- not harming others through their actions or inaction.
- following any safe work procedures that the Construction Site Owners and Principal Contractors have in place.
- identifying and reporting hazards – and controlling them where possible.
- using all guarding.
- keeping their work areas clear, clean and tidy.
- wearing and using all protective equipment and clothing.
- alerting their supervisor to any machinery faults or maintenance needs.
- telling their supervisor about any illness or condition that could stop or limit their ability to work with machinery – to keep others safe and help supervisors allocate work.

Workers who operate machinery and equipment should:

- check that the machinery they use is in sound working order.

- report immediately any problems to their supervisor.
- use any safety devices, guards, appliances, protective devices and any other methods used to make the machinery safe.

Where there is a risk of entanglement with machinery, Workers should:

- tie long hair back close to the head.
- not wear loose clothing.

Wearing loose clothing can lead to serious injury

Worker participation in health and safety

Workers are often in the best place to know the hazards of their job and how they could be injured, particularly when it comes to operating machinery and equipment.

Everyone benefits when Workers are involved in developing health and safety systems, and when those systems are part of the daily life in the construction site.

If a Worker has genuine concerns about machinery and equipment and how it may affect the health and safety of people on the construction site, the Worker must report the concern to the Construction Site Owner or Principal Contractor immediately.

Construction Site Owners and Principal Contractors must take a Worker's concerns seriously and look to fix any health and safety hazard that the machinery or equipment is or going to cause.

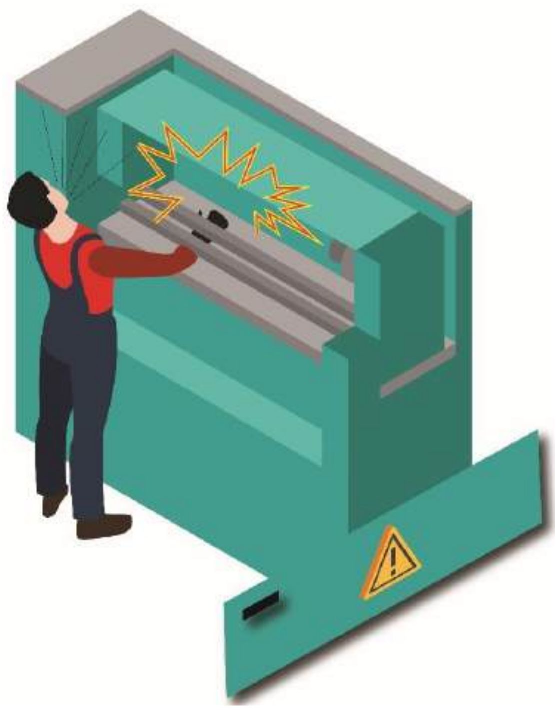
Workers are encouraged to report malfunctioning machinery and equipment to their supervisor

Simple safety tips for operators of machinery and equipment

- Only use a machine if you have been trained and the Construction Site Owner or Principal Contractor authorises you to operate it.
- Always follow the operating procedures for setting up, operating, cleaning and maintaining the machine.
- If there are difficulties following the procedures discuss these with your supervisor.
- Where necessary, tie your hair back, or wear a hairnet, or beanie and wear close fitting clothing to avoid entanglement in a machine.
- Do not wear gloves or lose clothing when operating equipment such as drills or lathes which can draw you into the machine.
- Do not use the machine if guards have been removed.

Always wear correct fitting PPE when operating equipment and machinery

- Do not use the machine if the interlocks are not working.
- Do not remove guards or override safety devices including interlocks.
- If required, conduct a pre-start check prior to using machinery to confirm it is safe to use.
- Where guards are adjustable, adjust them to provide the best protection when doing the job.
- Follow instructions, safe operating procedures and signage, and wear the required personal protective equipment, such as safety glasses and earmuffs.
- Keep the area around the machine clean and tidy to prevent slips and trips.



Guards are there to protect Workers. Do not use equipment if the guards are removed

Identify, assess and control hazards

Making sure hazards do not cause harm or injury is the basis of health and safety in any construction site. This section covers the basics of hazard management and the common hazards that are found when working with or near machinery and equipment.

Hazard management

Planning a safe approach to a job can help identify the hazards of working with machinery and equipment. The hazard management process includes:

- hazard identification.
- hazard assessment - decide if the identified hazards are significant.
- hazard control - either by eliminating, isolating or minimising the hazard.
- a safety plan or hazard register documenting this information.

- hazard monitoring, including construction site exposure monitoring or health monitoring of Workers.
- a schedule to update the safety plan.

Identify hazards

The first step in the hazard management process is to identify machinery or equipment hazards - anything that could injure or harm someone.

Do a construction site inspection to identify all machinery and equipment used. Include common items that may not normally be thought of as machines.

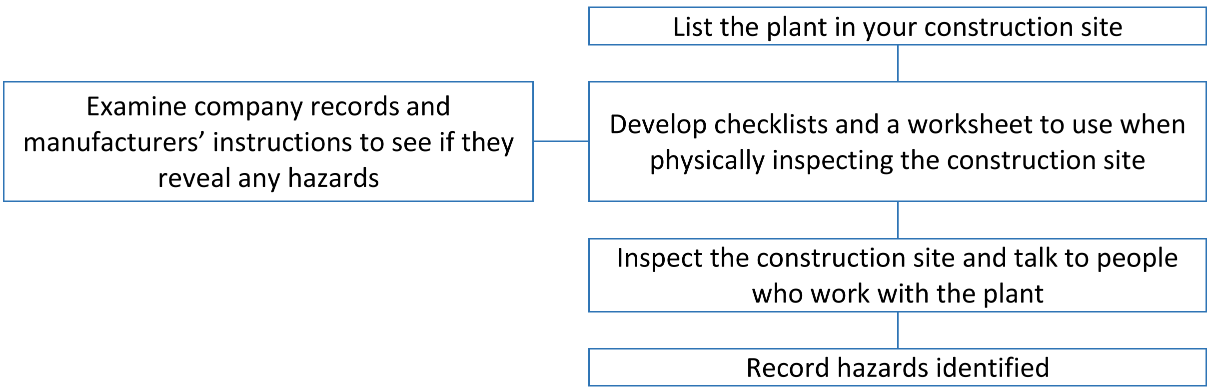
Hazard identification methods

Once you have identified all machinery and equipment on your construction site, you can identify their hazards.

A good hazard identification process is key to hazard management. You can identify hazards using:

- **Physical inspections:** Inspect the machinery and equipment and assess where someone could get injured or caught in the machinery or equipment.
- **Task analysis:** Identify the hazards involved in each task. This should include what happens when there is a blockage, or the machine or equipment needs cleaning or maintenance.
- **Process analysis:** Identify hazards at each stage of the process in which machinery or equipment is used.
- **Best practice guidelines and standards.**
- **Hazard and operability analysis (HAZOP).**
- **Accident investigation analysis:** Identify hazards and causes of harm from investigations involving similar types of work.

Hazard identification and management should be completed and monitored regularly to make sure control measures are working and no new hazards have been introduced.



Processes are used together to identify hazards

Critically inspect each piece of machinery and how it is used to identify where someone could be harmed by:

- any parts (moving and stationary).
- processes.
- procedures.
- construction site activities.
- related danger zones.

Machinery hazards

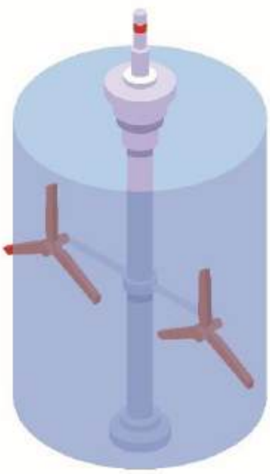
Many pieces of machinery use force and motion to cut, bend, join or shape materials. This force and motion can injure and even kill people. The images below show the most common types of machinery hazards.

Mechanical hazards

Prime movers

Prime movers are devices that turn energy into motion to power a machine. Prime movers include:

Water turbines



Electric generators

Electric motors

Motors powered by burning fuel, such as coal, petrol or natural gas.

Every flywheel directly connected to a prime mover and every moving part of a prime mover should be securely guarded, unless it is safe because of its position or construction. It must be safe for everyone in the construction site. Prime movers also include motors powered by burning solid, liquid, or gas fuels such as coal, petrol or natural gas.

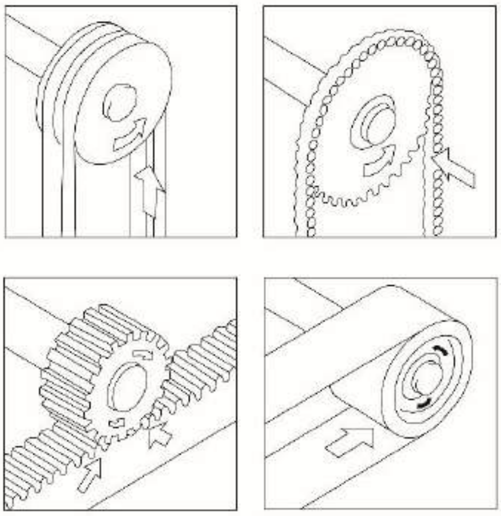
Transmission machinery

Transmission machinery takes energy from a prime mover to the part of a machine where it is used. Every part of any transmission machinery should be securely fenced unless, because of its position or construction, it is safe. The figure below shows some ways operators can be injured by this type of machinery.

Transmission machinery can include gears, shafts, pulleys and belts, chains and sprockets, or friction drives. All transmission machinery should have a device in every room or construction site to cut the power to the machinery.

KEY FOR ARROWS:

- Solid red arrows = where a part of the body could be drawn into a nip-point.
- White or grey arrows = movement of machine parts.

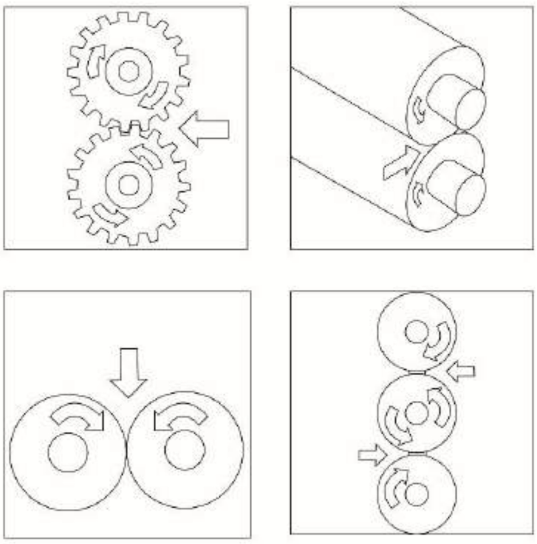


Nip-points can pull in clothing or hair very quickly and cause serious injury

Drawing-In or Trapping Hazards

Injuries can be caused when a part of the body is drawn into a ‘nip-point’. Figure 5 shows some ways operators can be injured by drawing in and trapping hazards, such as:

- in-running nips between two counter-rotating parts (like meshing gears, rolling mills, mixing rolls, press rolls).
- in-running nips between a rotating surface and another surface moving along it (such as a power transmission belt and its pulley, a chain and its chain wheel, a rack and its pinion).
- running nips between a rotating surface and another surface moving along it where material (like metal, paper, cable, rope) runs onto a reel, drum or shaft.
- nips between rotating and fixed parts, which can shear, crush or abrade, such as spoked hand-wheels, flywheels and screw conveyors.

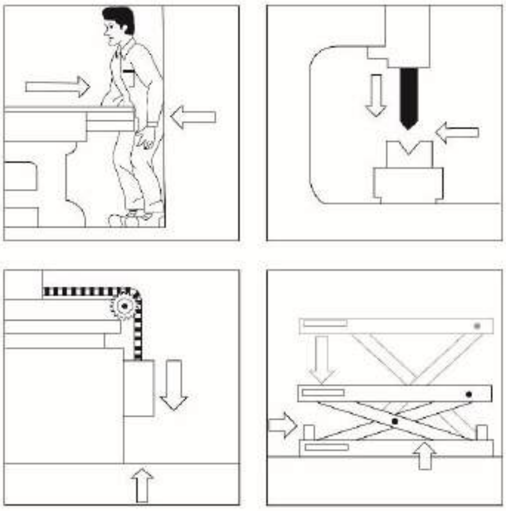


Rollers can pull in large objects and cause serious injury

Crushing hazards

The figure below shows some ways Workers can be injured through crushing hazards that can happen when part of the body is caught:

- between a fixed and moving part of a machine (such as the bed and tool of a power press).
- between two moving parts of a machine (such as the support arms of a scissor lift platform).
- between a moving part of a machine and a fixed structure (such as a counterweight and the floor).



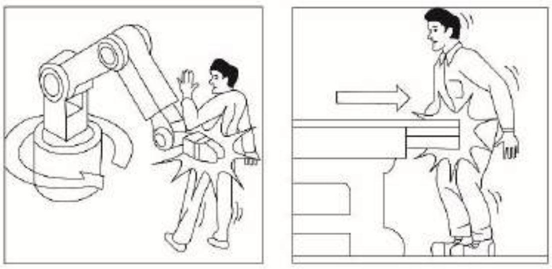
Crushing equipment is often very powerful and can cause serious injury

Impact hazards

Impact hazards are caused by objects that strike the body, but do not enter it.

The figure below shows some ways Workers can be injured by impact hazards. Examples include the rotating arm of a robot, the reciprocating bed of a metal planning machine and the arms of a wool-scouring machine.

Impact hazards are different from crush hazards even though the machines involved may be the same. Impact hazards involve the inertia of the body while crush hazards involve trapping the body between two machine parts or between a machine part and a fixed structure.

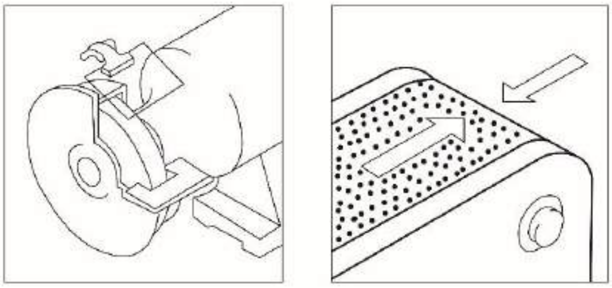


Always take care around moving machinery

Friction and abrasion hazards

Friction burns can be caused by smooth parts operating at high speed. The figure below shows some ways operators can be injured by friction and abrasion hazards. Examples of friction or abrasion hazards include:

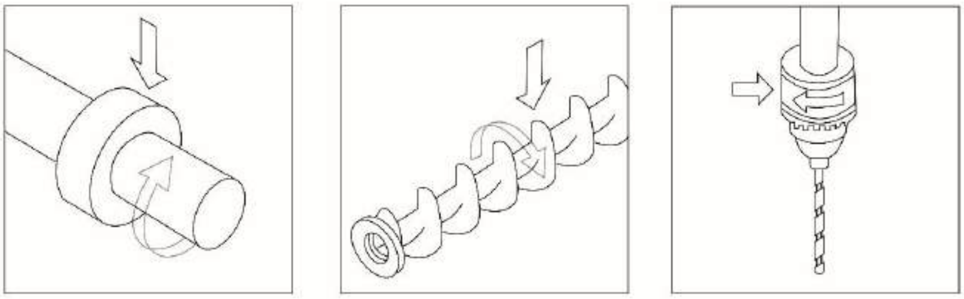
- the sides of a grinding wheel.
- the belt of a belt sanding machine.
- material running onto a reel or shaft.
- a conveyor belt and its drums.
- pulleys and fast-moving ropes or belts.



Equipment with a course surface like a sander can burn skin very easily

Entanglement hazards

Entanglement is when someone is caught in a machine by loose items (such as clothing, gloves, ties, jewellery, long hair, cleaning rags, bandages or rough material being fed into the machine).

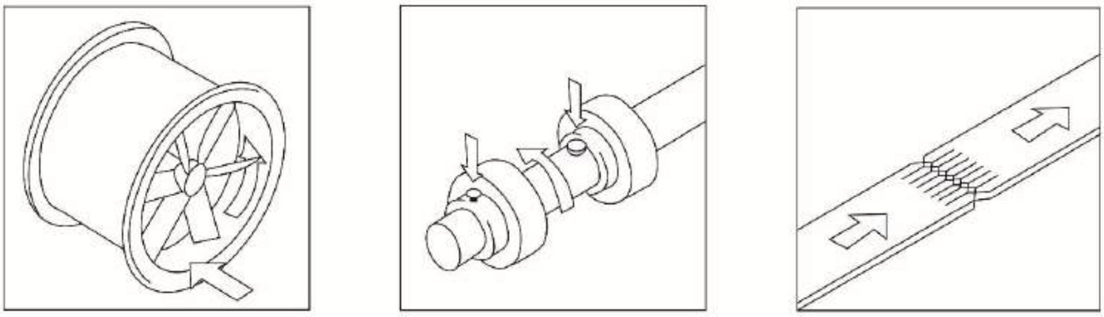


Entanglements can occur very quickly. Always watch what you are doing

The figures below show some ways Workers can be injured by entanglement with machinery. Contact that can lead to entanglement includes:

- touching a single rotating surface (such as plain shafting, couplings, spindles, chucks, lead screws, mandrels or rotating work pieces including plain bar material).

- catching on projections or in gaps. Belt fasteners and other projecting items (such as keys, set screws and cotter pins) are typical projection hazards. Fan blades, spoked wheels (such as pulleys, sprockets, gear wheels and flywheels), mixer and beater arms and spiked cylinders create gap-related hazards.
- touching moving materials in motion (such as in centrifuges, tumble driers and dough mixers or swarf).
- reaching between counter rotating parts (such as gear wheels, rolling mills).
- reaching between a rotating part and another part moving along it (such as a power transmission belt and its pulley, a chain and chain wheel, a rack and pinion, a conveyor belt and any of its pulleys, a rope and its storage reel).
- reaching between rotating and fixed parts (such as flywheels and the machinery bed, screw or worm conveyors and their casings, mixers, extruder screw and barrel, the edge of an abrasive wheel, or an incorrectly adjusted work rest).



It's very important to wear correct fitted PPE as loose PPE can catch very easily

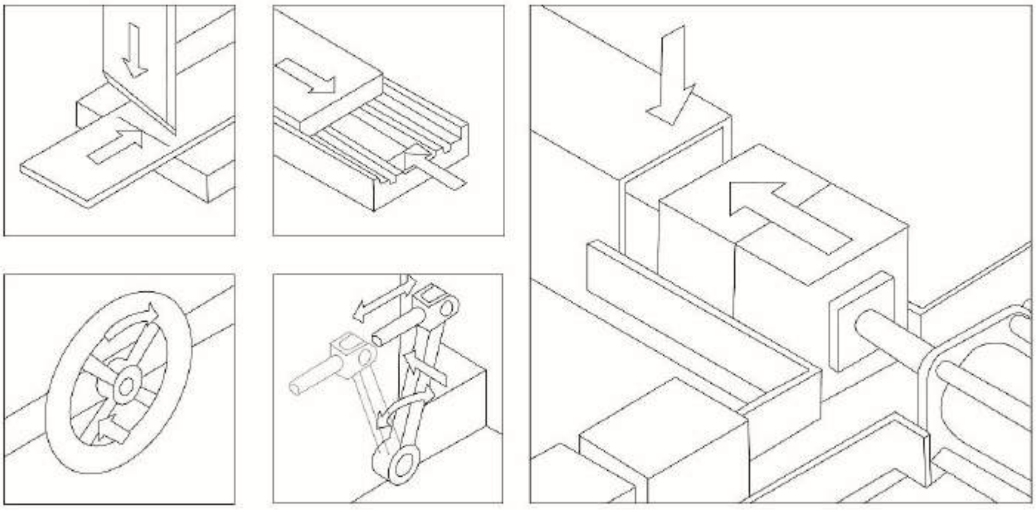
Shearing hazards

Shearing trims or shears metal (or other material) with a powered knife or slide. Shear points are found where stock is inserted, held and withdrawn. The figures below show some ways Workers can be injured by shearing hazards.

Parts of the human body can be sheared:

- between two machine parts, such as:
    - the table of a metal planning machine (shaper) and its bed.
    - the table and blade of a guillotine or power press.
    - nip-points between connecting rods or links and rotating wheels or between parts that move back and forth).

- between a machine part and a work piece, such as the tool of a broaching machine and the part being broached.



Always take care when around machinery that shears and slices

Cutting hazard

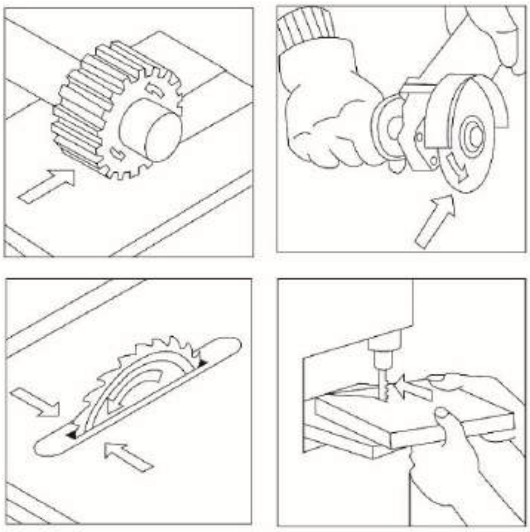
Cutting hazards exist at the point where wood, metal or other materials are cut. The figure below shows some ways Workers can be injured by shearing hazards.

Many kinds of tools create cutting hazards:

- Band and circular saws.
- Boring or drilling machines.
- Planning and tenoning machines.
- Milling machines.
- Cutting edges of milling tools water jet cutting.
- High energy lasers.
- Moving sheet material in a machine.
- Abrasive wheels.
- Cutting edges of endless band cutting machines.
- Reciprocating knives and saws.
- Revolving cutting tools.

Cutting hazards may involve rotating, reciprocating or sideways motion. Danger exists at the cutting point, where a finger, arm or body part can be injured. Flying chips or scrap material can strike the head, particularly in the eyes or face.

The danger is worse if the person caught cannot move away from the cutter.



Always be aware of where the most hazardous part of the machine is

Stabbing and puncturing hazards

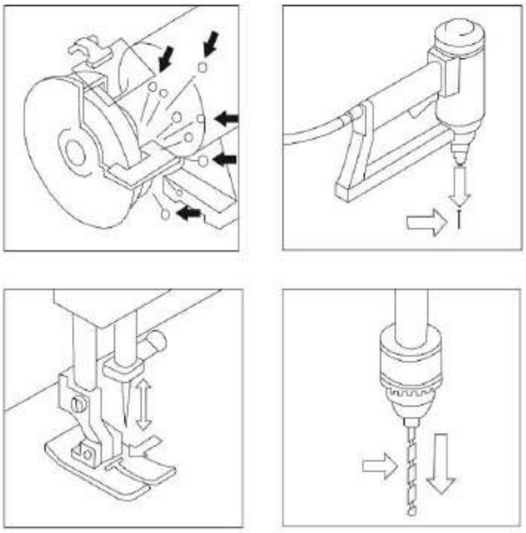
The human body can be pierced by flying objects. The figure below shows some ways Workers can be injured by stabbing and puncturing hazards. For example:

- a loose tool in a lathe.
- broken tooling on a press.
- an abrasive wheel breaking up.
- swarf.
- timber from a bench saw.
- molten metal from a die-casting machine.
- sparks from welding.
- a bolt from an explosive powered tool.
- debris thrown by rotary mowers and hedge cutters.

The human body can also be pierced by rapidly moving parts of machinery or pieces of material. For example:

- the needle of a sewing machine.
- the drill of a drilling machine.
- the arm of a robot.

Injection of fluids through the skin can cause tissue damage similar to stabbing.



It's always recommended to wear PPE that cannot be pierced when using machinery that can puncture the skin

Ergonomic hazards

Ergonomic hazards come about through the way the operator interacts with the machine or equipment. Sometimes machinery is not always designed for how an operator must use the machine. For example, Workers may have to overreach, reach above shoulder height, hold awkward postures, and use repetitive or forceful movements. Having to work this way can cause damage to nerves, muscles and tendons.

Ergonomic hazards can cause serious harm to Workers, but they do not need to. These hazards can be removed at the design stage.

Manual handling

By considering how and when a machine is used, you can reduce the risk of injury. This includes:

- how well the working environment is set up - are frequently used displays, instruments or control panels where operators can reach safely while keeping correct posture?
- what type of machinery is used - does the equipment expose anyone to too much vibration, noise or emissions or does it need physical force to work?
- how work is organised - how much work needs to be done? How urgent is the work? How many breaks do operators get? How long are the breaks?
- what physical demands are put on the person using the machinery - is the work repetitive? Does it require awkward movements or postures? Does the operator have to work in extreme temperatures?

Check whether tasks require repetitive movement or there is a risk of musculoskeletal injuries and gradual process disease.

Layout and design

Good layout makes any guarding better at keeping people safe. Machines that are poorly placed or too close together can be unsafe, even if guarded.

When designing layout:

- avoid congestion points or Worker movements near hazardous machinery.
- make sure people can use, clean and maintain the machinery without being harmed.
- make space for any waste materials to gather before they are cleared (they should not clutter walkways or work areas).
- note the movements of trucks, materials and people.
- mark out walkways and create vehicle movement areas.
- mark out 'no-go' areas, so people can stay away from dangerous machinery.

Check how close moving parts are to other machinery and fixtures in buildings.

Reaching and guarding

The main point of machine guarding is to stop Workers reaching past the guard into the machine. When deciding on the best way to guard a machine, consider how a Worker uses and interacts with a machine (ergonomic principles).

Chemicals and fumes

Many chemicals used with machinery can harm Workers. Assess all chemicals for hazardous health effects. Put appropriate controls in place to stop or control people's exposure. In some cases, you may need to monitor the environment or Workers' health to make sure exposure to the chemicals is not affecting their health.

Control of airborne hazards – ventilation

Protect Workers at all times from inhaling steam, fumes, dust and other airborne contaminants in the construction site. You can use ventilation, filtration and/or mechanical extraction. Remove any contaminants made as part of the work at the source.

Any mechanical extraction must pull contaminants away from Workers' breathing zone, not through it. If it is not practical to completely remove or isolate the hazardous substance, you must minimise any risk of harm to the Worker.

To minimise a hazard's effects, a Construction Site Owner and Principal Contractor can:

- monitor Workers' exposure to the hazard.
- monitor Workers' health (with their informed consent).
- provide protective clothing and equipment (such as breathing equipment or dust masks) and make sure they are used.

Fatigue and shift work

Construction Site Owners and Principal Contractors must take measures to prevent fatigue causing harm, such as when Workers must drive or use dangerous machinery. Construction Site Owners and Principal Contractors are not responsible for anything outside work that reduces a Worker's ability to cope or leads to fatigue. But they must have systems to identify and deal with such factors when they can affect construction site safety.

Shift work can be hazardous because it disrupts normal rest patterns. Workers need enough recovery time outside work so they can be safe and productive at work.

Along with enough sleep, breaks during work hours are important to maintain a Worker's physical and mental well-being.

Operating machinery when fatigued is dangerous to everyone

Electrical safety of machinery

The wiring and fittings of machinery connected to the mains (or similar) must meet all legal requirements and must be installed by a qualified electrician.

A certified, professional third party must do all tagging and testing in line with electrical regulations.

All portable or handheld machinery that gets power from electricity should be used with an isolating transformer or residual current device, where needed. Get specific advice from the electricity supplier on the best device to use.

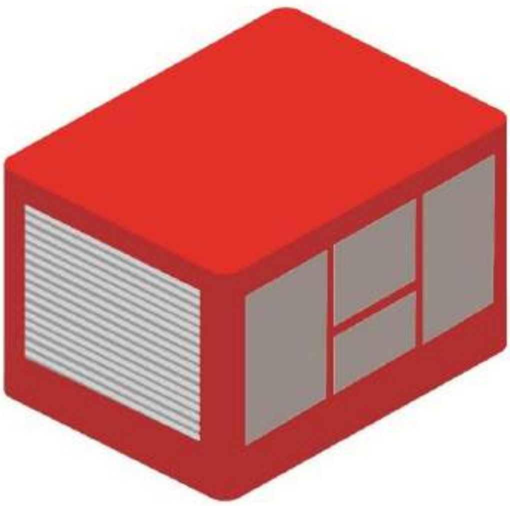
Ensure a qualified Electrician performs repair and maintenance work

Noise

Construction Site Owners and Principal Contractors must take all practicable steps to reduce any risk of harm to people from machinery or equipment noise. Machinery and equipment noise should be eliminated, or through isolation kept to a level that does not damage hearing.

Where this is not practical, Construction Site Owners and Principal Contractors should isolate people from excessive noise.

Where neither option is practical, Construction Site Owners and Principal Contractors must put systems in place to make sure people exposed to the noise are unlikely to suffer harm.



Some machinery can be enclosed to reduce noise

Operating speeds and dangerous vibration

No machine or equipment should be driven or used at an unsafe speed. Where a designer or manufacturer recommends a working speed for a machine or equipment, do not go any faster.

Maintain machines and equipment so there is no dangerous vibration when the machine or equipment is working or when moving parts and cutters are run at idle or full speed.

Weight of guarding

Large machinery and equipment may need a lot of guarding, which needs to be removed for maintenance access. Design guards to come off easily and be handled by one person. Well-placed handles make removing, lifting and handling easier and reduce the risk of manual handling injuries.

Where practical, use cranes or other lifting devices to move heavy guards.

Access hazards

Workers need safe access into, on and around machinery. Workers need a stable work platform that is right for the work they need to do. The Worker should be able to keep good posture while working. The platform must give a sure footing, a safe working environment and prevents falls it is at height.

When designing safe access to machinery, think about who, what, where, when and how.

- Who will be working on or around the machinery?
- Do people need to work in enclosed areas where the atmosphere could be harmful (such as pits, tanks or storage vessels)?
- What equipment or materials need to be carried to do the job?
- Where and when is access needed to use, maintain and clean the machine?
- How will people get safe access (such as from a walkway, gantry, elevated work platform, ladder)?
- What work will be carried out with the machine?
- Will people be near or exposed to any mechanical or non-mechanical hazards when they access the machine?
- Has consultation occurred with Workers or contractors about how they intend to gain access, and what equipment and work platform or structure is best suited for the intended task?

Housekeeping
Messing around machinery and equipment can cause slips, trips and falls. Avoid injuries by:

- keeping work areas, walkways and other access paths clear and clean.
- clearly marking walkways and no-go areas.
- preventing spills, which can cause slips.

Design machinery and work processes to minimise oil loss or spillage. Clean up spills as soon as possible and avoid any oily residues on the floor. Provide a rough anti-slip floor where this is not practical.

Operational hazards

The flowchart below shows the more common hazards associated with machinery operations. Apart from the hazards associated with the normal running of the machinery, the flowchart also covers hazards associated with cleaning, maintenance and repair, along with irregular hazards.

To keep people safe during inspections, cleaning, repairs, maintenance and emergencies:

- use isolation procedures whenever people need to enter the danger area around machinery for maintenance and repair.
- make sure Workers understand cleaning, repair, maintenance and emergency procedures.
- put in place a regular inspection regime to identify any problems with machinery and guards.
- identify and assess any other hazards specific to inspections, cleaning, repair, maintenance and emergencies.
- take special precautions when Workers cannot be seen or where there are multiple operating switches.
- if dangerous parts need to move while a guard is open (for example: setting, fault finding, or maintenance), use safe operating procedures (such as speed as slow as practical, and two-hand hold-to-run inching controls with pendant) to minimise hazards and the risk of injury.

Guarding types – isolate

This section covers the types of machinery guarding available and the situations where it is generally used. Depending on the situation, a combination of two or more safeguards may be needed to keep Workers safe.

Fixed guards

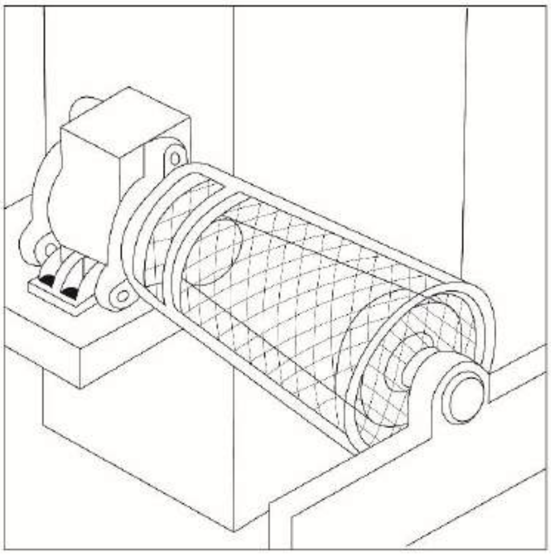
Fixed guards are physical barriers that keep people out of dangerous areas during normal use, maintenance or cleaning. The need to adjust drive belts and transmission chains, other machinery parts, can affect guard design.

Fixed guards can be:

- permanent – welded into or part of the body of the machine.
- removable – but they can only be removed when the machine is stopped with a special tool that is not easily available to operators. Do not use wing nuts, wedge inserts or anything that can be undone with the fingers.

Barriers or fences held securely in place with fasteners or other suitable devices can stop access to dangerous areas.

Machine guards should be made of substantial materials (such as sheet steel, wire mesh) that cannot be easily damaged.



An example of a fixed guard

Interlock guards

Interlocked guards work by cutting power to the machine when the guard is opened. They are a good guard to use when a machine needs to be accessed often.

If parts keep moving when the machine is not working, you must use a type of guard that cannot be opened until all parts have stopped moving, or fit devices that stop the machinery. Any brakes fitted to machinery must be well maintained.

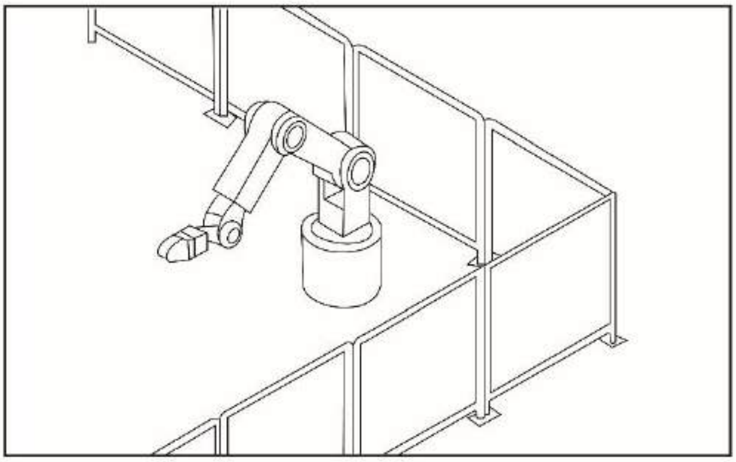
Use a suitable anti-free fall device with interlocked rise and fall guards on machine tools that can injure if they free fall under gravity.

Power-operated guards should work with a minimum of force, so they do not create a trapping hazard. Where it is not possible to reduce the closing force of a guard, fit a safety trip device to the leading edge of the guard that will stop and reverse the guard if it contacts an object, like a hand.

With barriers like fences, there is a danger that machines can start when someone is close to them, such as when an interlocked door accidentally closes and the machine re-starts. To avoid this hazard, fit devices to stop an interlock door or gate closing accidentally (such as a spring or gravity latch, which need a deliberate action from someone to close the door).

Interlocked guards must be designed so that any failure or loss of power does not expose people to danger. The design also needs to consider the possibility of someone being inside the area enclosed by the guard when someone tries to start the machine.

Only after doing a risk assessment can you know what type of safety device to install with the guard, and the level of integrity of the related control circuitry.



An example of a perimeter fence guard with fixed panels and interlocking access door

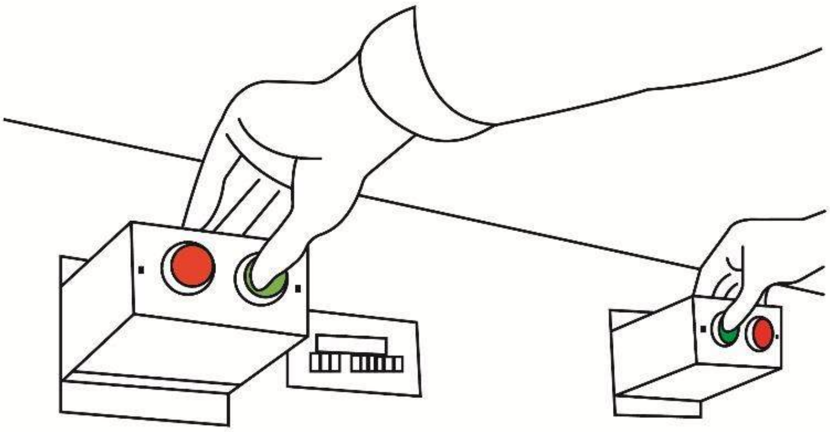
Two-hand controls

Only use this method to isolate people from machinery hazards as a last resort. Even when used properly, two-hand controls only protect the machine operator, not other people who may be near the machine.

Two-hand controls should:

- need to be turned on together (so people cannot tape one control down).
- need to be held to run, so the machine stops immediately when the control is released.
- be spaced well apart and shrouded so one arm cannot run both controls.

The rear and sides of the machine should be guarded by fixed guards to prevent stop access by other people.



An example of a two-hand control

Locked guards and gates

Locking guards and gates need a responsible person (usually a manager) to hold the key at all times. This person must also make sure the gate is not opened until the machinery or equipment is switched off, isolated and has stopped.

Only use locked guards and gates if after diligent trials, there are no practical alternatives. Senior management in association with staff should also write, approve and monitor any safe operating procedures and monitor the effectiveness of the safety process as a temporary means to minimise the hazards.

Isolation hold cards and lock-out devices can also be used so a machine is not accidentally restarted.

Adjustable guards

Adjustable guards are made up of a fixed guard with adjustable elements that are moved to suit each task. They can be:

- self-adjusting - guards that are forced open by the entry of work.
- distance guards - barriers that can be moved to a safe distance from the danger zone.

Guards that move out of the way for each operation (automatic guards) need special care. Hazards can be created between the guard and:

- machine.
- person.
- work piece.

Workers need full training on using and adjusting these guards. These guards are only effective when the people use them correctly.

The self-adjusting guard over the cutting wheel swings back as the cutting wheel cuts through steel

Emergency stop devices

Emergency stop devices should not be the only method used to control hazards. They are only a backup for other control measures. They should be red with a yellow background. Do not use emergency stops to lock-out the machine because the actuators can separate from the contacts. If this happens, the control will show the machine is off, but it is actually on.

Do a hazard assessment when choosing an emergency stop device and consider:

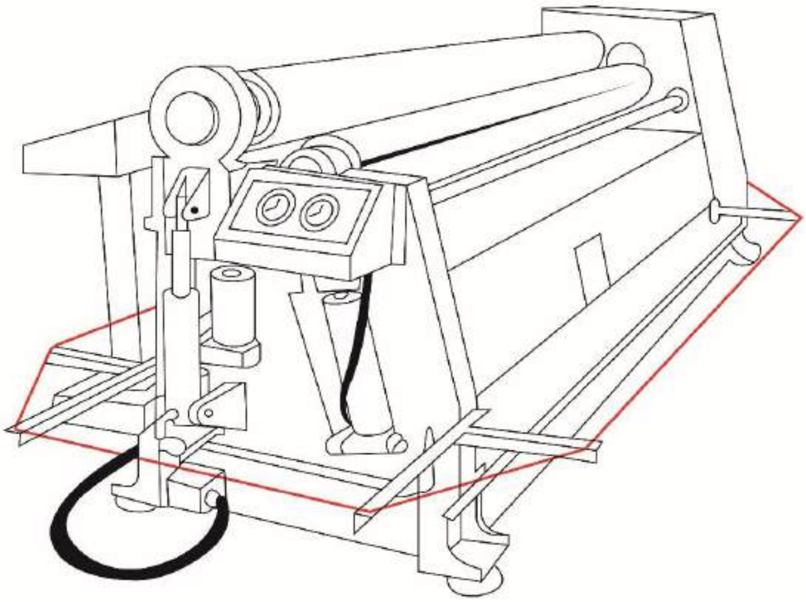
- whether part of the machine still needs to work in an emergency situation.
- what other safety features still need to work (such as pressure release valves).
- whether the stop introduces any new hazards.
- what level of integrity any associated circuitry needs.

Make sure emergency stop devices:

- are prominent, and clearly and durably marked.
- are immediately accessible to each user of the machine.
- have red handles, bars or push buttons (labelling can also be used).
- are not affected by electrical or electronic circuit failure.

Other considerations include:

- whether stop devices should be easily seen in contrast to their surroundings.
- the best access for Workers - ideally they are near where someone can be trapped in the machine.
- the environment the machine is used in (e.g., whether the device is exposed to dust, chemicals, temperature extremes or vibration).
- the number of emergency stop devices needed (if the machine is large, several devices or pull wires may be needed).
- a manual way to reset an emergency stop device.
- a regular testing routine to check the device still works.



The red line shows the emergency stop cord on the rollers that act as a trip guard

Badly placed emergency stop devices may slow shutdown in an emergency and encourage dangerous practices, such as:

- reaching across moving parts.
- failing to shut down machinery when there is a problem.
- allowing one Worker to start the machine while another is in a dangerous location (like cleaning a machine).

When there is more than one device, use a safe procedure so machinery cannot restart during maintenance or other temporary situations (such as a blockage of product). A lock-out and tag-out system is essential to isolate the machine from a power source to stop accidental start-up.

When servicing emergency stop devices, actuators can separate from contacts, meaning the machine appears to be off, but because of the fault it is still on. This why emergency stops are unsafe to use as a means of lock-out.

Colour coding

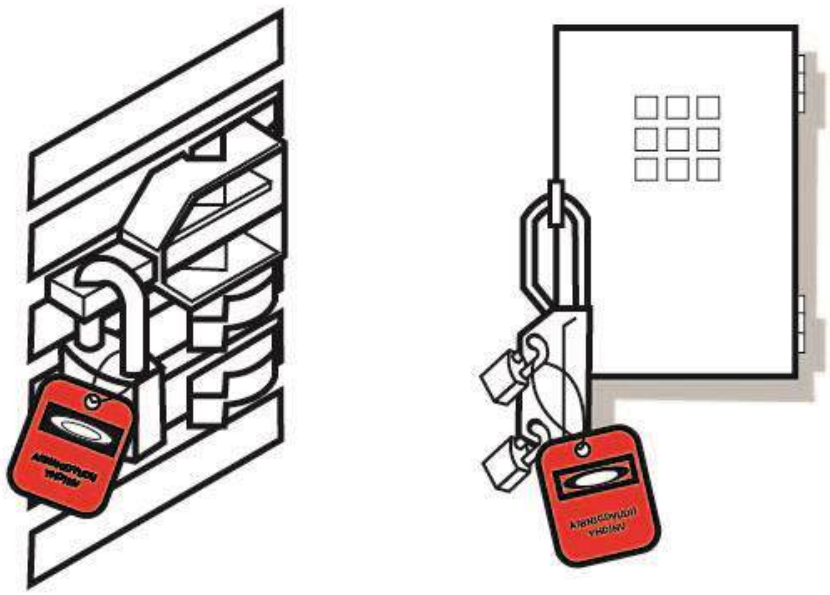
It is good practice to paint safety guard posts or frames yellow and any mesh black so it can be seen through more easily and staff do not need to open the guards for observation as much.

So, workers can easily see when a guard is out of place, it is good practice to:

- use high visibility yellow paint for the guard that is different from the machine’s colour.
- paint surfaces behind the guard a bright or contrasting colour (like blue or red).

Lock-out systems and isolation procedures

Lock-out systems are used to safely isolate machinery from its power source. They are used when someone needs to inspect, repair, maintain, alter or clean the machine, or when it is to be withdrawn for assessment or repair. The method used to isolate depends on the type of machinery. Construction Site Owners and Principal Contractors should develop these safe operating procedures with Workers. Once a procedure has been put in place it should be strictly obeyed.



An example of a lock-out system

Construction Site Owners and Principal Contractors must make sure there is a safe system to isolate all machinery from power sources.

They must:

- have procedures to prepare a machine for the application of isolation devices, locks and tags
- train and instruct Workers in the system so they are competent to isolate or lock-out and tag-out machinery
- give supervision to make sure that isolation procedures, are followed.

Workers trained in the safe system of isolation for machinery must make sure the system is followed at all times.

If the machine is powered by electricity, the Construction Site Owner and Principal Contractor should have a qualified electrician remove and keep the fuses. Where other sources of power are used, the parts that are removed to achieve isolation should also be kept in a place where they cannot be accessed by other Workers.

If access to machinery is required and it is not practical to stop it, a Construction Site Owner and Principal Contractor must ensure that:

- the machine is fitted with operating controls that allow controlled movement.
- there are written procedures to be followed for inspections, repairs, maintenance, alteration and cleaning.
- people working on the machine carry out the work in accordance with the written procedures.

Isolation hold cards and lock-out devices

Chains, clasps and locks are examples of devices that can be used to isolate machinery and equipment. Isolation devices must be reliable and clear. Each lock should:

- be strong enough to take physical abuse, either intentional or unintentional.
- be made of material suitable for the environment.
- have only one key and one owner who is responsible for it.

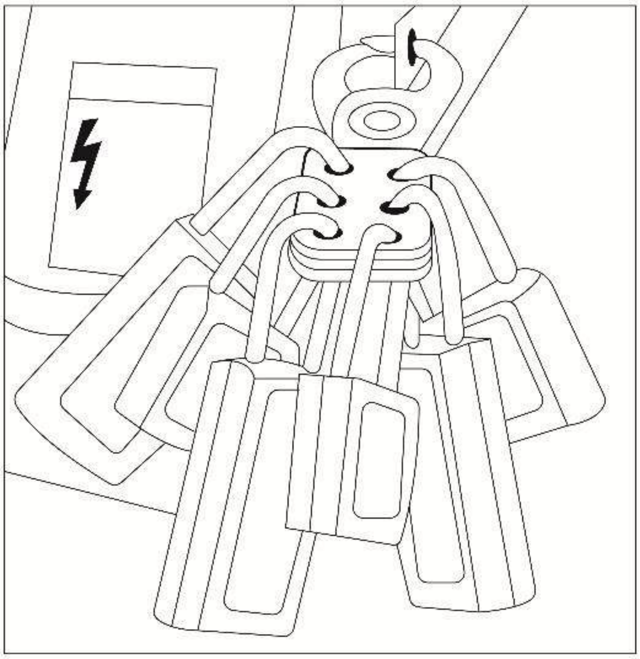
Lockout systems are vital when machinery or equipment is under maintenance

Master or spare keys should be kept in a designated place, away from the construction site and under the control of a competent person. There must be strict procedures about when to use spare keys. They must only be used in an emergency after thorough safety checks are done.

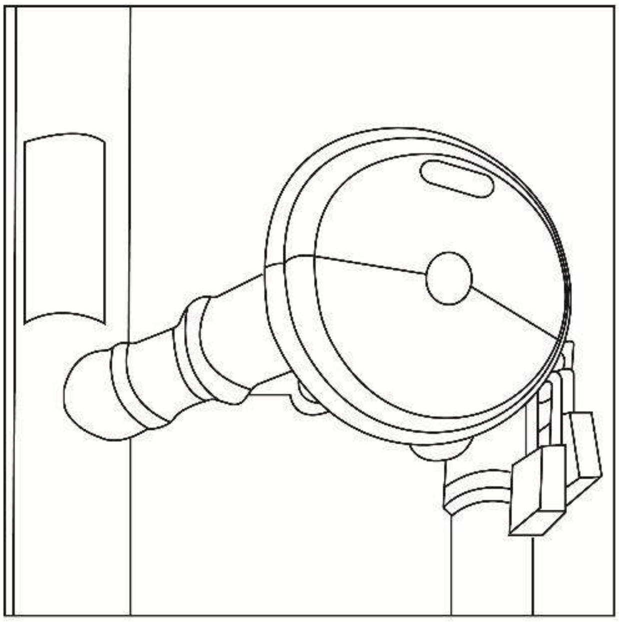
Lock-out and tag-out cards should be used together and be attached to the power controls of isolated machinery and equipment. This reduces the chance of someone starting the machinery or equipment inadvertently.

The cards must clearly state that under no circumstances should the machinery or equipment be connected to the power source or be started until the hold card is removed by the person named on the tag-out card. Include advice on the tag-out card of the actual or potential danger, where appropriate.

An example of a Tag and Lock



An example of multiple locks



An example of a valve lock and tag

Lock-out devices make sure people are out of the danger area before machinery or equipment can be started. They are mechanical-locking mechanisms used to physically lock machinery controls so they cannot be used.

Use lock-out devices when people have to work on or inside machinery and are out of sight of other people in the construction site. Anyone who has to work in a hazardous area should have a lock-out device that identifies who is protected by the device. The lock used with these devices should be durable and must only have one key, held by the operator.

Tag-out cards are sometimes referred to as danger tags, restricted-use tags and warning tags. Use a tag out card with lock-out devices and isolation to improve staff safety.

Guards for exposed rotating cutting machinery

Exposed rotating cutting machinery includes:

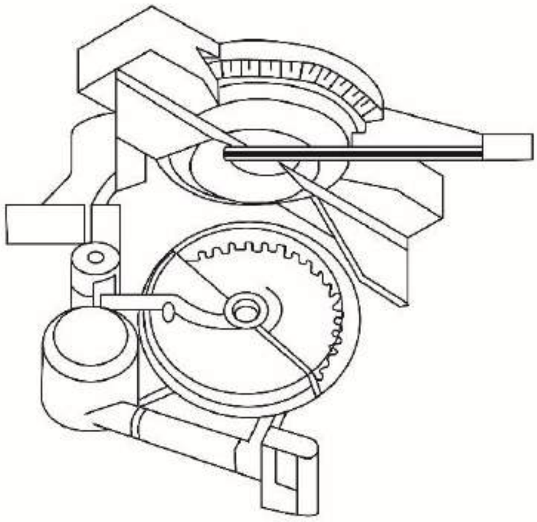
- cut-off saws.
- milling machines.
- friction cutting equipment.
- boring equipment.

Hazards arise from the exposed blades and risks include cutting people or entanglement.

Guards (or visors) that move must stay close to the work piece. The cutter's teeth can be exposed if the visor is:

- not attached to the fixed guard.

- in a poor position.
- jams in the open position.

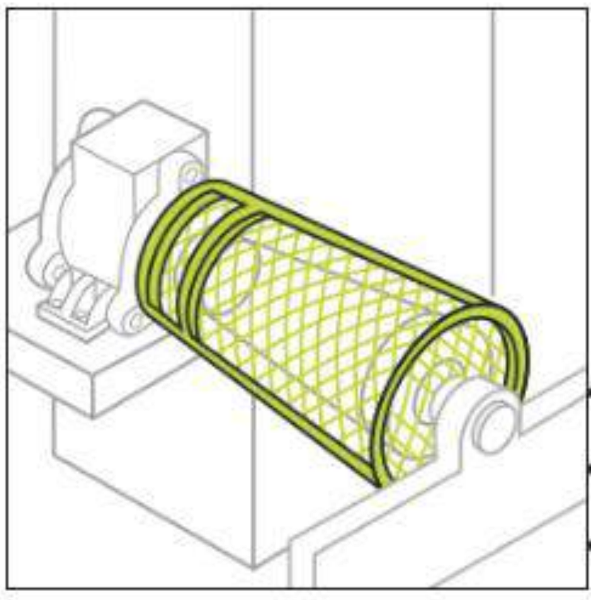


An example of a self-adjusting guard for a drop saw

Pulleys and drives

Pulleys and drives are used in many machines. Nip-points are the main hazard. They must be guarded so no one can get entangled.

Interlocked guards are preferable for pulleys and drives. In some cases, a hinged section may be appropriate to access the machine when setting it. Design and install the guard so a tool is needed to remove and replace it.



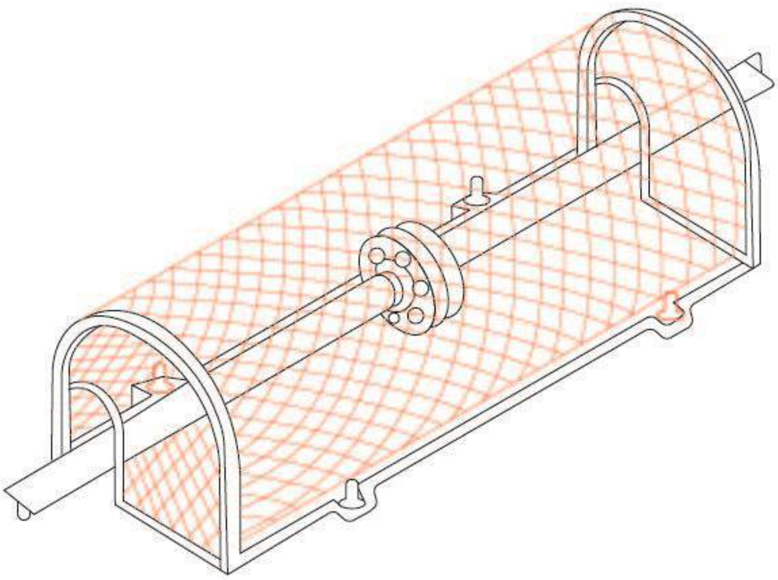
An example of a fixed guard for a pulley drive preventing access to transmission machinery

Rotating shafts and rollers

Interlocked guards are preferable for rotating shafts and rollers, such as:

- couplings.
- spindles.
- fan-shafts.
- ironing rollers.

Guards should stop loose clothing and long hair getting caught in rotating shafts. In addition to a guard, it may be appropriate to tell operators not to wear loose clothing (such as long-sleeved shirts or jackets) and tie long hair back or wear a head covering.



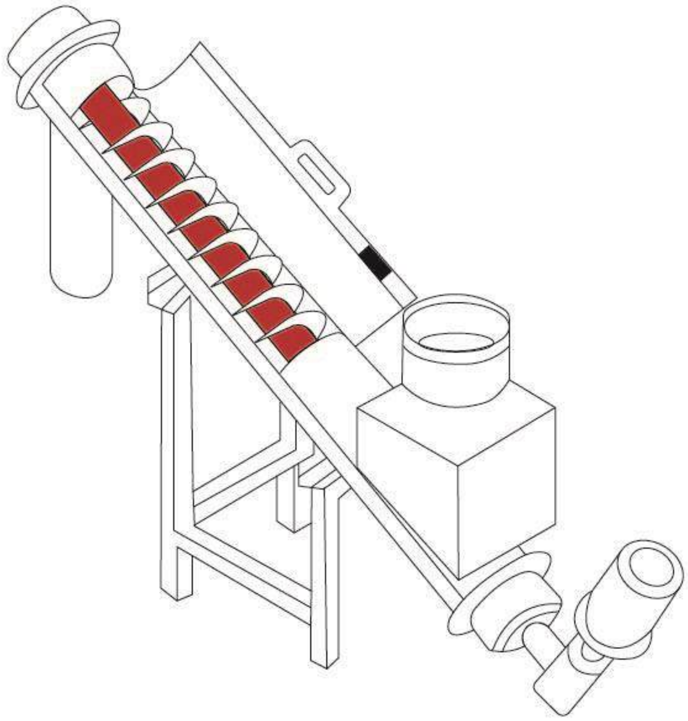
An example of a fixed guard on a rotating shaft or coupling

Conveyors

Conveyors move materials from one place to another. Types include belt, screw and bucket conveyors.

The main hazards of a conveyor are the many in-running nip-points, which can entangle, crush and abrade people. The drive system can also pose risks of entanglement or abrasion.

Fixed guards that enclose in-running nip-points and the drive mechanism are usually the best way to guard conveyors



An example of a typical guard for hand and tail section of a conveyor

Large conveyors, such as stockpilers, generally need both carry idlers and return idlers guarded where they are under high tension and accessible.

Welding and welding equipment

Welding is the process of joining materials together, usually metals, by heat or pressure or both. When heated, the metal reaches molten state and may be joined by heat only or with the use of filler materials. The heat is generated through electric currents (arc welding) or gases (gas welding).

Welding may be undertaken to manufacture machinery, tools and equipment as well as for construction work, repair and maintenance work.

Welding equipment, the welding process, welding material, fillers and gases involved in welding and the welding workspace can all be a source of risk to operators and nearby Workers' health and safety.

Construction Site Owners and Principal Contractors have a duty to provide and maintain for Workers a working environment that is safe and without risks to health.

<u>Welding hazards</u>

Common hazards associated with welding include:

Fumes and other airborne contaminants

The welding process can generate:

- fumes.
- mists.
- dust.
- vapours.
- gases (including ozone), which may be toxic to workers.

Worker exposure to airborne contaminants may cause:

- eye, skin and respiratory system irritation.
- asthma.
- nausea.
- headaches.
- dizziness.
- asphyxiation.

Welding fumes can cause serious lung diseases and increase the risk of cancer. For more information see Chapter 10 Hazardous Substances.

UV radiation

When welding, the electric arc emits ultraviolet light, visible light and infra-red radiation. Gas welding will emit visible light and infrared radiation.

Exposure to the welding arc can lead to burns to exposed skin and the eyes from ultraviolet and infra-red radiation.

UV radiation from welding has also been classified as a group 1 Carcinogen by IARC, meaning exposure can increase the risk of developing cancer. For more information see Chapter 4 Use of PPE

When welding, Workers may be exposed to direct UV radiation produced by the arc and radiation reflected off hard and smooth surfaces in the construction site. Exposure can cause eye melanoma, cataracts (clouding on the lens of the eye) and burns to exposed skin.

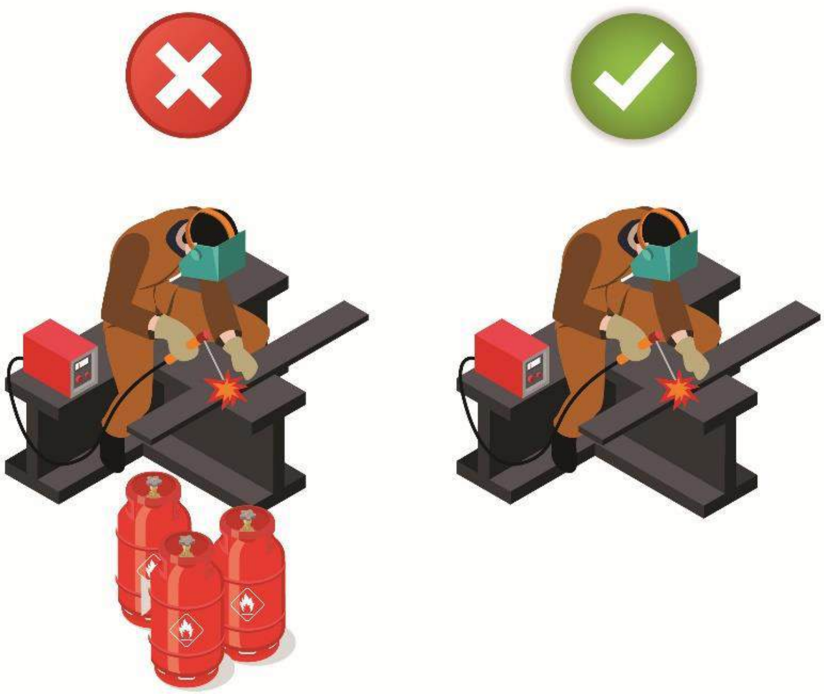
Exposure to the eyes can occur within seconds and can cause 'arc eye' or 'welders flash', which is very painful and can lead to temporary or permanent loss of vision.

Workers directly involved in the welding process are at greatest risk of exposure to UV radiation. However, other people in the construction site may also be exposed to UV radiation if they are present during the welding process and there are insufficient control measures in place.

Welding without the correct visor can severely damage your eyes

Fire and explosions

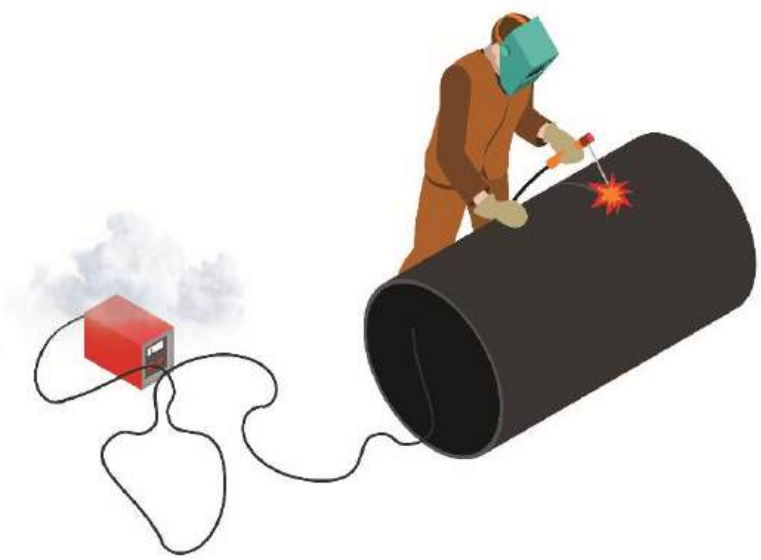
Welding generates heat as well as sparks and flames, which are sources of ignition. Flammable and explosive substances or gases including oxygen are often present when welding and when they are combined with an ignition source, there is a significant risk of fire and explosion. Welders are at risk of serious injuries including burns from explosions and fire.



Welding near gas or petrol is highly dangerous

Electric shock

Workers are at risk of electric shock or electrocution when welding. Electrical faults can result in electric shock, burns or death of the welder when in contact with the work piece, live parts, electrodes, or contact with an unearthed cable or tool. Workers should ensure that the open circuit voltage is at a safe level and the currents are grounded before welding. Equipment also needs to be well maintained to avoid electric shock from worn down handguns, body or hoses.



Ensure your welding equipment is setup correctly

Hazardous manual handling

When welding, Workers may be at risk of musculoskeletal disorders (MSDs) associated with hazardous manual handling. MSDs can occur suddenly or develop over time. Workers are at risk of MSDs if they are engaging in tasks such as:

- manual movement of heavy objects, such as moving or replacing gas cylinders.
- repetitive squeezing of welding handles or triggers.
- welding on the ground or in awkward positions.

Compressed and liquefied gases

Welding involves the use of compressed and liquefied gases as a source of fuel, oxygen or in some cases as a type of shielding gas.

Gas cylinders used for welding must be secured correctly in a safe location in the construction site, to prevent cylinders falling over. If this occurs and the valve on the cylinder breaks, it can become a dangerous projectile that can strike and injure operators. Workers may also be exposed to leaking gas, which is not always easily detectable if there is no odour and can be extremely hazardous. Depending on the type of gas, leaking gas may displace oxygen in the construction site, potentially leading to asphyxiation for the operator. Leaking oxygen will increase the risk of fire or explosion in the construction site.

All heat and ignition sources should be kept away from the gas storage areas, incompatible gases should be segregated, and all cylinder valves should be closed when not in use. For more information see Chapter 10 Hazardous Substances.

GLOSSARY

Abrade - to scrape or wear away by friction or erosion.

Administrative control - controls that alter the way the work is done, including timing of work, policies and other rules, and work practices such as standards and operating procedures (including training, housekeeping, and equipment maintenance, and personal hygiene practices).

Alcohol - a colourless volatile flammable liquid which is produced by the natural fermentation of sugars and is the intoxicating constituent of wine, beer, spirits, and other drinks, and is also used as an industrial solvent and as fuel.

Arc Eye or **welders flash** - a painful eye condition caused by damage to the cornea from ultraviolet radiation during arc welding.

Atmosphere - the air in a particular place or area.

Auxiliary Hoist - a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

Boom-type elevating work platform - a telescoping device, hinged device, articulated device or any combination of these, used to support a platform on which personnel, equipment and materials may be elevated.

Breathalysers - devices used to measure the amount of alcohol in a person's breath.

Building work - land work, building work of a new construction, repair work, modification work, and installation**.**

Cable Locator - an instrument used for detecting the presence and approximate location of buried services in advance of undertaking excavation works. It aims to avoid accidents while excavating.

Cantilevered suspension rig - a rigid structural element that extends horizontally and is supported at only one end. Typically, it extends from a flat vertical surface.

Carcinogen - a substance capable of causing cancer in living tissue.

Certification work - examination, analysis and certification of a design document, calculation, technical instructions for building or demolition work and operation of building or demolition work, compliance with building technical regulations and other existing regulations to ensure safety, well-being in building or demolition work and in the use of the construction.

Chain of Responsibility - a simple process of ensuring that everyone has a responsibility to look after the health and safety of themself, other Workers, visitors, and any other person who may interact with a construction site.

Commission - bringing (usually something newly produced) into working condition.

Competent authority - Government Ministries, departments and its officers who have been given responsibility to monitor and enforce regulations and laws relating to the construction industry.

Competent Person - a person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to workers, and who has authorization to take prompt corrective measures to eliminate them.

Control Strategies - the way to manage the execution of your strategic plan.

Control measure - a thing, work process or system of work that controls the WHS hazard or risk.

Construction - the process of construction work or to a building, a structure or permanent or temporary architecture constructed with construction materials, equipment or products.

Construction contract - a contract between a construction owner and a builder and a contract between a builder and a sub-contractor to carry out building or demolition work.

Construction controller - a technical official who is appointed by the competent authority in order to check building or demolition works and controls construction quality and safety.

Construction equipment - equipment that is assembled, made, or produced to be used in or fixed to a construction in order to increase quality, comfort and ease of construction use, namely lamp, electric wire, optic wire, sink, faucet, bathtub, air- conditioner, elevator, pipe.

Construction material - a raw material to be mixed, combined, assembled, or used as a construction structure, equipment or products, such as sand, crushed stone (aggregate), gravel, cement, steel, glass, clay, ceramic, wood.

Construction owner - an owner or a real estate developer of a construction that is built on his/her own land or on someone else's land with the landowner's permission or a perpetual lessee who builds a construction on the lessor's land.

Construction product - finished or semi-finished product that is made or produced with construction materials and used to build a construction structure, such as roof tile, brick, mortar, concrete, pillar, wall, decorated ridge-piece on rooftop, concrete floor, concrete pipe, ceiling plaster, corrugated iron/steel, fibreboard, wallpaper, paint, or tile adhesive.

Construction project management - the work that a construction project manager carries out on behalf of a construction site owner in order to ensure that a building or demolition project operates efficiently in terms of time, cost, quality and safety.

Construction work - design work, surveying work, building work, demolition work, site management work, certification work, testing work, construction project management or construction safety and quality control.

Contaminant - a polluting or poisonous substance that makes something impure.

COVID Safe Plan - an implemented Covid-19 plan consisting of construction site and Cambodian laws and regulations, procedures and policies to prevent and combat Covid-19 on the worksite.

Dangerous building - a construction or any part of a construction or construction materials, equipment attached to the construction which may cause danger to a neighbouring construction(s), lives, bodies, and health of construction users, neighbours and the public.

Dead load (scaffolding) - the weight of the scaffold itself.

Decommissioning - when equipment or machinery is removed and/or taken out of working service.

Demolition work - the work of dismantling or removing any part of a construction, or removing a whole construction, or the work of destroying the construction.

Design document - a technical document for the purpose of construction works such as architectural design, structural design, mechanical system plan, electrical system design, wastewater-clean water system design, fire safety system design, or other technical designs/plans, documents, and instructions for building or demolishing and using a construction.

Design work - plan/design drawing work, research work and data analysis for architectural and engineering work, planning work, preparation of lists of estimated costs, preparation of technical instructions, and detailed plan/design drawing work.

Dismantling - to take a machine apart or to come apart into separate pieces.

Drugs - a medicine or other substance which has a physiological effect when ingested or otherwise introduced into the body.

Electricity Supply Authority - a person or body engaged in the distribution of electricity to the public or the transmission or supply, directly or indirectly, to the public. An electricity supply authority may also be known as a network operator, a network service provider or an electricity entity.

Worker - a person employed under a contract of employment or contract of training.

Fire Warden - a person designated by the person with responsibility for workplace activities, or workplace manager, to assist them in implementing the necessary fire safety arrangements as identified by the manager to prevent a fire from endangering the health and safety of occupants and other relevant person for whom a duty of care is held.

Flammable waste materials - waste that will create fires under certain conditions, perhaps spontaneously combust, and have a flash point less than 60 °C (140 °F). Examples include waste ethanol, methanol, hexane, acetic acid and acetone.

Fatigue - extreme tiredness resulting from mental or physical exertion or illness.

Formwork - term used for the process of creating a temporary mould into which concrete is poured and formed. Traditional formwork is fabricated using timber, but it can also be constructed from steel, glass fibre reinforced plastics and other materials.

Hazard - a potential source of harm, illness, injury, disease or death, including the potential to cause illness, injury, disease or death.

Hazard and operability analysis (HAZOP) - a structured and systematic technique for system examination and risk management.

Health and safety officer (HSO) - a person at a worksite given the responsibility to monitor and identify health and safety issues at the worksite.

Hierarchy of control - a system for controlling risks in the workplace. The hierarchy of control is a step-by-step approach to eliminating or reducing risks and it ranks risk controls from the highest level of protection and reliability through to the lowest and least reliable protection.

High-risk work licence - a photographic licence issued to persons who have been trained and assessed as competent to work in a class of work defined as high-risk work.

Hot work - work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

Housekeeping program - the routine cleaning and organizing of the workplace. As housekeeping is an ongoing safety practice, orderly conditions in the workplace should be maintained on a consistent basis, not restored after orderliness has been allowed to slip.

HSR - Health and Safety Representative.

Hungover - someone who is unwell because they drank too much alcohol on the previous day.

Ignition source - a flame, spark or hot surface capable of igniting flammable vapours or fumes, or any substance capable of burning.

Independent contractor - a self-employed person or entity contracted to perform work for or provide services to another entity as a nonworker.

Interlocking door - an interlocking system that is composed of two doors electronically connected so one cannot open until the other has closed.

Live load (scaffolding) - the weight of the workers, equipment and materials which will be used on at any one time on the scaffold

Load - weight, pressure, or any force that presses or has impact on a construction structure.

Local authorities - any authority that needs to be contacted prior, during, and post construction, e.g., law enforcement, emergency services, and government departments.

Material safety data sheet - a technical document which provides detailed and. comprehensive information on a controlled product related to health effects of exposure to the product, hazard evaluation related to the product's handling storage or use and measure to protect workers at risk of exposure.

Metabolic heat load - the term used to measure how hard muscles are working during physical activity.

Modification work - alteration of the function of the whole or a part of a construction.

Musculoskeletal injury or disorder - an injury relating to the muscles and skeleton, including bones, joints, tendons, and muscles.

Nip-point or **pinch point** - a point of convergence between two rolling parts, or a rolling part and a stationary part, where all or part of the human body could become trapped and injured.

Other persons - site inspectors, government officials, and persons who do not fall into the categories of contractor, worker, or visitor.

Passive fall prevention device - material or equipment, or a combination of material and equipment, that is designed for the purpose of preventing a fall and that, after initial installation, does not require any ongoing adjustment, alteration or operation by any person to ensure the integrity of the device to perform its function.

pH neutral - a chemical that is neither acidic nor alkaline.

Power Take Off (PTO) - any of several methods for taking power from a power source, such as a running engine, and transmitting it to an application such as an attached implement or separate machine.

Principal Contractor - a person who employs one or more people to work on a construction site.

Registered Training Organisation - an organisation providing Vocational Education and Training courses to students, resulting in qualifications or statements of attainment that are recognised and accepted by industry and other educational institutions.

Reinforced concrete - concrete in which metal bars or wire is embedded to increase its tensile strength.

Residual Current Device (RCD) - a safety device that quickly breaks an electrical circuit to protect equipment and to reduce the risk of serious harm from an ongoing electric shock.

Risk - the chance or likelihood that a hazard will cause harm to a person.

Safe system of work - formal procedure based on a systematic examination of work in order to identify the hazards.

Safe working load (SWL) - sometimes stated as the Normal Working Load is the maximum safe force that a piece of lifting equipment, lifting device or accessory can exert to lift, suspend, or lower, a given mass without fear of breaking.

Safe Work Method Statement (SWMS) - is a document that sets out the high-risk construction work activities to be carried out at a workplace, the hazards arising from these activities and the measures to be put in place to control the risks.

Scaffolding - temporary structure on the outside of a building, made of wooden planks and metal poles, used by workmen while building, repairing, or cleaning the building.

Scaffold designer - usually a civil engineer who designs scaffolding structures to support construction work.

Shear - when something, especially something made of metal, shears, it breaks into two pieces, usually because of a sideways force.

Shoring up - the process of temporarily supporting a building, vessel, structure, or trench with shores (props) when in danger of collapse or during repairs or alterations.

Task analysis - the analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task.

Testing work - study, analysis, geological calculation of construction structures, construction tools and machinery, and construction materials, equipment and products.

Trades person - a construction technician (skilled worker/workman) who has received a training at a related specialized technical school or who is skilled and experienced in carrying out building works, or a tradesperson whose professional board has not been created.

Under the influence - someone affected by alcoholic drink or drugs.

Utility Owner - the owner or operator of any Utility (including both privately held and publicly held entities, cooperative Utilities, and municipalities and other governmental agencies.

Young worker - an inexperienced worker between the ages of 18 and 24 years old.

WHS - work, health & safety.

Contact Details

Ministry of Land Management, Urban Planning & Construction	
Contact Ph:	+855 (0) 23 215 279
Address:	771-773, Preah Monivong Blvd., Sangkat Boeung Trabek, Khan Chamkarmon Phnom Penh
Email:	mlmupc.cabinet@gmail.com
Website:	www.mlmupc.gov.kh
Ministry of Public Works and Transport	
Contact Ph:	1275 (free call)
Address:	St 598 (Street HE Chea Sophara) Sangkat Chrang Chamres 2, Khan Russey Keo, Phnom Penh
Email:	info@mpwt.gov.kh
Website:	www.mpwt.gov.kh
Police Department	
Contact Ph:	117
Fire Department	
Contact Ph:	118
Ambulance (Calmette Hospital)	
Contact Ph:	119
Electricity of Cambodia	
Contact Ph:	023 723 871
Address:	Ang Yukanthor (St. 19), Wat Phnom, 12202, Phnom Penh
Phnom Penh Water Supply	
Contact Ph:	023 724 046
Address:	No. 45, Preah Moha Ksat Triani Kossomak (Ave. 106), north of the Railway Station, 12201, Phnom Penh

CONSTRUCTION WORKPLACE HEALTH & SAFETY GUIDELINES

VOLUME 3

Ministry of Land Management, Urban Planning and Construction

Preface

The Royal Government of Cambodia has considered the construction sector as an engine of economic growth and it has become a pillar along with three other pillars, such as agriculture, garment and footwear industry, and tourism. The Ministry of Land Management, Urban Planning and Construction has been effectively implementing the Law on Construction.

With the growth of the construction sector, construction site safety and health require great attention in order to assure the safety of and mitigate risks to individuals engaged in construction works, especially workers employees, and staff at construction sites. In this regard, the Ministry of Land Management, Urban Planning and Construction has continually introduced legal measures and regulations to further strengthen and promote well-being and safety of workers, employees, and staff at construction sites.

Addressing these issues the Ministry of Land Management, Urban Planning and Construction cooperate with the Australian Embassy in Cambodia to develop Construction Workplace Health and Safety Guidelines which are a regulation for workers employees ad design companies and construction companies, and individuals involved in construction works so as to avoid accidents at construction sites which affect people's health and lives as well the planning and plans of construction projects.

I requires that investors, workers, employees, and people involved in Cambodia's construction sector pay close attention to their own safety and health while working at construction sites.

Deputy Prime Minister
Minister of Land Management, Urban Planning and Construction

CHEA SOPHARA

Preface of

His Excellency the Australian Ambassador to the Kingdom of Cambodia

Cambodia's dynamic and growing construction sector is a key driver of economic growth. It also supports the livelihoods of 150,000 construction sector workers and their families. While the construction sector has supported Cambodia's rapid development, it also presents new challenges including the need to improve workplace safety on Cambodia's construction sites.

Following several serious incidents at construction sites, Australia responded quickly and effectively to the Royal Government of Cambodia's request for support to improve the safety of Cambodia's construction workers, their families and the public.

In September 2021, I had the pleasure of participating in the signing ceremony for the Memorandum of Subsidiary Agreement (MSA) between Australia's Department of Foreign Affairs and Trade and the Ministry Land Management Urban Planning and Construction (MLMUPC) to enhance construction safety in Cambodia.

Since the signing, a technical adviser funded by the Government of Australia and a team of experts from the MLMUPC has developed the Construction Workplace Health and Safety (WHS) Guidelines. These Guidelines are an important step to improving the health and safety of Cambodians engaged in the Kingdom's dynamic building construction sector.

I commend these Guidelines to all the designers, engineers, project managers, contractors and workers involved in Cambodia's construction sector. By diligently managing safety risks, we will see the necessary improvements in an industry that is vital to Cambodia's future.

The Australian Ambassador to the Kingdom of Cambodia

Pablo Kang

Introduction

Throughout the country, in all facets of construction and demolition activities, measures to guarantee the health and safety of workers and employees need to be considered and put into practice. In doing so, construction workers and employees will be protected from the hazards and dangers that are present on construction sites. To meet this goal, before implementing any measures, it is necessary for those controlling and managing construction sites to consult with and inform workers and employees, or their representatives, in all aspects of construction work, to prevent accidents and incidents and the potential impacts on health and safety.

There are many professionals, technical experts and skilled and unskilled workers involved in Cambodia's construction sector. On any given day, between 150,000 to 180,000 individuals are engaged in construction work. Some workers do receive training in health and safety and are offered at least a basic guarantee of a safe workplace. However, through careful implementation of safety measures, all workers and employees can return safely to their homes and families at the end of each workday

The Construction Workplace Health and Safety Guidelines focus on key areas of construction safety risk. They aim to protect and promote the health and safety of workers and employees. Also, by reducing injury and time lost to accidents, the Guidelines will assist in enhancing the productivity of the construction sector.

The Guidelines do not in any way substitute for the provisions set forth in the Law on Construction promulgated by Royal Kram NS/RKM/1119/019 on 2 November 2019. Nor do they substitute for other legal documents prepared by the General Department of Construction of the Ministry of Land Management Urban Planning and Construction or other government entities. The Guidelines act as a supplementary to existing legal measures and regulations, and serve to inform and guide the workers, employees, design companies, construction companies and individuals involved in construction work.

The production of the Construction Health and Safety Guidelines represents a further example of the effective cooperation between the Ministry of Land Management, Urban Planning and Construction and the Australian Embassy in the Kingdom of Cambodia. They offer a roadmap for construction site workers, employers, professionals, businesspeople in the field of construction and officials at all levels of government for advancing workplace health and safety on Cambodia's construction sites.

TABLE OF CONTENTS

CHAPTER 19

SAFE USE OF SCAFFOLDING FOR PERSONNEL

Scaffolds and scaffolding work are hazardous. You must have the right skills, training and capabilities to work with them safely on a construction site.

This section provides information on how to manage risks associated with scaffolds and scaffolding work at a construction site. It is supported by guidance material for specific types of scaffolds and scaffolding, suspended (swing stage) scaffolds, scaffold inspection and maintenance, and advice for Principal Contractors and workers on managing the risks associated with tower and mobile scaffolds and related scaffolding work.

An example of scaffolding for personnel

What is a scaffold, scaffolding and scaffolding work?

A scaffold is a temporary structure erected to support access or working platforms. Scaffolds are commonly used in construction work so workers have a safe, stable work platform when work cannot be done at ground level or on a finished floor.

Scaffolding in this section means the individual components, for example tubes, couplers or frames and materials that when assembled form a scaffold.

Scaffolding work is erecting, altering or dismantling a temporary structure erected to support a platform and from which a person or object could fall more than 4 metres from the platform or the structure. Scaffolding work must be undertaken by a person holding the appropriate training and high-risk work licence.

Work health and safety duties

Everyone in the construction site has work health and safety duties. Some have specific responsibilities for scaffolds and scaffolding, including:

- designers.
- principal contractors.
- scaffolding contractors and workers who carry out scaffolding work.

Who	Duties
A person conducting a business or undertaking	**A person conducting a business or undertaking** has the primary duty to ensure, so far as is reasonably practicable, workers and other people are not exposed to health and safety arising from the business or undertaking. This duty requires the person to manage risks by eliminating health and safety risks so far as is reasonably practicable, and if it is not reasonably practicable to eliminate the risks, by minimising those risks so far as is reasonably practicable. It also includes ensuring so far as is reasonably practicable: ▪ provision and maintenance of safe scaffolding and scaffolds ▪ safe erection, alteration dismantling and use of scaffolds, and ▪ safe use, handling, storage and transport of scaffolding.
Designers, Manufacturers, Suppliers, and Importers	**Designers, Manufacturers, Suppliers, and Importers** of scaffolding or scaffolds must ensure, so far as reasonably practicable, the plant or structure they design, manufacture, import or supply is without risks to health and safety. This duty includes carrying out analysis, testing, or examination and providing specific information about the plant. Information must, so far as reasonably practicable, be passed on from the designer through to the manufacturer and supplier to the end user.
People installing, constructing or commissioning plant or structures	**People installing, constructing or commissioning** scaffolding or scaffolds must, so far as is reasonably practicable, all construction site activity related to the plant or structure including its decommissioning and dismantling is without risks to health or safety. The Scaffolding Contractor is the person responsible for installing, constructing and commissioning scaffolds.
Officers	**Officers**, such as company directors have a duty to exercise due diligence to ensure the business complies with appropriate WH&S Regulations. This includes taking responsible steps to ensure the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks from plant.
Workers and others	**Workers and other people** at the construction site must take reasonable care for their own health and safety, co-operate with reasonable policies, procedures and instructions and not adversely affect other people's health and safety.

How can risks be managed?

Use the following steps to ensure, so far as reasonably practicable, that workers and other people are not exposed to health and safety risks.

#1 Identify hazards

Find out what could cause harm. The following can help you identify potential hazards:

- Observe the construction site to identify areas where scaffolds are used, or scaffolding work is performed and where there is interaction with vehicles, pedestrians and fixed structures.
- Look at the environment in which the scaffold is to be used including checking ground conditions.
- Identify the major functional requirements of the scaffold like the maximum live and dead loads and access requirements.
- Inspect the scaffolding before and after use.
- Ask your workers about any problems they encounter or anticipate at your construction site when constructing or interacting with scaffolds and scaffolding work–consider operation, inspection, maintenance, repair, transport and storage requirements.
- Inspect the erected scaffold.
- Review your incident and injury records including near misses.

#2 Assess risks

Assess the risk. In many cases the risks and related control measures will be well known. In other cases, you may need to carry out a risk assessment to identify the likelihood of somebody being harmed by the hazard and how serious the harm could be. A risk assessment can help you determine what action you should take to control the risk and how urgently the action needs to be taken.

#3 Control risks

Take action to control the risk and do all that is reasonably practicable to eliminate or minimise risks.

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the hierarchy of risk control. You must work through this hierarchy to manage risks.

The first thing to consider is whether hazards can be completely removed from the construction site. For example, risks can be eliminated by carrying out work at ground level or on completed floors of a building.

If it is not reasonably practicable to completely eliminate the risk then consider the following options in the order they appear below to minimise risks, so far as is reasonably practicable:

- substitute the hazard for something safer e.g., using mechanical aids like cranes, hoists, pallet jacks or trolleys to move equipment and materials wherever possible instead of manually lifting scaffolding.

- isolate the hazard from people e.g., install concrete barriers to separate pedestrians and powered mobile plant from scaffolds to minimise the risk of collision, and
- use engineering controls e.g., provide Toe Boards, perimeter containment sheeting or overhead protective structures to prevent objects falling hitting workers or other people below the work area.

Install Toe Boards on scaffolding as an engineering control

If after implementing the above control measures a risk still remains, consider the following controls in the order below to minimise the remaining risk, so far as is reasonably practicable:

- Use administrative controls e.g., storing scaffolding as close as practical to the work area to minimise the distance over which loads are manually moved, and
- Use personal protective equipment (PPE) e.g., hard hats, protective hand and footwear and high visibility vests.

A combination of the controls set out above may be used if a single control is not enough to minimise the risks.

You need to consider all possible control measures and make a decision about which are reasonably practicable for your construction site. Deciding what is reasonably practicable includes the availability and suitability of control measures, with a preference for using substitution, isolation or engineering controls to minimise risks before using administrative controls or PPE. Cost may also be relevant, but you can only consider this after all other factors have been taken into account.

#4 Review control measures

Check your control measures regularly to ensure they are working as planned. Control measures need to be regularly reviewed to make sure they remain effective, taking into consideration any changes, the nature and duration of work and that the system is working as planned.

Control measures on scaffolding should be regularly checked

Who is involved?

As a Principal Contractor, you must consult your workers and their health and safety representatives (if any) when deciding how to manage the risks of scaffolds and scaffolding work.

If there is more than one contractor involved at your construction site you must consult them to find out who is doing what and work together so risks are eliminated or minimised, so far as is reasonably practicable.

This may involve discussing construction site-specific requirements including the type of scaffold to be erected, the scaffolding to be used and what training is required for workers particularly if a scaffolding high risk work licence is not required.

BEFORE STARTING SCAFFOLDING WORK

A primary objective of scaffold planning and design is to prevent scaffold collapse before, during and after placement of the scaffold. The collapse of a scaffold can cause death or significant injury to workers or passers-by and damage to structures.

Types of scaffold and scaffolding

Managing the risks associated with scaffolds and scaffolding work begins when you first start making decisions about how scaffolds are going to be used at a construction site and what type of scaffold will be best and safest for the job.

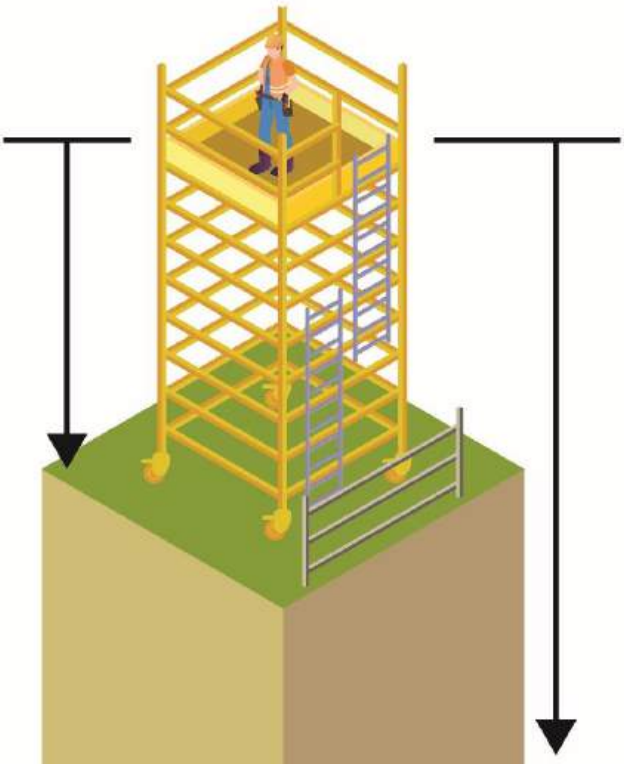
Tower and mobile scaffold

A mobile scaffold is a tower scaffold that is mounted on castors. Manufacturers and suppliers must provide information regarding the safe use and erection of mobile scaffolds. If a scaffold is to be altered, contact the manufacturer or supplier for additional guidance. All modular mobile scaffolds are to be erected in accordance with manufacturer's specifications.

Mobile Scaffolds are commonly used for low-height jobs

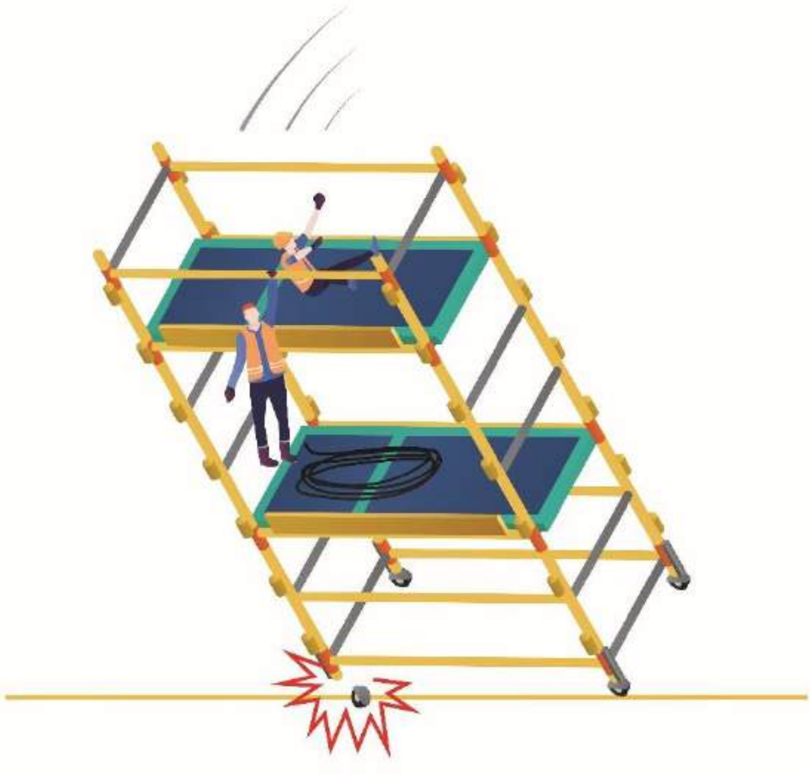
The following control measures should be implemented for mobile scaffolds:

- The height of a mobile scaffold, from the bottom of the scaffold to the working surface, should be no greater than the multiple of the minimum base dimension as specified in the manufacturer, supplier or designer information.



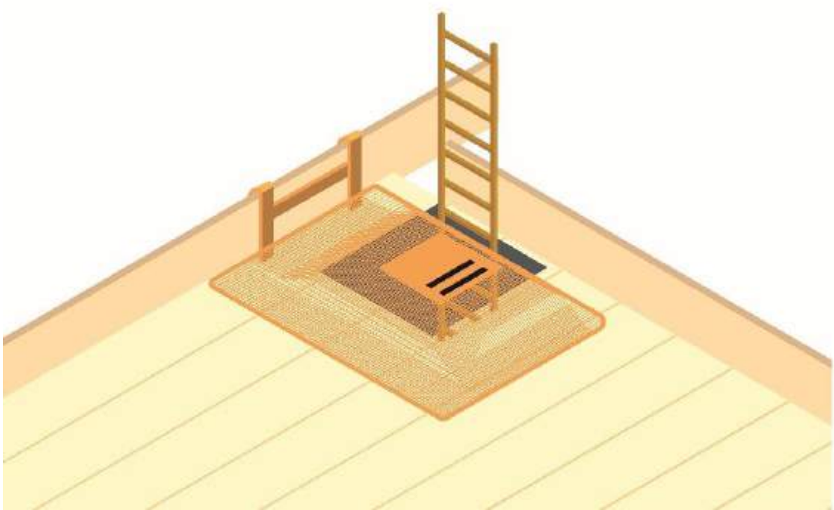
A licenced scaffolder is required for a scaffold over 4 metres

- Where adjustable castors are used, the slope of the surface should not exceed 5 degrees.



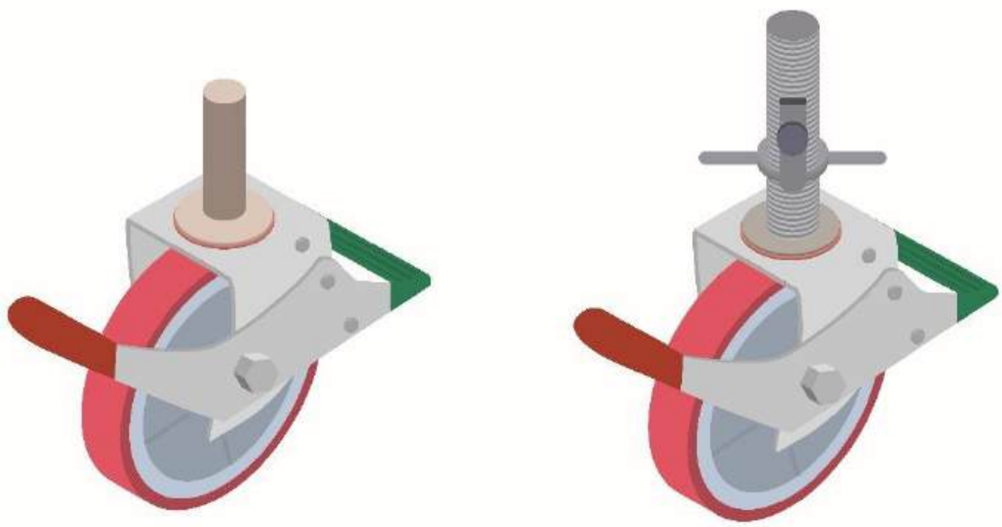
Brakes on castors are to be locked at all times unless moving the scaffold.

- Use a secure internal ladder with a protected opening (for example, a hinged trap door) for access and egress to and from the scaffold.



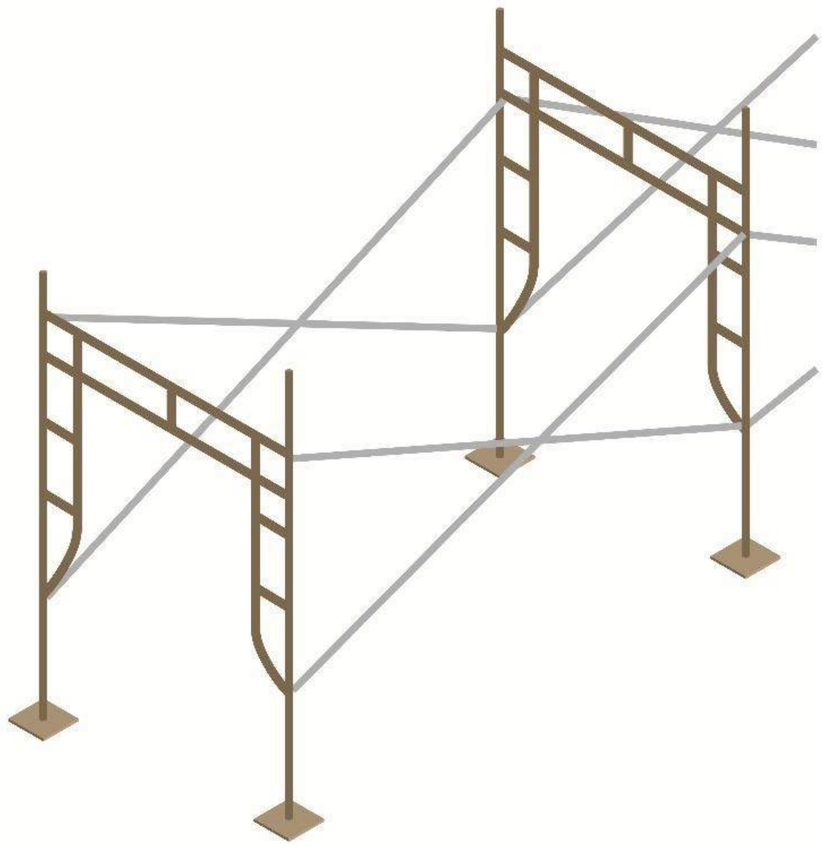
The trapdoor on scaffolding should remain closed unless workers are exiting or entering the scaffold

- Select the appropriate size and capacity castors to support the total mass of the dead and live loads of the scaffold.
- Use castors that have the working load limit clearly marked.
- Castors fitted to standards should be locked before erection continues.
- Castors with adjustable legs should be used and adjusted to keep the platform level when the supporting structure is at different heights.



Adjustable castors are helpful, when working on a level surface is not possible

- Incorporate plan bracing at the base of mobile scaffolds to provide greater stability.



Bracing will provide more stability to the scaffold

- Before moving mobile scaffolds check that:
    - there are no power lines or other overhead obstructions.
    - the ground is firm and level.
    - no person is on the scaffold.
    - no equipment and material can be dislodged from the platform.
    - the supporting surface is free of obstructions (a small obstruction may cause a mobile scaffold to overturn).
    - electrical equipment and leads cannot be tangled.

- Brakes on castors are to be locked at all times unless moving the scaffold.
- Never move the scaffold in windy conditions.
- Push or pull the mobile scaffold from the base - never use powered vehicles to move the scaffold.

Do not use powered vehicles to move scaffolding

- If lifting a mobile scaffold by crane, sling the scaffold at its lowest point to prevent dislodgment of scaffolding components. However, a crane should not be used to lift aluminium mobile scaffolds because the scaffolding components may fail.
- Ensure guardrails, mid-rails and toe boards are installed on all working platforms.

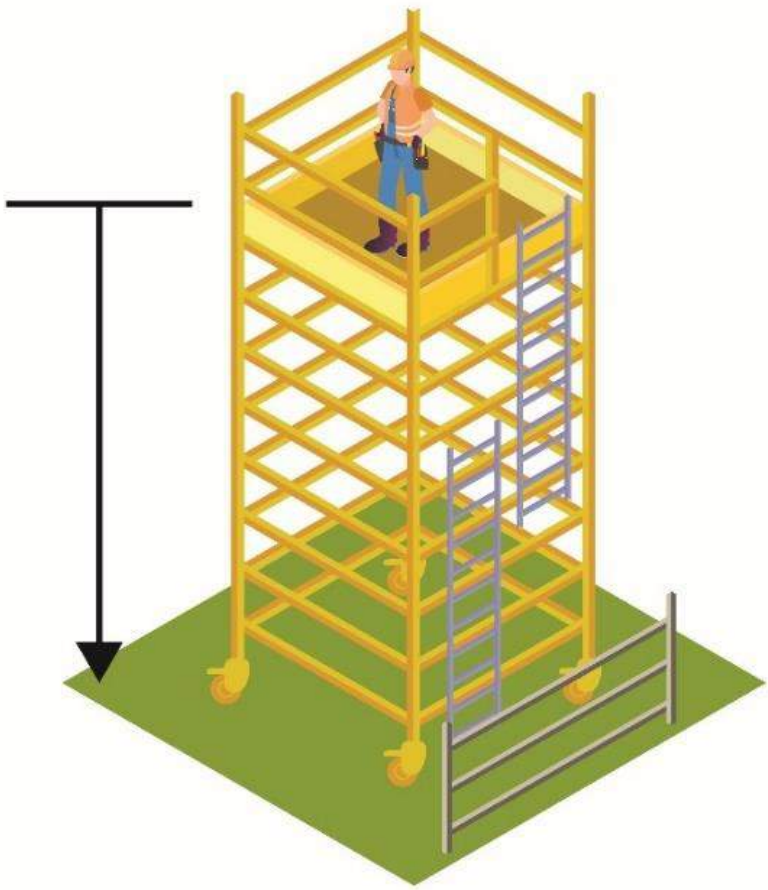
Toe Boards and Mid-Rails can prevent serious accidents.

How high can tower-frame scaffolds be safely erected?

The maximum height for which the particular tower-frame scaffolding system has been designed should be clearly stated in the supplier's documented safe-use information.

The freestanding height of a light duty aluminium tower-frame scaffold with a base width of less than 1.2 m should not exceed twice the least base width (unless otherwise specifically stated in the supplier's documented information).

The height of any light-duty tower-frame scaffold should not exceed 9 m (unless otherwise specifically stated in the supplier's documented information).



The height of a scaffold is regarded as being the vertical distance from the supporting structure to the highest working platform of the scaffold.

How many working platforms can a tower-frame scaffold have?

The maximum number of working platforms the particular tower-frame scaffolding system has been designed to support should be clearly stated in the supplier's documented safe-use information. If this is not clearly stated, then only one working platform should be used.

Note: *A working platform should be the full width of the scaffold frames. Most systems include prefabricated platform units (usually about 600 mm in width) which can be positioned side-by-side to form the platform. Some older steel systems are designed to be used with cleated timber scaffold planks. Intermediate platforms are generally installed for access purposes only, not as working platforms.*

What are the requirements for a ladder access provided to a tower-frame scaffold?

Generally, a ladder access to a platform supported by a tower-frame scaffold should be constructed within the framework with a hinged trapdoor in the working platform. (See illustration on the right.)

The ladders should be single, industrial-grade ladders. They should:

- be pitched at a slope of not less than 1:4 and not more than 1:6 (horizontally to vertically).
- be secured against displacement.

- be provided with landings at the head and base; except where the ladder rests on a fully covered supporting structure, the base landing may be omitted.
- extend at least 900 mm above landings.

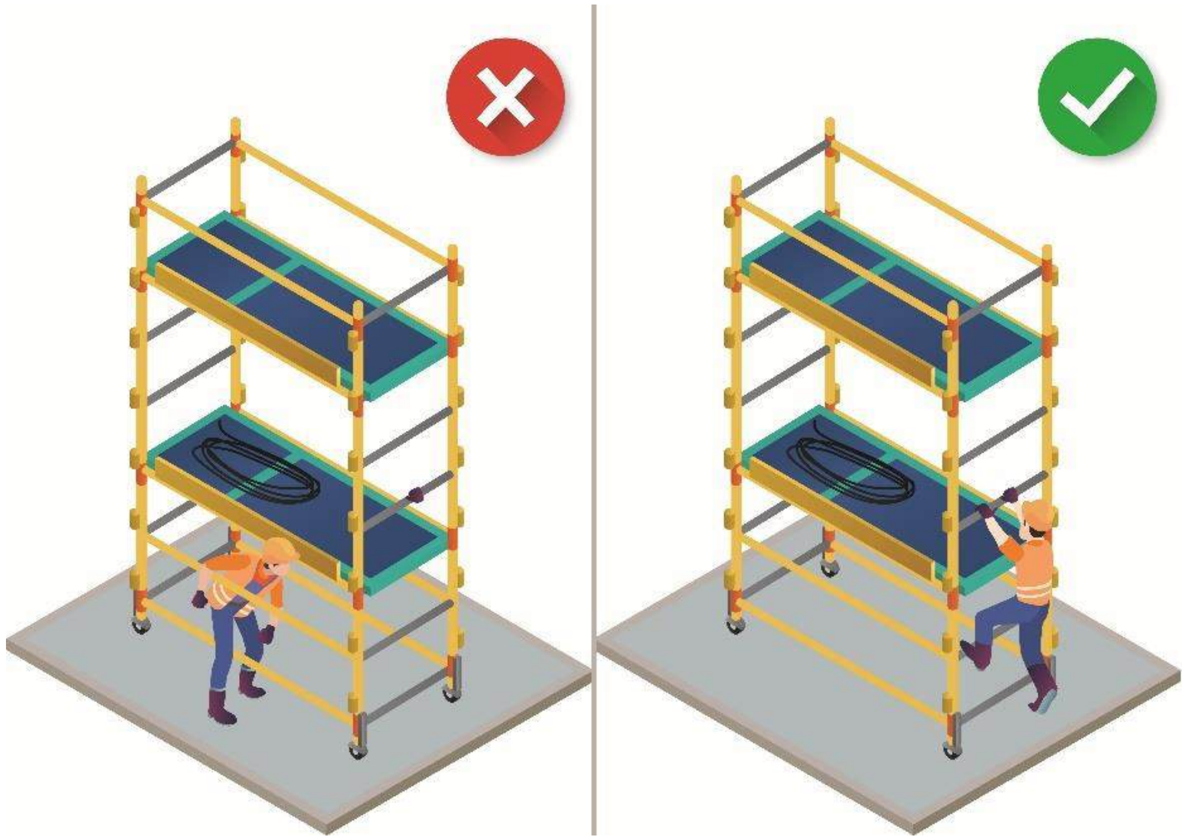
The height between ladder landings should not exceed 4 m. Ladders on mobile scaffolds need to be clear of the supporting surface.

Are the access requirements the same for low-height tower-frame scaffolds?

- Every scaffold working platform must have a safe and suitable means of access and egress.
- The suitability of forms of access and egress depend upon several factors, including the actual environment in which the scaffold is used and the platform's height above the supporting surface.
- Making people climb into the scaffold's framework in a crouching position in order to reach an internal ladder is a risk to their health or safety.
- Attaching angled external ladders to small and light aluminium tower-frame scaffolds is also not an acceptable form of access because of the potential instability of the scaffold to which this could give rise.

Never use an outside ladder to enter the scaffold

- When the scaffold is set up on enclosed floors or similar areas where a person could not fall from the platform more than 2 metres, and where the height of the working platform above the supporting service does not exceed 2 metres, the means of gaining access to the working platform that presents the least overall risk of injury is to climb the scaffold's end- frames, but not the diagonal braces.
- Where end-frame climbing is used for platforms of up to 2 metres in height, there should be no obstruction at the point of access, such as from a toe-board or a guardrail.



The incorrect and correct methods of entering a scaffold

At what height is edge protection required on tower-frame scaffolds?

Generally, wherever a person or object could fall a distance of 2m or more from a platform, edge protection in the form of guardrails, mid-rails and Toe Boards is required to be fitted to all open sides and ends of the platform.

Situations where edge protection should be provided regardless of the height include:

- where the type of work to be undertaken from the scaffold makes it difficult for the worker to be fully aware of the location of the platform edge.
- where the work involves restricted vision such as welding and oxyacetylene cutting.
- where workers on scaffolds are adjacent to impalement hazards such as exposed reinforcement bars or star pickets.

Unless Mid-Rails or Toe Boards are installed, workers are at risk of falling onto hazardous objects

What is the load limitation on a tower-frame scaffold?

Working platforms on scaffolds are generally rated as light, medium or heavy duty. The duty rating for a particular scaffold should be established from the supplier's information.

The load limits for these duty ratings are as follows:

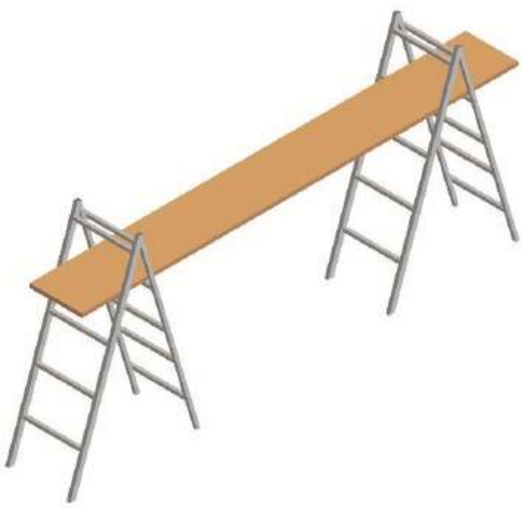
- **Light duty** - up to 225 kg per full-width platform per bay. This is usually suitable for plastering, painting, electrical work, and other light tasks.
- **Medium duty** - up to 450 kg per full-width platform per bay. This is usually suitable for general trades work.
- **Heavy duty** - up to 675 kg per full-width platform per bay. This is what is generally needed for bricklaying, concreting, demolition work and most other work tasks involving heavy loads or heavy impact forces.

These safe load limits include the weight of people (which is taken to be a nominal 80 kg per person), plus the weight of any materials, tools and debris on the platform.

Therefore, a properly constructed scaffold with a light duty working platform can safely support 1 worker and 145 kg of tools and material, or 2 workers and 65 kg of tools and materials.

Trestle scaffolds

Heavy duty trestle scaffolds and split-head trestle scaffolds can provide simple and inexpensive catch platforms. The latter are particularly effective in openings and stairwells.



Trestle scaffolds are commonly used in stairwells

Trestle scaffolds may be used at heights greater than 2 metres only when guard-railing and toe-boards are incorporated to prevent people and material falling off the open side or end of the working platform. The system (including planks) should be assembled according to the manufacturer's specifications. Trestle scaffolds without guard-railing are only suitable for tasks requiring a work platform of less than 2 metres. Some trestle ladder scaffolds include outriggers to increase stability. Trestle ladder scaffolds are only suited to light duty tasks such as painting and rendering.

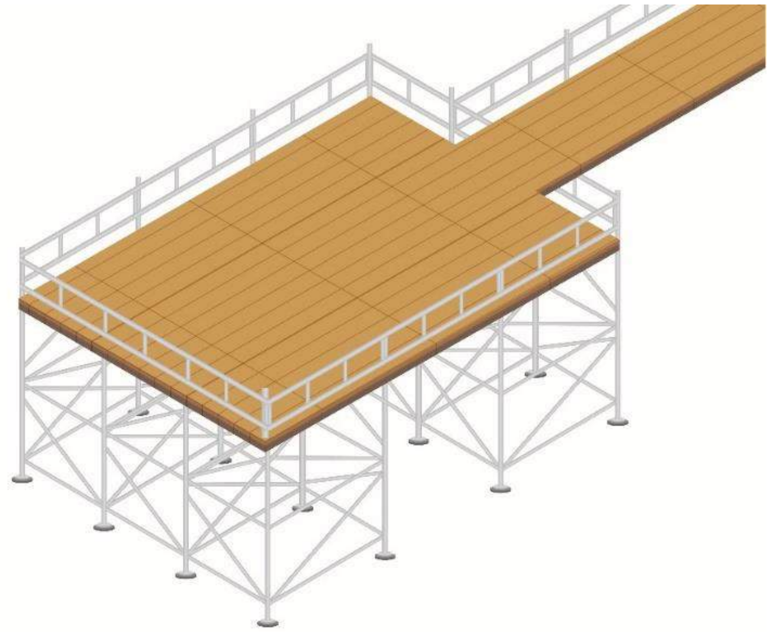
When adjusting the height of a trestle scaffold, make sure that only the purpose-designed pins are used. Do not use nails or pieces of reinforcing bar.

Work should only be performed between the trestles. The working platform of a trestle scaffold should be a minimum of two planks or 450 mm wide. The maximum spacing of trestles should not exceed the maximum recommended span of the scaffold planks. Where this information is not known, reference should be made to the table below.

Nominal thickness of plank	Maximum span
38 millimetres	1.5 metres
50 millimetres	2.0 metres
63 millimetres	2.5 metres

Birdcage scaffold

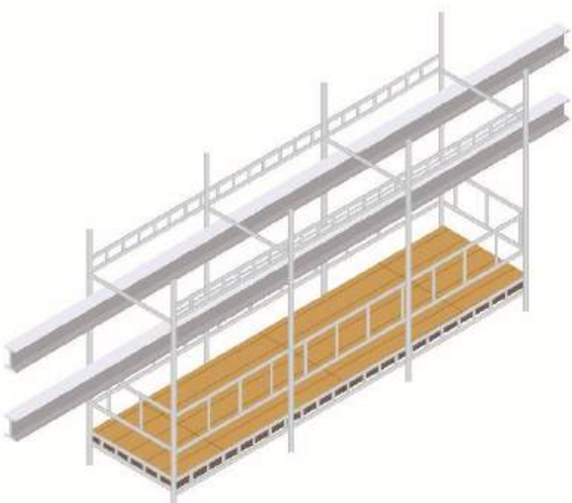
A birdcage scaffold is an independent scaffold that has more than two rows of standards in both directions that are connected by ledgers and transoms. It is mainly used for work carried out on a single level, for example ceilings. You should refer to its specifications when erecting and dismantling birdcage scaffolds made from modular scaffolding.



Birdcage scaffolds are commonly used when a large area of work is required

Hung scaffold

A hung or hanging scaffold is an independent scaffold that hangs from another structure but can't be raised or lowered when in use.



Hung scaffolds are often attached to I-beams

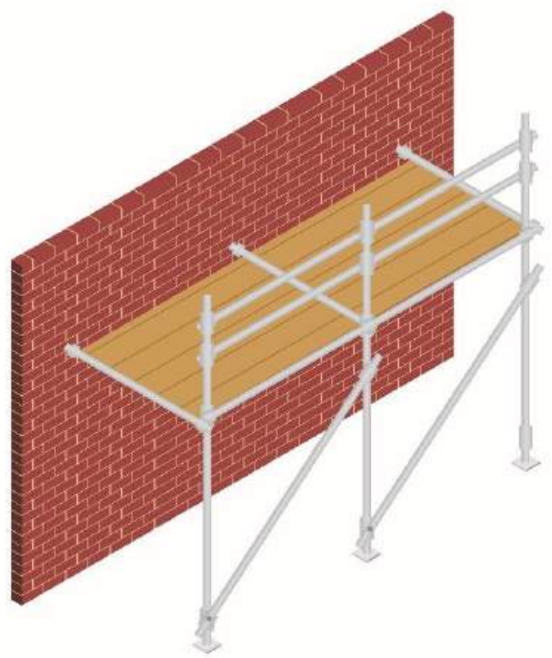
The following control measures should be implemented for a hung scaffold:

- the hung scaffold should be designed by a competent person and verification obtained that the structure that is to support the hung scaffold is capable of bearing the load.
- the scaffolding plan should include information about the position of the check couplers.
- if a cantilevered suspension rig is to be used, information should be included on how the rig is to be constructed and secured.
- standards on a hung scaffold should be tension spliced.
- all vertical hanging tubes are to be provided with check couplers at the suspension points and underneath the platform.

Single pole scaffold

A single pole scaffold consists of a single row of standards connected by ledgers. Putlogs are fixed to the ledgers and built into the wall of the building or structure.

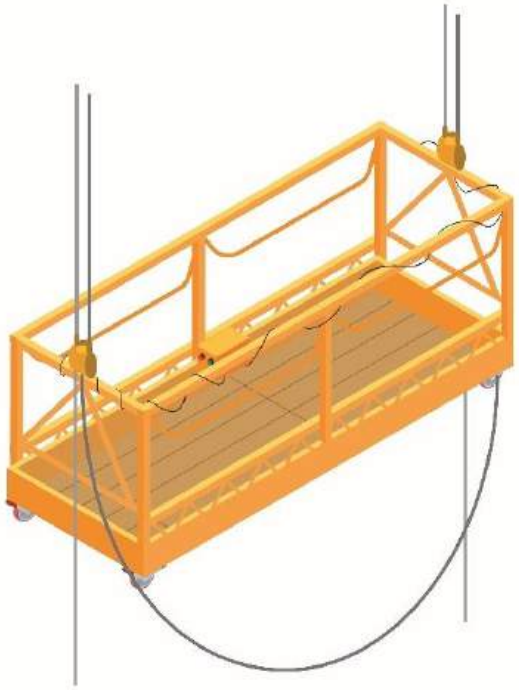
A single pole scaffold is dependent on the structure against which it is placed for support. It is important that no components of this type of scaffold are removed until the scaffold is being dismantled.



Single Pole scaffolds require a strong stable structure to attach to

Suspended (swing stage) scaffold

A suspended scaffold incorporates a suspended platform capable of being raised or lowered when being used. An example of a suspended scaffold is a swing-stage scaffold.



Suspended scaffolds are commonly used by window cleaners on high-rise buildings

Cantilevered scaffolds

Cantilevered scaffolding is a form of scaffolding that is usually used to overcome obstacles that prevent a scaffolding tower being erected, or reduce the chances or damage occurring to the structure beneath the cantilevered area.

Cantilevered scaffolds are commonly used when the ground below is unstable

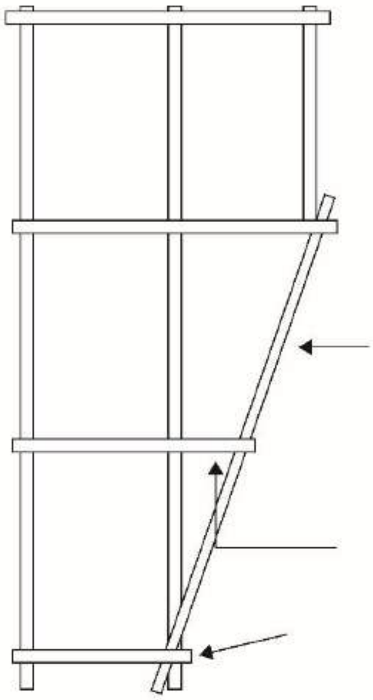
Cantilever or needle is used under the following circumstances: (i) ground is weak to support standards. (ii) when the upper part of the wall is to be carried out. (iii) it is required to keep the space, near the wall, free for a walk and for traffic, etc.

The following risk control measures should be implemented for a cantilevered scaffold:

- design and position cantilever beams in accordance with the engineer's requirements and the scaffolding plan.
- ensure a competent person certifies that the supporting structure can support the cantilevered scaffold.
- use the following preferred methods for fixing the inboard length of the cantilevered beam to the structure:
    - fix the beam to the floor below using a positive fixing (for example, a U-bolt fitted over the beam and through the concrete floor slab).
    - use counterweights on the beam, or
    - install props to the top of the beam and to the under-side of the floor above. Ensure the props are fixed to prevent dislodgement.

Spur scaffold

A spur scaffold is a scaffold supported by inclined load-bearing members. Tube and coupler scaffolds are built from tubing (tube) and joining or fixing components (couplers) fixed together, to form a required scaffold design. They are frequently used on structures with unusual design, shape or function.



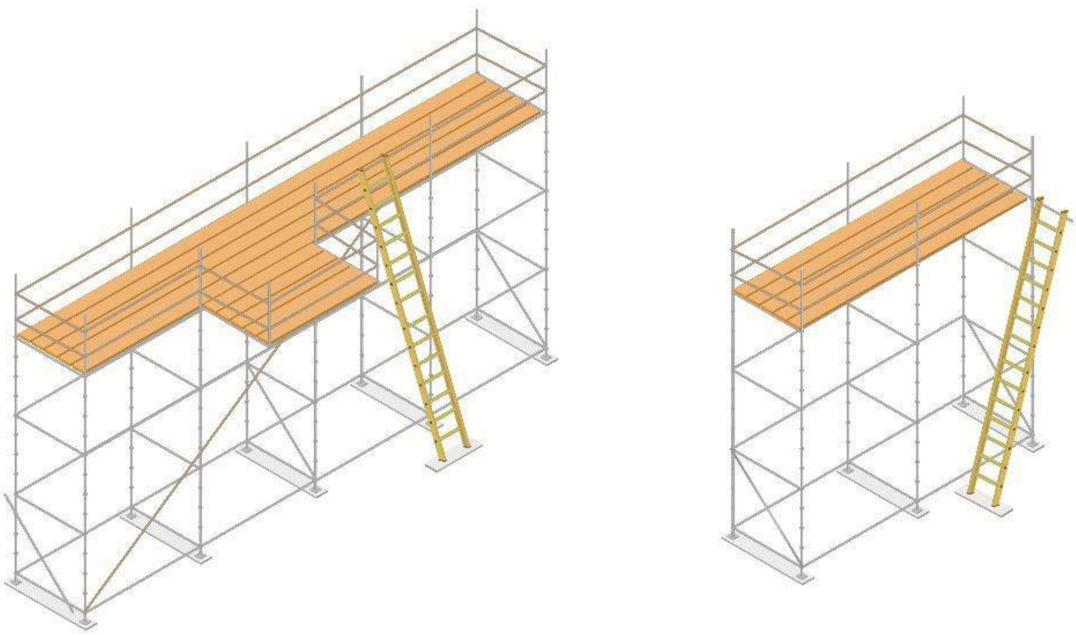
Spur Scaffolds are used to negate unusually shaped structures

The following control measures should be implemented for a spur scaffold:

- fix propping systems between the floor and ceiling at intervals to suit the spacing of the standards within the scaffold.
- provide suitable headstocks at the top of each propping system to distribute the loads imposed.
- ensure all propping systems are securely tied together and braced.
- brace spurs exceeding 1.8 metres in length in both directions at the centre, unless designed otherwise.

Tube and coupler scaffold

Tube and coupler scaffolds are so named because they are built from tubing connected by coupling devices. Due to their strength, they are frequently used where heavy loads need to be carried, or on structures with unusual design, shape and locations. The versatility of tube and coupler scaffolds enables them to be assembled in multiple directions in a variety of settings.



Tube and Coupler Scaffolds are commonly used when heavy loads are used

When using tube and coupler scaffolding consideration should be given to the diameters and strength of the tube and components being used to form the scaffold. Steel tubes and aluminium tubes should not be mixed in the one scaffold, except for guardrails, mid-rail or other members that are not structural members.

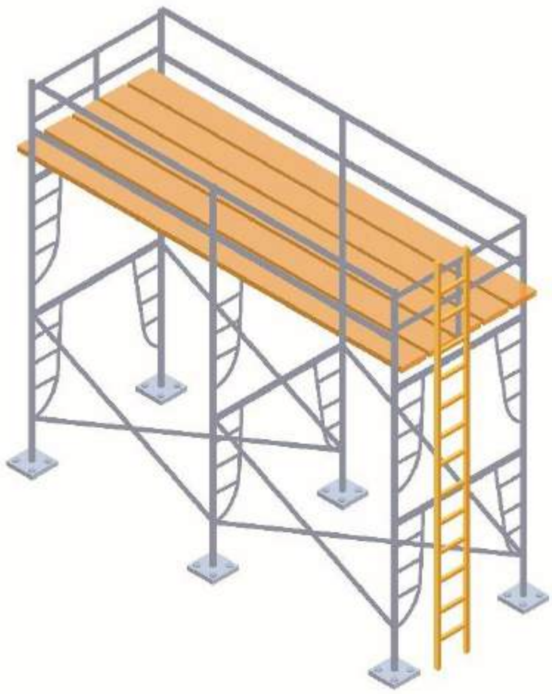
For a scaffold incorporating plain steel tube, the analysis and design should consider the most adverse combination of tubes by wall thickness, strength of the tube material, or both.

Except where used as standards, tubes of different wall thicknesses must not be interconnected by spigots or internal-type end-to-end couplers, unless additional measures are taken to positively secure the joint, such as by fixing a short tube with swivel couplers over and parallel to the joint (scarfing), or by fixing a bridle with right-angle couplers to the adjacent members.

Metal tube and coupler components should be regularly inspected for damage and particular attention given to crushing, deformation, cracks, corrosion and splitting.

Frame scaffold

Frame scaffold is a scaffold assembled from prefabricated frames, braces and accessories. Frame scaffolds such as ‘A’ and ‘H’ frame trestle scaffolds are commonly used by bricklayers, plasterers and painters, and for general fit-out and finishing work.



Frame Scaffolds come prefabricated

Frame scaffold should be erected and dismantled by a competent person in a progressive manner to ensure both the installers safety and the stability of the overall structure and braces should be attached to the frames in accordance with the manufacturer’s or supplier’s instructions. As the height of frames increase, there is a greater need to provide lateral stability to the frames.

Frame scaffold should be stable and erected on a suitable foundation to ensure it can adequately carry and distribute the loads such as materials and workers evenly to each frame. Measures to control instability and prevent possible toppling can include the use of ties to a permanent structure or using outriggers.

Frame scaffold should:

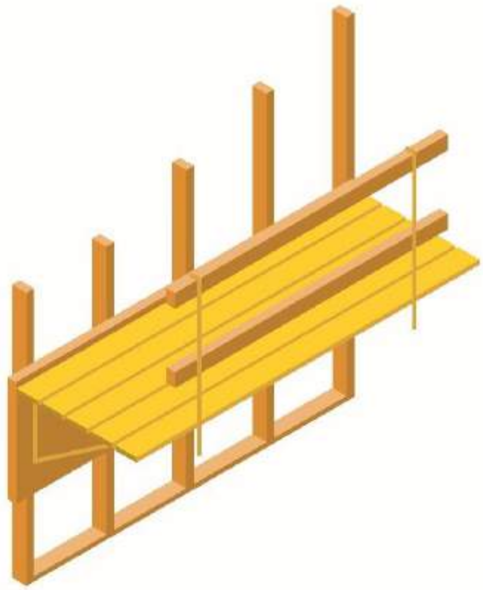
- install barriers (or edge protection) where the potential fall exceeds 2m or the fall area contains hazards such as sharp objects - e.g., steel reinforcing bars.

- support the relevant live load or duty rating - not exceeding load limit. Note: the full width of a frame trestle must be fully planked, irrespective of the duty rating.
- have scaffold planks that are uniform and in good condition (no splits, cracks, knots, bends, etc), overhang their end supports between 150–250 mm and are secured against uplift.
- establish a horizontal work platform. On sloping or uneven ground use a frame trestle that incorporates height adjustment. Do not use bricks or blocks as soleplates.
- have a safe means of access and egress - e.g., by secured ladders or from the building if approximately level with the platform.
- have a safe means to load material onto the working platform - e.g., use mechanical means or, if this is not practicable, pass (do not throw) material up to the working platform.
- control the movements of multiple persons - e.g., do not walk around others on 2-plank platforms.

Most bracing systems for tubular frame scaffolds are manufactured from light materials and are easily damaged by misuse or abuse so care should be taken during installation and dismantling. Under no circumstances should anyone climb the braces or frames.

Hanging bracket scaffold

Hanging bracket scaffolds are systems supported by frames on buildings or other structures. Hanging brackets are sometimes in the shape of an upside down ‘L’, one arm of which is fixed to a vertical surface, the other projecting horizontally to support scaffold planks.



Hanging Bracket scaffolds can be used to install or repair roofing

Other hanging bracket scaffold systems may include horizontal members that are supported by floors of buildings or other structures.

The following risk control measures should be implemented for hanging bracket scaffolds:

- Provide a safe means of access for persons installing hanging brackets.
- Use connectors where differential deflection becomes a tripping hazard.
- Use an engineer to design hanging bracket scaffolds and their means of support. Engineering verification may be provided by calculation and/or load testing.
- Supporting structure should be able to support dead and live loads applied by the hanging brackets.
- Where hanging bracket scaffold is to be used as a fall arresting platform ensure that spacing of brackets does not exceed the maximum plank spans specified by the manufacturer.
- Planks may overlap planks on straight runs on hanging bracket scaffolds (where butting of planks at a pair of brackets cannot be achieved), provided the overlap is at least 300 mm.

Designing the scaffold

The first step in controlling the identified risks should be at the design stage where the focus is on eliminating risks through good design & setup of:

- scaffolding and its individual components.
- the scaffold structure.
- work systems and processes for the safe erection, alteration and dismantling of the scaffold.

The scaffold structure

The scaffold designer or person responsible for deciding what type of scaffold is to be used on your construction site, will be responsible for selecting the appropriate scaffolding and preparing a scaffold design for the job. They design the scaffold installation.

The scaffold designer should consider:

- the intended use of the scaffold.
- hazards and risks for people who erect, dismantle, use or are near the scaffold.
- the foundations including ground conditions.
- the load bearing capacity of the surface where the scaffold is to be erected or the suspension systems for hung or suspended scaffolds.
- dead loads e.g., resulting from the size and weight of the scaffold.
- live loads e.g., workers, plant and material on the scaffold.
- environmental loads e.g., wind loads.
- bracing, tying and anchors - where anchors will be placed on the supporting structure and types of anchors to be used.
- supporting structures.
- edge protection.
- protection against falls and falling objects.

- containment sheeting, and safe entry and exit.

Where necessary, improved scaffold stability may be achieved by:

- tying the scaffold to a supporting structure.
- guying to a supporting structure.
- increasing the dead load by securely attaching counterweights near the base.
- adding bays to increase the base dimension.

Scaffolds should be designed by a competent person, for example a person holding a relevant scaffolding high risk work licence.

The system of work

Systems of work should be clear but flexible to meet changing circumstances as the work progresses. The system of work should provide for the assessment and control of any new risks arising from proposed changes to the work before they are implemented.

A documented safe system of work is an administrative control. For scaffolding work this could include consideration of:

- worker competency and licensing requirements.
- consultation and coordination of the work with others.
- access and exit.
- exclusion zones.
- permit-to-work systems.
- fall arrest systems.
- inspection and maintenance.
- emergency arrangements, and
- changes to the work arrangements.

Competency and licensing

A person who erects, alters or dismantles any scaffold must be competent to do the work safely. A person undertaking scaffolding work must hold the relevant class of scaffolding high risk work licence. The scaffolding high risk work licence classes are:

- Basic scaffolding licence - required for scaffolding work involving:
    - modular or prefabricated scaffolds.
    - cantilevered materials hoists with a maximum working load of 500 kilograms.
    - ropes.
    - gin wheels.
    - fall arrest systems including safety nets and static lines, and

    - bracket scaffolds (tank and formwork).

- Intermediate scaffolding licence - required for scaffolding work involving:
    - cantilevered crane loading platforms.
    - cantilevered scaffolds.
    - spur scaffolds.
    - barrow ramps and sloping platforms.
    - scaffolding associated with perimeter safety screens and shutters.
    - mast climbing work platforms, and
    - tube and coupler scaffolds including tube and coupler covered ways and gantries.

- Advanced scaffolding licence - required for scaffolding work involving:
    - cantilevered hoists.
    - hung scaffolds including scaffolds hung from tubes, wire ropes or chains, and
    - suspended scaffolds.

A person who erects, alters or dismantles a scaffold where there is a risk of a person or object falling four metres or less from the platform or structure does not require a high-risk work licence. This sort of work may involve tasks like erecting a small frame scaffold to repair the eaves of a house or to paint a ceiling. These types of scaffolds are not generally used to provide a work platform at a height in excess of one storey or for use by many workers at once.

Safe work method statements for construction work (SWMS)

Erecting a scaffold or work on a scaffold may involve activities defined as high-risk construction work.

High risk construction work includes any construction work where there is a risk of a person falling more than two metres. Scaffolding work is defined with a four-metre threshold for licensing purposes. This means in some cases a high-risk work licence may not be required to erect a scaffold—because it is less than four metres - but there may still be need for a SWMS because it is more than two metres.

High risk construction work also includes work which:

- involves structural alterations or repairs that require temporary support to prevent collapse.
- is carried out on or near energised electrical installations or services, and
- is carried out in an area at a construction site in which there is movement of powered mobile plant.

A SWMS must be prepared for high-risk construction work before the work starts. The SWMS must:

- identify the type of high-risk construction work being done.
- specify the health and safety hazards and risks arising from the work.

- describe how the risks will be controlled, and
- describe how the control measures are to be implemented, monitored and reviewed.

The SWMS must be developed in consultation with workers and their representatives who are carrying out the high-risk construction work.

Scaffolding plan

Where required, a SWMS will set out the work method to safely erect, use and dismantle a scaffold. Where a SWMS is not required, a scaffolding plan will help identify ways to protect people who are:

- erecting, using, maintaining, altering and dismantling the scaffold, and
- near the scaffold or scaffolding work e.g., other workers and members of the public.

For more complex scaffolds a scaffolding plan should be prepared by a competent person. In preparing a scaffolding plan the person should consult with a range of other people relevant to the work and construction site, for example:

- the scaffold designer e.g., to discuss the design loads and the capability of the structure to support extra loadings.
- the scaffolding contractor or builder - this may be the person conducting a business or undertaking or a principal contractor - e.g., to assess where underground drains or pits and underground services are located. The work should be planned to avoid excavating service trenches under, through or adjacent to scaffolds.
- workers, work health and safety committees and health and safety representatives regarding erecting, maintaining, altering and dismantling the scaffold.
- other competent people familiar with similar structures e.g., an engineer or a person holding an intermediate or advanced scaffolding high risk work licence, and
- the electricity supply authority if the scaffold is being erected near overhead electric lines.

The scaffolding plan should include a site layout plan and detail the elevations and sections of the scaffold. It should be kept at the construction site if reasonably practicable or be readily accessible near the scaffold should it be required. The scaffolding plan should address:

- basis of design.
- type of scaffold.
- foundations including ground conditions.
- the weight bearing capacity of the surface where the scaffold is to be erected.
- dead loads e.g., resulting from the size and weight of the scaffold.
- live and environmental loads e.g., wind loads.
- containment sheeting.
- supporting structures.
- entry and exit.

- tying and anchors - where anchors will be placed on the supporting structure and types of anchors to be used.
- bracing, and
- edge protection.

ERECTING, DISMANTLING AND MODIFYING A SCAFFOLD

The sequence of work should be planned and followed for each type of scaffold to be constructed. The sequence of work should include consideration of the following unless you have developed an alternative process that provides an equivalent or higher level of work health and safety.

Erecting a scaffold safely

Erecting a scaffold safely will include preparing the foundations for the scaffold, installing sole-boards and baseplates where required, and erecting the scaffold including for adequate access and work platforms that minimise the risk to those doing the scaffolding work and people who will use the scaffold.

Foundations

Scaffold foundations should be designed and constructed to carry and distribute the full weight of the scaffold including both dead and live loads.

Ground conditions, the effects of the weather - particularly wind and rain - and live loads should be considered when designing and preparing the scaffold foundation.

Sole boards and baseplates

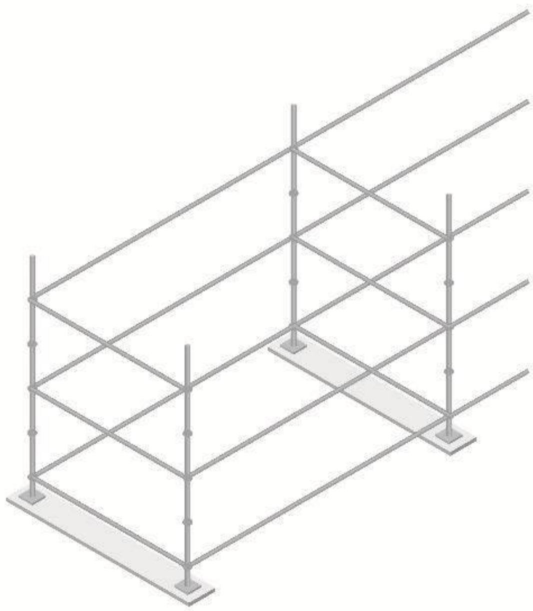
Sole boards and baseplates should evenly distribute the load from the scaffold to the supporting surface to provide scaffold stability (see below figure). A sole-board distributes the load from a load-bearing member to a supporting surface and is intended for use underneath baseplates.

Both sole-boards and baseplates may be required for use on less stable surfaces, for example soil, gravel, or fill. The size of the sole board will vary depending on the supporting surface. They can be placed under a single standard or multiple standards.

Where necessary a competent person should determine the bearing capacity of the ground or other supporting structure.

Sole-boards and baseplates should be level. Adjustable bases can be used on uneven surfaces for modular scaffold systems to give a level base lift. No part of the baseplate or adjustable base should protrude over the side of the sole-board to ensure the loads are carried evenly on the sole-board.

Needles and spurs should be considered where ground conditions are very unstable.

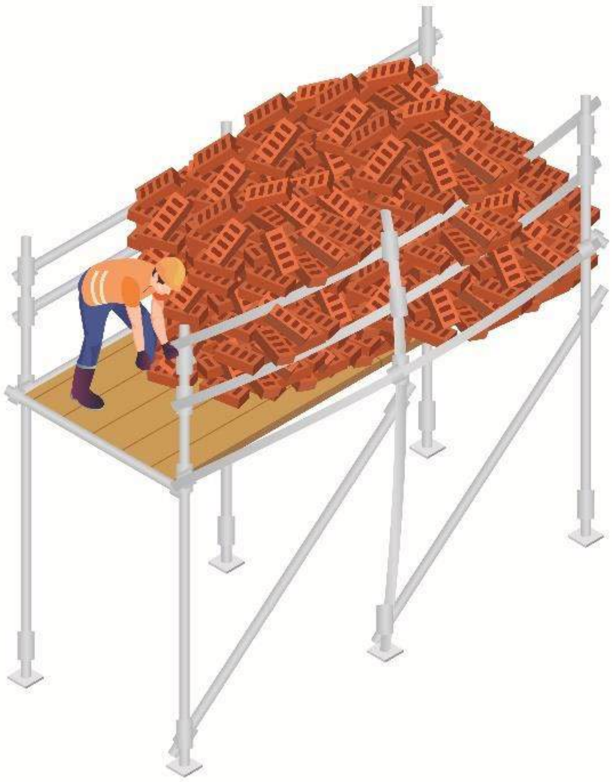


Sole boards and Baseplates provide stability to the scaffold

Scaffold erection

The following safe work practices should be used when erecting a scaffold:

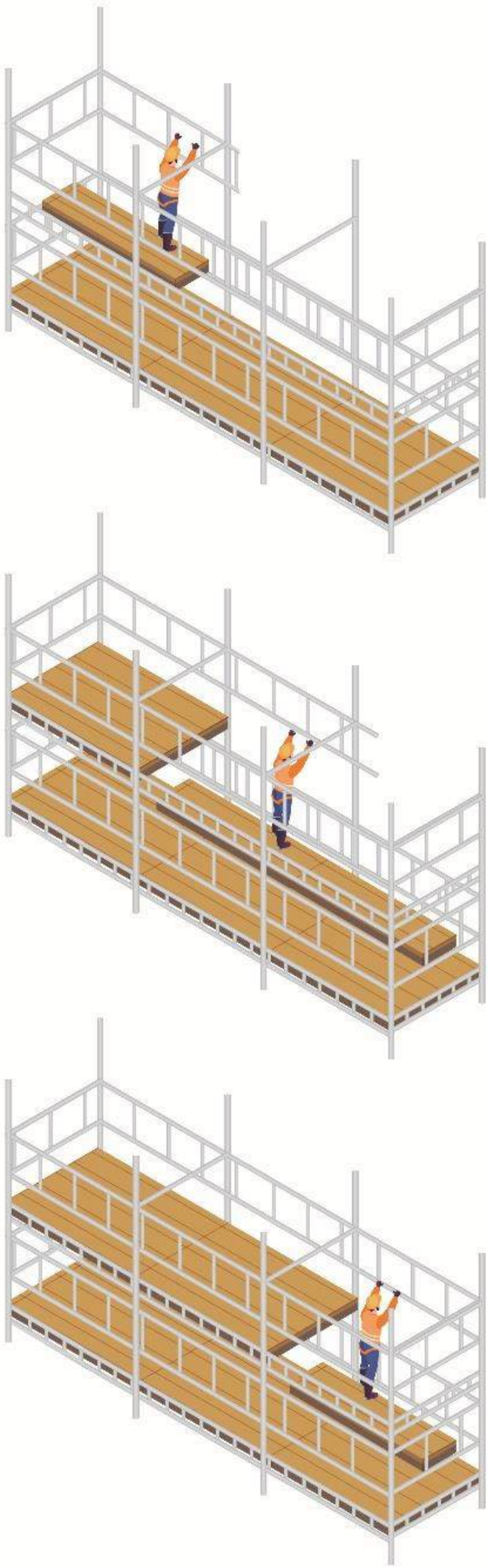
- Develop and follow a methodical work sequence - e.g., in a SWMS or scaffolding plan.
- Scaffold fittings and other connections should be securely tightened where required. Fittings should be in accordance with the manufacturer's or designer's specifications and the scaffolding plan.
- Scaffolding including all bracing and ties, guy ropes or buttresses should be installed as the scaffold is erected.
- Consider using specifically designed loading platforms or back propping to prevent overloading the building floor or the scaffold.
- Get certification from a competent person before erecting scaffold on awnings.
- Check live loads arising from the work of erecting or dismantling the scaffold are within the specification for the final design - the number of workers on the scaffold at any one time may need to be limited.
- Work from a full deck of planks whenever possible.
- Do not overload scaffold bays with scaffolding awaiting installation.



Do not overload the scaffolding

- Do not climb on guardrails to gain extra height.
- Do not climb on outside of scaffold.
- Implement measures to control the risk of a fall if the internal gap - the gap between the inner edge of the length of the platform and the face of the building or structure immediately beside the platform - on scaffolds including hanging bracket scaffolds is greater than 225 mm. For example, install:
    - edge protection, and
    - extra scaffold planks to minimise the size of the internal gap.

The below figures show an example of workers erecting scaffold.



Scaffolding should be erected one level at a time

In this example the scaffold is being erected against an existing building so guardrails are only needed on external faces. Access ladders and Toe Boards have been omitted for clarity. After enough components of the scaffold have been erected to support it, immediately install:

- a platform at least 450 mm wide along the full length of the section of scaffold.
- edge protection across the space between the standards forming the outer frame of the scaffold at the level the scaffold has reached, and
- a way to access the scaffold e.g., temporary stairs or a ladder to the level the scaffold has reached.

Before the next level of the scaffold is erected, a platform should be installed not more than two metres below the position of the next level. When erecting scaffolding:

- a section of the platform may be left open to allow the passing of planks or other scaffolding between levels.
- a platform may be removed after work has started two levels above the level from which the platform is to be removed.
- over or beside water, risk controls may include alternative erection methods, for example prefabrication away from the water and installation by crane.
- the scaffolding should be checked, and any defective scaffolding should be clearly marked with paint or tags so it is identified and can be removed from the work area to prevent use.

Tying and anchoring

Tie methods and spacing should be in accordance with the manufacturer, designer or supplier instructions. Consult the scaffold designer, manufacturer, supplier or an engineer if it is not practical to position the ties in accordance with the instructions.

Control measures for tying scaffold include:

- using more ties if:
    - the scaffold is sheeted or netted due to increased wind loadings.
    - it is used as a loading platform for materials or equipment, and
    - lifting appliances or rubbish chutes are attached.
- regularly inspecting scaffold ties to check they are not modified or altered by unauthorised people e.g., finishing trades who may loosen, relocate or remove ties to gain access to walls and openings.
- not attaching extra loads to the scaffold e.g., signs and perimeter containment screens, without first consulting a competent person like the scaffold design engineer or the supplier.
- using cast-in anchors or through bolts that pass through a wall in preference to expansion or chemical anchors for securing scaffold ties because of possible failure due to faulty tensioning or chemical adhesion.

- deformation-controlled anchors, thread cutting anchors and insert type anchors should not be used.
- drill-in expansion anchors should be limited to the load (torque) controlled type - the working load limit (WLL) should be limited to 65 percent of the 'first slip load' stated in the information provided by the supplier.
- all drill-in expansion anchors should be installed using a torque wrench set to the required torque, unless the anchor has an in-built torque indicator. Documented verification should be kept on site stating:
  - the anchor setting torque.
  - install date, and
  - location and name of the competent person installing the anchors.

- where chemical anchors are used, all anchors should be tested, and proof loaded to the working load multiplied by a factor of 1.25.
- all insert anchors including expansion and chemical anchors should have a safety factor of 3 to 1 on their failure load. If any anchors fail the remaining anchors on the same level should be tested.
- ties should not obstruct access along the working and access platforms.
- ties should interconnect with both the inner and outer scaffold standards unless otherwise specified by an engineer to increase the rigidity of the scaffold.
- ties from scaffold to structure should be designed to be non-pivoting and fully secured to ensure they cannot be loosened.

Working platforms

Working platforms, except suspended scaffolds, should have duty classifications and dimensions complying with the manufacturer's information on loadings. Scaffold working platforms are generally rated as light, medium or heavy duty:

- Light Duty - up to 225 kg per platform per bay including a concentrated load of 120 kg. Platforms should be at least two traditional scaffold planks wide - approximately 450 mm. Use examples include painting, electrical work, many carpentry tasks and other light tasks.
- Medium Duty - up to 450 kg per platform per bay including a concentrated load of 150 kg. Platforms should be at least four traditional scaffold planks wide - approximately 900 mm. Use examples include general trades work like tiling and light steel framing.
- Heavy Duty - up to 675 kg per platform per bay including a concentrated load of 200 kg. Platforms should be at least 1000 mm wide. This duty scaffold is needed for concrete block laying, bricklaying, concreting, demolition work and most other tasks involving heavy loads or heavy impact forces.
- Special Duty - has a designated allowable load as designed.

Each scaffold should be designed to carry the required number of working platforms and to support the dead and live loads. Where tools or materials are to be used or stored on working platforms, an unobstructed access width of at least 450 mm should be maintained.

Scaffold planks on working platforms should:

- have a slip-resistant surface.
- not be cracked or split.
- be of uniform thickness.
- be secure - so it cannot be kicked off or susceptible to uplift or displacement during normal use.
- be positioned so no single gap between planks exceeds 10 mm, and
- not be lapped on straight runs of modular and tube and coupler scaffolding but may be lapped on hanging bracket scaffolds where butting of planks at a pair of brackets cannot be achieved.

Lapped scaffold planks may sometimes be used to cover gaps around corners of scaffold. These planks should be safely secured. In some circumstances they may not need to be secured provided the following are met:

- timber is lapped over metal planks.
- planks are 1.2 metres long or greater.
- plank overlap - past the edge of the plank underneath - is 300 mm or greater, and
- standards prevent planks from moving sideways on the scaffold.

In these cases, wind forces should be considered and if wind is a potential hazard then the lapping planks should be secured.

If using plywood sheets to cover gaps between scaffold bays the plywood sheets should be:

- a minimum of 17 mm thick.
- only used to cover gaps less than 500 mm wide unless approved by an engineer, and
- secured.

Metal planks lapped on other metal planks should be secured using fixings, for example metal strapping. Tie wire or another system not structurally rated should not be used to secure planks on hop-up brackets.

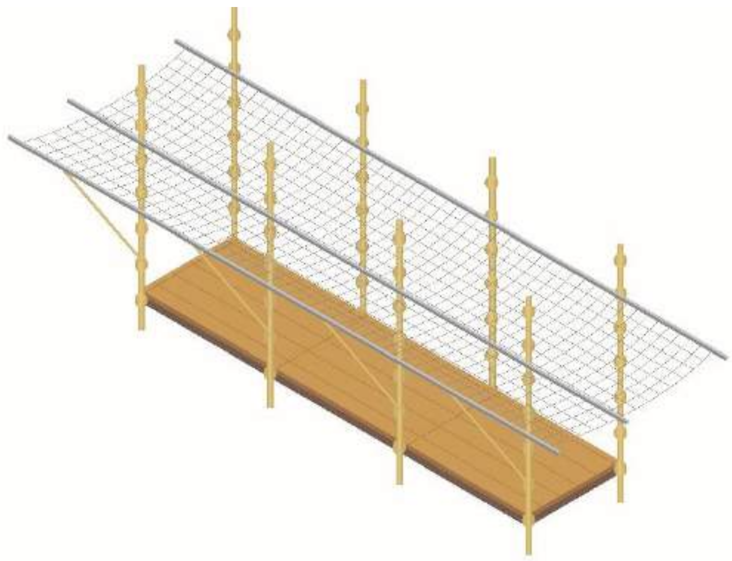
More generally:

- planks should be secured.
- each hop-up bracket should be provided with tie bars unless constructed with scaffold planks locked into position to stop brackets from spreading apart or causing planks to dislodge unless otherwise specified by the scaffold designer.
- the overhang of planks which are supported by putlogs should be greater than 150 mm but less than 250 mm - otherwise uplift might occur.
- avoid nailing or screwing laminated planks into position unless otherwise specified by the manufacturer. Moisture penetrating the planks can cause damage and may not be easily

detected.

Catch platform

A catch platform is a temporary platform located below a work area designed to catch a falling person. The platform should be of robust construction and designed to withstand the maximum potential impact load. Scaffolding components may be used to construct fixed and mobile catch platforms.



An example of a Catch Platform

Catch platforms should:

- incorporate a fully planked-out deck.
- be positioned so the deck extends at least 2 metres beyond all unprotected edges of the work area, except where extended guard-railing is fitted to the catch platform.
- be positioned as close as possible to the underside of the work area. It is recommended that the distance a person could fall before landing on the catch platform should be no more than 1 metre: and
- always be used with an adequate form of edge protection.

Dismantling a scaffold safely

The following safe work practices should be used when dismantling a scaffold:

- edge protection and a way to enter the scaffold can be removed as the scaffold is dismantled, provided it is removed at the last possible stage.
- where possible a platform of at least 450 mm wide at the level the dismantling has reached should be in place.

- ensure when dismantling the scaffold, the platform immediately below the level the worker is standing on has a full set of planks across its width and is no lower than 2 metres.
- a section of the scaffold may be left open to allow the lowering of planks or other scaffolding between levels.
- scaffolding should never be dropped in an uncontrolled way when dismantling the scaffold.

Altering a scaffold

When altering a scaffold, you should:

- consult the scaffold designer before making alterations.
- ensure scaffold alterations are in accordance with the scaffolding plan.
- ensure alterations do not compromise the structural integrity of the scaffold, and
- ensure systems are in place to identify unauthorised interference with the scaffold e.g., regular inspections.

Adjacent buildings or structures

No part of the scaffolding work should adversely affect the structural integrity of other buildings. You should ensure risks are controlled to prevent injury to people or damage to adjacent buildings or structures from the:

- collapse of the scaffold onto an adjacent building or structure, and
- collapse of an adjacent building or structure, or a part of a building or structure due to scaffolding work or related activities.

Electric lines

Electric lines whether overhead or underground can be a significant hazard. Construction work carried out on or near energised electrical installations or services is high risk construction work and a SWMS must be prepared before this work starts.

Entry and exit

Safe entry and exits are required for workers when erecting, using and dismantling a scaffold. Common means of entry and exit include:

- temporary stairs or ladder access systems installed at the start of erection and progressed with the scaffold.
- permanently installed platforms or ramps e.g., part of an adjacent building.
- personnel hoists - non-mechanical forms of exit e.g., a ladder or stair tower should be provided in case of emergency, and
- the existing floor level of a building if entry from there is safe.

Stairs should be secured to the scaffold bay. If stairs cannot be self-secured to the scaffold they should be lashed. If not secured the designer or supplier should provide documentation showing the maximum amount of clearance allowed between the transom and the top and bottom of the stair module. The gap between the end of a stair module and a transom should be as small as possible. Large gaps can lead to stairs dislodging and falling when a load is placed onto it.

Falls

A risk to health and safety associated with a fall by a person from one level to another that is reasonably likely to cause injury to the person or any other person must be managed. Hazards that may increase the risk of falls include:

- poor environmental conditions like:
  - strong winds that may cause workers to lose balance.
  - rain causing slippery work surfaces.
  - glare emitted from work surfaces or poor lighting affecting visibility.

- materials, equipment or protruding objects below or in adjoining work areas like:
  - pallets of construction materials.
  - vertical reinforcing steel.
  - rubbish skips.
  - exposed starter bars.
  - large tools.

- void areas not identified or protected e.g., ladder access voids.
- incomplete scaffolds or loose scaffolding in areas where work is being done or is likely to be done, and
- inadequate training, instruction and supervision of scaffold workers.

Passive engineering controls like handrails and edge protection can minimise the risk of a fall during work at height. Catch platforms can be used to minimise the distance a person could fall during work at height and also to catch falling objects.

Fall arrest systems should only be used during the following scaffold activities:

- Erecting or dismantling drop or hung scaffolds where the scaffold is constructed from top to bottom - this allows for a clear fall zone in the event of a fall.
- Fixing and removing trolley tracks on suspension rigs.
- Erecting or dismantling cantilevered needles and decking between the needles. Fall arrest systems could also be used when the first lift of scaffold is erected where workers are standing on the deck between the needles.
- Erecting and dismantling the first lift of a cantilevered scaffold including the first platform.
- Attaching and removing spurs projecting from the supporting structure.

Falling objects

- Falling object risk control measures include fall arrest platforms, overhead protective structures, perimeter containment screens and exclusion zones to eliminate or minimise the risk of falling objects.
- Perimeter containment screens can be made of mesh, high quality shade cloth, timber, plywood, metal sheeting or other suitable material. Before using perimeter containment screening, consider other risks like conductivity of electricity and additional dead and live loads. For example, the extra wind loading on the scaffold should be considered when selecting a screening material and the framework supporting a screen must be able to support loads resulting from the screen.
- Perimeter containment screens should be located inside the standards on working platforms or in accordance with the manufacturer's specifications. Where used, the lining should be attached to the inside of the mesh.
- The scaffold design and its ties fitted with containment sheeting should be approved by a competent person, for example an engineer with experience in structural design.

Ladders

Ladders may be used where entry to the working platform is needed by only a few people and where tools and equipment can be delivered separately to the working platform, for example by materials hoist, crane or a rope and gin wheel. Ladders used for entry to or exit from a scaffold should be:

- fixed industrial single ladders - not extensions ladders.
- located within a separate ladder access bay of the scaffold wherever space permits, and
- set up on a firm, level surface, be securely fixed and not used on scaffold bays to gain extra height above the scaffold structure.

Only fixed industrial ladders should be used on scaffolds

If the access bay is part of the working platform a trap door should be provided. Ladder entry should be far enough away from the working platform where possible to prevent people falling through openings. Engineering controls and safe work procedures should be implemented so that the trap door remains closed while working from the platform.

Platforms should also allow correct use of ladders, for example a person passing through the trap door should not need to hold it open. Gates should be self-closing and not open away from the platform.

Ladders should not be used as a work platform or to gain extra height to carry out work from a scaffold.

Fall arrest & travel restraint systems for scaffolders

The use of a safety harness as a fall injury prevention system has limited practical application for the construction of scaffolds. A harness should not be used where:

- it is possible for scaffolders to hit an object prior to their fall being arrested.
- its use would restrict the scaffolder's free movement so as to increase the risk of sprain or strain injuries.
- its use would present a risk of scaffold components becoming entangled or unbalanced during handling.
- there is no adequate and correctly positioned anchorage for lanyards or inertia reels.

Safety harnesses systems would be an acceptable control solution in the following situations when erecting or dismantling scaffolds:

- on hung scaffolds, where the scaffold is constructed from top to bottom and there is nothing for the scaffolder to strike below in the event of a fall.
- on cantilevered needles (for the erection of the first lift and later for dismantling that lift) and for decking between the needles.
- when attaching and removing spurs that project from the supporting scaffold or supporting structure.
- when fixing and removing trolley tracks on suspension rigs. (A trolley track is a suspended rail that supports and guides trolleys for swing stages, work cages, boatswain's chairs and other types of suspended scaffolding.)

NOTE: If harness systems are used, in all instances a scaffolder must not be exposed to a fall prior to being securely connected to, or after disconnected from, the anchorage point.

Ground conditions

Ground conditions should be stable and those doing the scaffolding work should be aware of any factors that may affect ground stability before the scaffold is erected or during its use.

Ground conditions should be assessed by a competent person to check the ground is stable and able to bear the most adverse combination of dead, live and environmental loads that can reasonably be expected during the period the scaffold is to be erected and dismantled and while it is in use.

Water and nearby excavations may lead to ground subsidence and the collapse of a scaffold. Any likely watercourse, for example a recently filled trench that has the potential to create a wash out under the scaffold base should be diverted away from the scaffold.

Loading

A scaffold should be designed for the most adverse combination of dead and live loads that can reasonably be expected during the period the scaffold is in use.

Dead loads relate to the self-weight of the scaffold structure and scaffolding including:

- working, catch or access platforms.
- stairways, ladders, screens and sheeting.
- platform brackets, suspension ropes, secondary ropes, traversing ropes and tie assemblies, and
- hoists and electrical cables.

Live loads include the:

- weight of people.
- weight of materials and debris.
- weight of tools and equipment.
- environmental loads e.g., wind, rain, and impact forces.

The specifications of the designer, manufacturer or supplier should be followed for the maximum loads of the scaffold. The dead and live loads should be calculated during the design stage to ensure the supporting structure and the lower standards are capable of supporting the loads that will be applied at the construction site.

If the scaffold is to be altered at the construction site, consider any new loads that may apply and consult the scaffold designer. For example, wind and rain loads may increase if perimeter containment, shade cloth or signs are attached to the scaffold. Staggering the joints in standards may help control the risk of scaffold collapse from additional environmental loads.

Scaffolds should not be used to support formwork and plant, for example hoist towers and concrete pumping equipment unless the scaffold is specifically designed for this purpose.

Mixing scaffolding from different systems

Scaffolding from different manufacturers or suppliers, while sometimes looking compatible, often has different dimensions and tolerances.

Mixing incompatible scaffolding can reduce the structural integrity of a scaffold and could lead to the collapse of the scaffold. It can also lead to increased wear on the scaffolding and difficulties in disassembly which in turn may increase the risk of musculoskeletal injury to workers.

The following controls can be used to prevent or minimise the risk of injury and scaffold collapse due to the incorrect mixing of scaffolding:

- Do not mix scaffolding from different manufacturers unless a competent person e.g., an engineer has determined that:
    - the different scaffolding is of compatible size and strength.
    - the different scaffolding has compatible deflection characteristics.
    - the different fixing devices are compatible, and
    - mixing the different scaffolding does not lessen the strength, stability, rigidity or suitability of the designed scaffold.
- Do not mix scaffolding couplers and tubing of different outer diameters and strengths unless designed specifically for the task by a competent person or the coupler manufacturer has designed the couplers for this purpose. For example, do not mix aluminium and steel scaffolding as steel clamps may cause aluminium tubing to be crushed and reduce the strength of the tube.

Beam clamps or flange clamps should be provided with information about safe use including tightening torque required. If no information is provided contact the supplier, manufacturer or designer of the scaffold.

Powered mobile machinery and traffic

Powered mobile machinery and vehicular traffic are hazards which can potentially affect worker safety and the safe use and structural integrity of a scaffold.

Control measures to minimise the risks associated with moving plant and traffic include:

- re-routing vehicles and machinery away from where the scaffold is located, e.g., by using traffic controllers to redirect traffic.
- using barricades, signs, posts, buffer rails, guards, concrete or timber kerbs to prevent mobile plant and traffic from coming into contact with a scaffold, and
- ensuring the scaffold does not have unnecessary protrusions e.g., over - length transoms, putlogs, tie tubes or over-height standards.

Supporting structures

You should consider the capability of a supporting structure such as a building to bear the most adverse combination of loads possible when erecting and using the scaffold. Get advice from a competent person before anchoring a scaffold to a building or erecting scaffold on verandas, suspended flooring systems, parapets and awnings.

Propping of the supporting structure may be required where the supporting structure is not capable of bearing the most adverse combination of loads.

Unauthorised access

A person with management or control of a scaffold at a construction site must prevent unauthorised access to the scaffold while the scaffold is incomplete or unattended.

This applies to suspended, cantilevered, spur or hung scaffolds, as well as any scaffold from which a person or thing could fall more than 4 metres.

Entry to scaffold areas should be restricted to those carrying out the scaffolding work while the scaffold is being erected, altered, repaired or dismantled. Control measures, for example barriers and warning signs should be used to prevent unauthorised access when the scaffold is left unattended.

Scaffold safety: 4 common hazards and how to reduce exposure

1. Falls

Falls are attributed to the lack of guardrails, improper installation of guardrails and failure to use personal fall arrest systems when required. The OSHA standard requires fall protection must be used when work heights reach 10' or more. OSHA's standards represent the minimum level of protection; many general contractors require 100% fall protection at 2 metres or greater when working on scaffolds. These contractors are increasing safety margins by exceeding the minimum requirements of the OSHA standards.

Lack of proper access to the scaffold work platform is an additional reason for falls from scaffolds. Access in the form of a secured ladder, stair tower, ramp, etc. is required whenever there is 24" vertical change to an upper or lower level. The means of access must be determined before erection of the scaffold and workers are never allowed to climb on cross braces for either vertical or horizontal movement.

2. Scaffold collapse

The proper erection of a scaffold is essential in preventing this particular hazard. Before erecting the scaffold, a number of factors must be accounted for. The amount of weight the scaffold will be required to hold including the weight of the scaffold itself, materials, and workers must be considered. Foundation stability, placement of scaffold planks, distance from the scaffold to the work surface, and tie-in requirements are just a few of the other items that must be considered prior to building a scaffold.

<u>Scaffold competent person</u>

A knowledgeable individual who can perform preplanning will reduce the chances of injury and save money for any task. However, when building, moving, or dismantling a scaffold, a knowledgeable person, also known as the scaffold competent person, must be present. A competent person must also inspect the scaffold daily to ensure the structure remains in a safe condition. Improper construction can lead to a total collapse of the scaffold or falling components – both of which can be fatal.

3. Struck by falling materials

Workers on scaffolds are not the only ones exposed to scaffold related hazards. Many individuals have been injured or killed due to being struck by materials or tools that have fallen from scaffold platforms. These people must be protected from falling objects. OSHA requires that this is done one of two ways. The first is to install toe boards or netting on work platforms to prevent these items from falling to the ground or lower-level work areas. The other option is to erect barricades that physically prevent individuals from walking under work platforms.

Caution or Danger tape is often used in an attempt to keep people away from overhead hazards but is often disregarded or taken down creating possible struck by hazards. A more robust system such as plastic mesh or wooden barricades is generally more effective and much easier to maintain. When members of the public could potentially move close enough to be struck by falling objects, creating barriers to prevent them from entering the area where objects can fall is a recognized best practice. Regardless of the type of falling object protection used, it is crucial that other individuals on the work site are aware of the overhead work.

4. Electrocution

Once again we look to preplanning and the competent person to assure there are no electrical hazards present during scaffold use. A minimum of 10' must be maintained between the scaffold and electrical hazards. If this distance cannot be maintained, then the hazard must be de-energized or properly insulated by the power company. Coordination between the power company and the company erecting / using the scaffold cannot be overstated.

Lastly, all workers who work on scaffolds must have documented training. The training topics must include identification and prevention of fall hazards, falling tools and materials hazards, and knowledge of electrical hazards.

Key takeaways:

- Fall protection is required when work heights reach 10 feet or more.
- Provide proper access to the scaffold and never allow workers to climb on cross braces for horizontal or vertical movement.
- The scaffold competent person must be present when building, moving or dismantling the scaffold and must inspect it daily.
- Erect barricades to prevent individuals from walking under work platforms and place signs to warn those close by of the possible hazards.
- Maintain a minimum of 10 feet between the scaffold and any electrical hazard.
- Ensure all workers working on scaffolding have had proper training.

Scaffold safety starts from the ground up. Only safe work conditions and actions will prevent unnecessary injuries when working on these ever-changing structures.

CHAPTER 20

AMENITIES AND FACILITIES FOR WORKERS

Construction Site Owners must provide adequate amenities and facilities for construction sites to ensure the health, safety and welfare of their Workers and others using their sites. Facilities at construction sites must accommodate for the health, safety and welfare of Workers and other persons working on that site.

Examples of facilities are:

- meal and shelter facilities.
- toilets separated for men and women.
- washing facilities separated for men and women.
- drinking water.
- sleeping areas separated for men and women.

If workers live on site, Construction Site Owners must provide separate sleeping areas for men and women

Construction Site Owners must provide appropriate restroom facilities that are separated for men and women

Who needs facilities

Construction Site Owners must provide facilities for their Workers and other persons such as independent contractors and their Workers using the site.

Facilities are for:

- workers.
- Contractors.
- other persons.
- visitors to the site.

Meal and shelter facilities

Construction Site Owners should provide hygienic and weatherproof meal and shelter facilities at the construction site as soon as possible. This could be a garage or a similar covered area.

These facilities should include:

- adequate seating, which could include a board across two trestles and other alternatives to chairs.
- a hygienic surface for meals.
- a means of keeping perishable foods safe for consumption.
- a rubbish bin with a lid or appropriate alternatives for the hygienic disposal of food scraps.
- appropriate ventilation and be weatherproof.

A contractor can use their vehicle for shelter at the start of construction - only until they can make a more suitable area available.

Note: The designated meals area should not be used to store construction materials or equipment.

The meals area should be kept free of construction related dust, mud and odours. To maintain hygiene, ensure that the floor, tables, benches, and food storage and preparation facilities are kept clean and if necessary disinfected.

Garbage bins in meal areas should be regularly emptied, the liner replaced, and disinfected if necessary; this may need to be done more frequently in hot weather or during heavy usage.

Meal areas should be separated from work areas

Toilets

Workers must have easy access to clean and hygienic toilet facilities on the construction site. Provide self-contained fresh water flushing portable toilets if there is not a toilet connected to the sewerage system. Service these toilets at least once a month in accordance with the supplier's information and instructions.

To provide an acceptable standard of hygiene and privacy, the toilet should:

- be kept clean.
- be weatherproof.
- be well-lit and well ventilated (naturally or artificially).
- have a hinged seat and lid.
- have a door which can be locked from inside.
- have a well-drained floor above ground level covered with a durable waterproof material.
- be provided with sufficient toilet paper.
- be set up to remain level and stable.,

Toilets may be shared between sites if:

- sites are under the control of the same Construction Site Owner and there is clear agreement between the Construction Site Owner and workers.
- toilets are convenient and accessible to the workers on each site.
- there is at least 1 toilet per 15 workers.

Adequate and hygienic means for disposing of sanitary items need to be provided for toilets where required.

Not using the designated toilet is unhygienic

Hand washing facilities

Provide hand washing facilities, including clean water and soap inside or next to each toilet to maintain good standards of personal hygiene.

Workers may need to wash their hands at different times (for example, after visiting the toilet, before and after eating meals, after handling chemicals or handling greasy machinery).

Ensure hand washing facilities are provided to workers

Number of hand washing basins

In most cases, for both males and females, hand washing basins should be provided in at least the ratio of one wash basin for every 30 males and one for every 30 female workers, or part thereof.

The number of hand washing basins may need to be increased depending on the nature of the work carried out at the construction site. For example, where the work involves exposure to infectious substances or other contaminants, separate hand washing basins should be provided in addition to those provided with toilets.

Drinking water

An adequate supply of clean drinking water must be available to all Workers on the site. Install the site water tapping, complete with hose bib-tap, at the earliest opportunity.

Where a mains water supply connection is not possible, provide drinking water using flasks, labelled water containers, water bags or similar, so Workers do not share drinking containers.

Provide mains water supply as soon as possible. Separate drinking water facilities from toilet facilities to ensure hygiene.

Principal Contractors should provide water facilities on-site

Personal storage

Accessible and secure storage should be provided at the construction site for personal items belonging to workers (for example, handbags, jewellery, medication or hygiene supplies).

This storage should be separate from that provided for personal protective clothing and equipment in cases where contamination is possible.

Where any work involves the use of tools provided by a worker, provision should be made for secure and weatherproof storage of those tools during non-working hours.

Mobile, temporary or remote construction sites

Where the construction site is temporary or mobile, lockable containers that can be held in a safe place should be provided. Where lockers are provided, they may also serve as secure storage for other personal items.

Change rooms

If workers have to change in and out of clothing due to the nature of their work, access to private changing areas with secure storage for personal belongings should be provided.

This includes workers who need to:

- wear personal protective clothing or uniforms while they are working.
- leave their work clothing at the construction site.

If male and female workers need to change at the same time, separate male and female changing rooms should be provided. The changing room should allow a clear space of at least 0.5 m2 for each worker.

The temperature in the changing room should be maintained so that it is comfortable for workers when changing. Additional heating or cooling may be needed.

Change rooms should be conveniently located and equipped with:

- seating to enable the numbers of workers changing at one time to sit when dressing or undressing.
- mirrors, either within the changing room or directly outside it.
- an adequate number of hooks and/or shelves.

Where change rooms are provided, it may be reasonably practicable to provide lockers for storing clothing and personal belongings. Lockers should be:

- well ventilated, accessible and secure.
- a sufficient size to accommodate clothing and personal belongings.

There should also be a clear space of at least 1800 mm between rows of lockers facing each other and at least 900 mm between lockers and a seat or wall.

Lockers or lockable storage boxes should be provided to workers

Shower facilities

Certain jobs may involve dirty, hot or hazardous work and may require the provision of showering facilities.

At least one shower cubicle for every 10 workers who may need to shower should be provided. Usually, separate facilities should be provided for male and female workers. However, in small or temporary construction sites where privacy can be assured, it may be acceptable to provide one unisex shower.

Showers should have:

- a floor area of not less than 1.8 m2.
- a slip-resistant surface that is capable of being sanitised.
- partitions between each shower that are at least 1650 mm high and no more than 300 mm above the floor.
- an adjacent dressing area for each shower containing a seat and hooks.
- a lockable door enclosing the shower and dressing cubicle.

Each shower should be supplied with clean hot and cold water and individual non-irritating soap or another cleaning product.

If grime or other by-products of the work process cannot be removed just by washing, individual nail or scrubbing brushes should be provided. Also provide drying facilities such as towels if the work the workers carry out means they need to shower before leaving the construction site.

Make sure to separate the male and female shower facilities

Outdoor work

Outdoor workers should have access to shelter for eating meals and taking breaks, and to protect them in adverse weather conditions. Access to shelter should be provided, for example, using sheds, caravans, tents, windbreaks or portable shade canopies. In some situations, vehicles or public facilities may provide appropriate short-term shelter. For more information see Chapter 16 Safe Work in Hot Humid Conditions.

Protection against solar ultraviolet (UV) exposure should also be provided for outdoor workers, for example:

- reorganising outdoor work if possible so that workers carry out alternative tasks, or work in shade, when the sun is most intense.
- providing personal protective clothing (wide brim hat, long-sleeved collared shirt, long pants, sunglasses) and sunscreen.

Accommodation

If a business has workers working in regional and remote areas, accommodation may need to be provided while the work is being carried out. An example of such arrangements would be where accommodation is provided to fruit pickers during the harvesting season, shearers on a sheep station or workers engaged in construction work at a remote location. Where reasonably practicable, the accommodation should be separated from any hazards at the construction site likely to adversely affect the health and safety of a worker using the accommodation.

The accommodation facilities should also:

- be lockable, with safe entry and exit.
- meet all relevant structural and stability requirements.
- meet electrical and fire safety standards.
- have a supply of drinking water.
- have appropriate toilets, washing and laundry facilities.
- be regularly cleaned and have rubbish collected.
- be provided with suitable sleeping quarters shielded from noise and vibration.
- have crockery, utensils and dining facilities.
- have adequate lighting, heating, cooling and ventilation.
- have storage cupboards and other suitable furniture.
- be provided with a refrigerator or cool room.
- have all fittings, appliances and equipment in good condition.

Some workers on remote sites may require accommodation

General provisions

When providing facilities, consider the:

- location of the site.
- type of work to be done.
- number of Workers.
- availability of power and services.

The Construction Site Owners should plan for:

- safe and convenient location of facilities.
- positioning and construction to prevent flooding of facilities.
- clear access to facilities at all times.
- hygienic and safe discharge of wastewater.
- clean and sanitary facilities.
- adequate natural and/or artificial lighting for safe access and use of facilities.

Enclosed facilities should be well built and weatherproof and have adequate ventilation and lighting.

Maintaining the work environment and facilities

The work environment should be maintained so that it remains in a clean and safe condition. Broken or damaged furniture, fixtures and fittings, including chairs, plumbing, air- conditioning and lighting should be repaired promptly. Facilities should be clean, safe, accessible and in good working order. Consumable items, including soap and toilet paper, should be replenished regularly. Equipment and furniture such as rice cookers, fridges, lockers or seating should be maintained in good working order.

Construction sites and facilities should be cleaned regularly, usually on a daily or weekly basis. The cleaning schedule of facilities such as dining areas, toilets, hand basins and showers should take into account shift work, the type of work performed, the likelihood of contamination and the number of workers using them.

Keeping facilities clean is very important for safety and hygiene

Entry and exit to amenities

The means of entry and exit to and from the amenities and facilities on a construction site must be safe. This may include ensuring that workers with special needs or disabilities can safely enter and leave amenities area or the construction site.

Entries and exits should be slip-resistant under wet and dry conditions.

Aisles and walkways should be at least 600 mm wide and kept free of furniture or other obstructions at all times. Where it is necessary to clearly define entry and exit routes, the boundaries of the route should be marked by a permanent line of white, yellow or other contrasting colour at least 50 mm wide or by glowing markers. Entry and exit routes, stairs and walkways should be adequately lit.

Open sides of staircases should be guarded with an upper rail at 900 mm or higher and a lower rail. A handrail should be provided on at least one side of every staircase. Additional handrails may be needed down the centre of wide staircases.

Separate entries and exits for mobile equipment (for example, forklifts or trucks) and pedestrians should be provided to minimise the risk of persons being hit by moving vehicles. If people and vehicles have to share a traffic route, use kerbs, barriers or clear markings to designate a safe walkway. Doors and gates should be fitted with safety devices if necessary. Doors on main traffic routes should have a transparent viewing panel (unless they are fire- rated doors).

Power-operated doors and gates should have safety features to prevent people being struck or trapped. Upward-opening doors or gates should be fitted with an effective device (such as counterbalance springs or ratchet devices) to prevent them falling back.

The location of exits should be clearly marked, and signs should be posted to show the direction to exit doors to aid emergency evacuation.

Ensure your site caters for people with disabilities

CHAPTER 21

ABUSE OF DRUGS AND ALCOHOL

All workers have a duty to take reasonable care for their own health and safety and ensure they don't adversely affect the health & safety of others. This means they must be fit and well enough to do their job, not be under the influence of alcohol or drugs, or use alcohol or illegal drugs while at work.

Drug and alcohol use (including legitimate over the counter or prescribed medications) can affect a person's ability to work safely. Even if someone drinks alcohol or uses drugs outside working hours, it can impair their judgement, co-ordination, concentration and alertness while on the job.

Using Drugs & Alcohol impede the ability to perform work duties

The results could be:

- construction site accidents, injuries or damage to.
- increased absenteeism and reduced productivity.
- poor teamwork or construction site relationships.
- disciplinary or conduct problems.

Using Drugs and Alcohol can cause problems with work colleagues

Workers that choose to use drugs and alcohol not only put themselves at greater risk but put others around them at greater risk too. Both colleagues and members of the public can suffer due to the actions of these people.

Depending on what has been taken, the effects of drugs and alcohol can vary. However, the most common influences that can affect an individual in a working environment are:

- impaired awareness including in vision and hearing.

- reduced concentration and ability to focus.

- Diminished judgement and decision making.
- Compromised balance and bad co-ordination.

Using Drugs & Alcohol can affect your balance and co-ordination

Being hungover at work can be almost as dangerous as being drunk at work. When hungover, people tend to be increasingly tired, they have decreased reaction times, are more un-coordinated and have a decreased attention span. Productivity levels also go down massively when someone is hungover, and absenteeism increases.

Alcohol and drugs

Alcohol and drug use may damage a person's physical and mental health and impact workplace health and safety.

The work health and safety risks associated with alcohol and drug use is greater at some construction sites than others. The construction site culture, physical location or isolation, job satisfaction and stress are just a few of the factors that might increase a worker's likelihood of alcohol or other drug consumption.

Workers 'under the influence' may show signs of:

- illness or inability to turn up to work.
- dizziness, blurred vision or slurred speech.

- alertness, co-ordination and motor control may be affected.
- workers may be drowsy or fall asleep at work.
- workers may suddenly become aggressive or violent.
- judgement or self-control may be affected.
- hangovers including headaches, shaking, vomiting and nausea.
- putting co-workers in the difficult position of being expected to cover for unsafe work practices or having to report a fellow worker.
- preoccupation with obtaining and using substances or the illegal sale of alcohol or other drugs while at work.
- damage to property or equipment.
- loss of productivity.
- workers who are injured at work while affected by alcohol or other drugs may not be able eligible for workers compensation.

Drugs & alcohol – impact on health

It is not just the risks associated with drinking and using drugs at work but the increased risks it has on a person’s short-term and long-term health.

Alcohol and drug abuse are incredibly dangerous and are seriously detrimental to your health, they can lead to a number of serious health issues such as liver problems, pancreatitis, cardiovascular diseases, stomach ulcers, increased risk of cancer and even death.

Economic impact

Drug and alcohol misuse in the construction industry also has an economic impact. The increased health risks that come with drug and alcohol misuse can lead to workers having to take long periods of time off work.

Workers are also much more likely to call in sick to work if they are drunk, under the influence of drugs or hungover, due to the increased level of tiredness, feelings of nausea, dizziness and bad co-ordination and a fear of being caught.

Productivity is also decreased because people are more tired, work slower and have decreased attention span. The effects of drugs and alcohol can also lead to workers making costly mistakes and work having to be re-done or prolonged because of their misjudgement. Not being able to get a job done in the set amount of time will affect a Principal Contractor financially, not to mention the costs of extra materials if a mistake is made.

Principal Contractors also face criminal prosecution and/or fines if accidents occur due to drug and alcohol misuse in the construction site.

Drug and Alcohol incidents can result in a prison sentence

Worker & worker responsibilities

Workers & Workers on construction sites all have a responsibility to make sure any drug or alcohol use outside of work hours doesn't affect your ability to work, affect your safety or the safety of others.

You must not use any drugs or alcohol while you're at work. Exceptions are:

- if you're taking prescription or over-the-counter medication for legitimate medical reasons. Ask your doctor about the effects on your ability to work safely. If it's likely they'll affect your ability to do your work safely, tell your manager/Principal Contractor; they may give you other duties while you're taking the medication.
- with the permission of your Principal Contractor: for example, having a drink at your construction site Christmas party or at the end of a day when work duties have ceased.

If you think one of your co-workers is affected by alcohol or drugs at work, you must talk to your manager or health and safety representative.

Workers, including independent contractors and their workers, must cooperate with the measures in place to control hazards pertaining to alcohol consumption and drug use at a construction site. This means a worker must:

- follow the instructions given by Principal Contractors in relation to controlling risks associated with alcohol consumption and drug use.
- inform their supervisor if they suspect they are in an impaired condition due to alcohol consumption or drug use.

- inform their supervisor if they suspect or observe another worker is in an impaired condition due to alcohol consumption or drug use.
- not enter or remain at the construction site if adversely affected by alcohol or drugs.
- not take alcohol into a construction site without permission of the site owner and/or Principal Contractor.
- not take drugs into a construction site that may adversely affect a worker (regardless of whether a registered medical practitioner has prescribed the drugs and authorised their use at work).
- understand through consultation with the Principal Contractor what is meant by 'adversely affected by alcohol and drugs.
- arrange activities outside working hours so they are not in an adverse state from alcohol or drugs when arriving to work.

Drinking alcohol on a construction site must be prohibited unless authorised by the Construction Site Owner

Principal contractor responsibilities

Principal Contractors must manage the hazards associated with drugs and alcohol in the construction site. You must identify if there is drug and alcohol use at your construction site or if workers are coming to work under the influence and take steps to ensure workers are not affected by drugs & alcohol whilst working, implement strict policies and procedures relating to the drugs & alcohol and implement measures to test workers and take action if workers are found to be under the influence by drugs & alcohol.

The specific recognition of alcohol consumption and drug use as a potential health and safety hazard means it must be managed as part of the OHS responsibilities of the Principal Contractor. This means:

- ensuring workers are informed of the risks associated with alcohol consumption and drug use and how to control the risks.

- ensuring the definition of ‘adversely affected by alcohol and drugs’ is understood through consultation with workers.
- ensuring systems of work are structured and managed to minimise the effects and impairment of alcohol and drugs.
- ensuring a process through which a worker can inform their supervisor that they or someone else may be in an adverse state following the alcohol consumption or drug use.
- ensuring the use of drugs prescribed by a registered medical practitioner are authorised.

Controlling the risks

The culture you set for your construction site is crucial to whether or not workers will abuse drugs & alcohol whilst working on your construction site.

If there are construction site factors that may influence someone to turn to drugs or alcohol - such as shift work, unreasonable schedules, bullying or high stress levels - consult with everyone in your construction site on ways to address these. For example, review and improve workloads, rosters and excessive working hours, staffing levels and resource availability, address bullying, and address factors causing unreasonable stress.

If you have high risk tasks, you might find you need a tougher approach or even a zero-tolerance approach. Consult with the workers involved. This should be reflected in your safe work procedures and your drug and alcohol policy.

Provide regular training and information about the effects of drug and alcohol use on personal and work health and safety.

Being under the influence of Drugs or Alcohol at work is harmful to your personal work, health and safety

Drug and alcohol policy

Creating policies and procedures for your construction site are an important step to having a safe construction site. Your construction site drug & alcohol policy should state:

- that you will not allow drugs or alcohol in your construction site (except prescription or over-the-counter medication taken for legitimate medical reasons, or any specified construction site-based social event), and you take their threat to personal and work health and safety seriously.
- the ways you will reduce or remove drugs and alcohol from your construction site.
- the procedures and disciplinary actions you will take if you find someone drinking or using drugs at your construction site or working under the influence.

Create a hierarchy of actions to follow if someone breaches your policy. This might be a formal warning, followed by encouraging them to get treatment, then suspension, and finally dismissal. More important than writing a policy is enforcing it, fairly and consistently.

Consult with workers and their representatives to develop your policy. Make sure everyone knows and understands your drug and alcohol policy. Email it to staff, display it on notice boards, and discuss it at staff meetings or briefings before work commences. Include it in training and inductions, too.

Principal Contractors should educate workers about the company Drug & Alcohol policies

Consultation

Principal Contractors must consult with their workers and HSRs (if any) when developing and implementing risk controls to health and safety associated with the presence and consumption of alcohol and/or drug use at a construction site.

Principal Contractors should consult with workers and HSRs:

- when the presence and consumption of alcohol and/or drug use is identified as a hazard or there are indications alcohol or drugs are affecting the health and safety of workers.
- when carrying out risk assessments and taking steps to eliminate or control risks.
- when developing and implementing educational programs for the control of any risks to health and safety associated with alcohol and drug use.
- post-incident or after a near-miss occurs.

It is important to consult workers to establish a common understanding of alcohol consumption and drug use in the construction site and how their presence and use is different from other physical hazards.

Using a risk management approach

Using a risk management approach is a key part of managing alcohol consumption and drug use in the construction site. The table below shows an example of such an approach. Consultation should take place at every step of the process.

<table>
<tr><th colspan="3">Risk Management approach to alcohol consumption and drug use</th></tr>
<tr><td>Getting started</td><td>1. Establish a joint approach to controlling the risk through consultative forums.</td><td rowspan="5">Consult the workforce throughout the process</td></tr>
<tr><td>Agreeing on how to do it</td><td>2. Agree on a process that supports effective control, including and education and communication strategy and adequate resources.
3. Identify hazards that can cause the use of alcohol and drugs in the construction site.
4. Assess the risk factors
5. Decide how to control the risks associated with the presence and use of alcohol and drugs, ensuring workers are closely involved.
6. Document the control measures in an alcohol and drugs management plan</td></tr>
<tr><td>Setting it up</td><td>7. Implement agreed controls</td></tr>
<tr><td>Making it work</td><td>8. Evaluate the effectiveness of controls</td></tr>
<tr><td>Review</td><td>9. Monitor and review</td></tr>
</table>

Developing a plan

Before developing a plan, it is critical to understand that the hazards associated with alcohol consumption and drug use on a construction site can be greater than other construction sites due to their nature and type of work.

Both alcohol and drugs have hangover effects that can continue beyond alcohol consumption and drug use. It is important to note that other factors (such as fatigue) may also display hangover effects. Signs that may indicate a person is adversely affected by alcohol or drugs include:

- initial stimulation, euphoria.
- loss of inhibition.

- impairment of co-ordination, judgement, intellectual capacity and ability to act quickly.
- blurred vision.
- slurred speech.
- hangover-headache, shakiness, nausea and vomiting.
- in the longer term, toxic to the brain, liver, heart and stomach.

In some occupations, a worker impaired by alcohol consumption and/or drug use could be more likely to jeopardise the health and safety of others (e.g., machinery operators or crane operators). Specific factors to consider in relation to increased risks of injury or harm by impaired workers include:

- operation of machinery.

- work-related driving.

- situations where concentration or motor coordination is relied on to carry out a task.

- use of hazardous substances.
- performing duties as part of a team.

A range of factors, both at the construction site and in workers' personal lives, can impact on the ability to work safely. Alcohol consumption and drug use may be one of them.

Many factors may contribute to the misuse of alcohol and other drugs including:

- shift work.

- high risk of personal injury or illness at work.
- dirty, noisy work environment.
- poorly designed, difficult to use equipment.
- poor job design, including boring or extremely demanding work.
- unrealistic deadlines and performance targets, or inadequate resources.
- lack of participation in any decision-making process.
- inadequate training and supervisory support.
- harassment, bullying or victimisation in the construction site.
- access to alcohol and/or drugs at work or a culture tolerating or encouraging alcohol consumption and/or drug use during work hours.
- fear of losing job.
- conflict with peers or supervisors.
- discrimination or prejudice.
- peer pressure.
- marital or personal relationship problems.
- grief or bereavement.
- trauma or stress.
- health issues or concerns.
- gambling or financial problems.
- habituation or addiction.

Alcohol consumption and drug use is an occupational health and safety issue if a worker's ability to exercise judgment, coordination, motor control, concentration and alertness at the construction site is impaired, leading to an increased risk of injury or incidents to himself/herself or others

Use of medications

The management of workers impaired by prescription or over-the-counter medication may be addressed in the construction site alcohol and drugs management plan or considered separately.

A number of steps taken to minimise the risk of injury or harm caused by this medication use include:

- if a worker's ability to work safely is impaired as a result of medication, their Principal Contractor, supervisor, HSR should be notified. The worker does not need to disclose their illness.
- the worker providing verification of the side-effects of the medication (e.g., a medical certificate).
- where a company nurse or doctor issues medication at work (including non-prescription), the potential of impairment must be assessed when determining if the worker should return to usual duties.

- if a worker can work safely, depending on the situation, a person should be assigned to monitor their safety performance.
- if a worker is unable to perform their usual work tasks safely, they should be given reasonable alternative work until the use of medication stops.

Principal Contractors should develop a construction site management of alcohol and drugs plan with supporting procedures that address specific circumstances at the construction site.

A construction site alcohol and drugs management plan should be a written document that applies to all workers at the construction site. It should be developed by management, workers and an HSR and/or union representative working together. It should also have the total commitment of management. Evidence suggests that construction sites with good worker consultation have good OHS outcomes.

A construction site alcohol and drugs management plan should outline the construction site's aims to eliminate or reduce hazards and risks, so far as reasonably practicable. The supporting procedures should provide strategies and action plans to meet this objective.

There are a number of reasons for construction sites developing a construction site alcohol and drugs management plan. These include:

- the OHS Regulations require strategies be implemented to control any risks to health and safety associated with the presence and use of alcohol and drugs at a construction site.
- preventing uncertainty when such situations arise – without a clear plan and supporting procedures in place it may be difficult to deal with certain situations when they arise.
- demonstrating management commitment to a safe construction site and informing workers and others about acceptable behaviour. Having a plan also provides a means of informing workers and other persons at the construction site about changed behaviours in relation to someone adversely affected by alcohol consumption and drug use.
- facilitating peer support – policies that facilitate peer involvement will be useful in encouraging peers to pick up on changes in behaviour of those at the construction site and assist in construction site cultural change.

Construction site induction

Supporting procedures should be raised in a construction site induction to ensure new workers are aware of and understand the construction site alcohol and drugs management plan.

Evaluation

It is important to evaluate the construction site alcohol and drugs management plan after implementation. Supporting procedures may provide a time frame and criteria for such an evaluation.

Other people at the construction site

It may be appropriate to include supporting procedures to deal with the situation where customers, clients or visitors enter the construction site impaired by alcohol and drugs. Supporting procedures should specify safety precautions and procedures to minimise the risk of problems.

Work sponsored functions

If work functions include alcohol, include an additional section in the supporting procedures outlining the organisation's policy on consumption of alcohol at social functions. Alternatively, a separate policy or set of procedures dealing with work- sponsored functions may be developed. The document should clearly outline the Principal Contractor's expectations of appropriate behaviour in relation to the consumption of alcohol.

There are also a number of steps that can be taken by management to minimise the risk of alcohol and drug related problems at functions including:

- communicating the responsibility of workers for safe behaviour at the construction site and expectations about low-risk alcohol consumption.
- providing non-alcoholic drinks and low alcohol beverages and substantial food.
- ensuring an intoxicated worker gets home safely.
- ensuring construction site social activities do not centre around alcohol (e.g., hosting family friendly functions during the day as an alternative to evening functions).
- encouraging workers to arrange alternative transport prior to a function where alcohol is available. This can minimise the risk of workers driving under the influence of alcohol.

Self-assessment by workers

The construction site alcohol and drugs management plan should state that workers must not present themselves for work if they have recently consumed alcohol or used drugs. The plan should also state that workers should not remain at the construction site if they become impaired by alcohol consumption and/or drug use.

A simple self-assessment may be useful in assisting people to assess problems and attitudes. These tools can be developed by the construction site or obtained from other services.

Self-assessment tools can also have a positive impact on behaviour (e.g., providing workers with a breathalyser). A worker who identifies impairment could take voluntarily leave (e.g., sick leave or unpaid leave).

Education, training and healthy lifestyle programs can also have a positive impact on behaviour and educate workers about the safety and health risks of alcohol consumption and/or drug use.

Advantages and disadvantages of testing

There are advantages and disadvantages that must be considered by Principal Contractors if a construction site testing program is implemented.

If a risk assessment suggests a level of risk from alcohol consumption and/or drug use Principal Contractors should consider that:

- drug testing does not measure impairment. It only detects whether somebody has been exposed to drugs. Saliva testing measures the presence of a drug, not how much has been consumed or how intoxicated a person is and urine testing usually measures the presence of metabolites of drug use.

- breath testing for alcohol measures the direct presence of alcohol and is a reliable indicator of level of intoxication.

Excluding alcohol testing, a positive drug test is not directly related to impairment, nor does it provide a reliable indicator of impairment. Other issues to consider with a drug testing program include:

- current testing techniques do not disclose the quantity of drugs consumed, when consumed or the level of impairment resulting from drug consumption.
- a possibility of inaccurate results and false positives in drug testing.

Drug testing

If after careful consideration a construction site decides to introduce drug and/or impairment testing:

- it should form part of a comprehensive alcohol and drug program (e.g., a policy, education and rehabilitation or counselling program). The rationale for drug testing should be clearly communicated and workers should be informed of relevant construction site processes at the time of taking a drug test.
- it should not be assumed the worker is intoxicated if they refuse a test. Procedures should be developed to address the next step if this arises.

Appropriate safeguards include:

- ensuring the policy is written simply in clear language and regularly communicated to all staff.
- ensuring cut-off points for a positive result are selected and clear.
- stating the types of drug testing (e.g., pre-employment, after probation, after accident, random or voluntary).
- ensuring there is no discrimination in the selection of workers for testing.
- ensuring there are well defined procedures indicating to whom the final result will be communicated.
- ensuring confidentiality is protected and the procedure identifies who will have access to the results, who will interpret them, how the results will be stored and for how long.
- ensuring there is a grievance and complaints process included in the procedure, including accepted procedures to challenge the outcome of a drug test.

If testing is introduced, written procedures on construction site testing should be in place and independent expert guidance sought.

Testing for alcohol

Principal Contractors should adopt the least invasive means of testing. Breathalysers for example, use less invasive processes and eliminate the need for chain of custody considerations, as the worker and person testing are both present during the process. Breathalysers may also provide a more cost-effective solution than other testing options.

Procedures for identification should be clear in the construction site alcohol and drugs management plan and supporting procedures and made clear to all people at the construction site.

A cut-off point must be indicated in the management plan and communicated (e.g., some companies use a cut-off point of 0.05mg% for general staff and a cut-off point of 0.0-0.02mg% for safety sensitive or designated jobs).

If a construction site does not have a plan, written procedures should be in place to assist identifying impaired workers.

Independent advice should be sought before using a breathalyser to ensure they are reliable and accurate. To maintain accuracy regularly calibrate breathalysers following manufacturer's guidelines.

Impaired performance and inappropriate behaviour are the risks from alcohol consumption and drug use in the construction site. The hazard factors that could lead to these risks may include:

- patterns of alcohol consumption or drug use - different patterns of use create different risks. For example, people who use large amounts on single occasions may create different risks compared to people who are regular users.
- type of construction site culture - there may be a culture at work that encourages or accepts consumption of alcohol and use of drugs at the construction site or socially.
- availability of alcohol and other drugs - at some construction sites, workers are more likely to be exposed to usage and the risk of being impaired may increase. In other construction sites, they may be more exposed to the consequences.
- isolation from family and friends - workers in isolated/remote areas or separated from family and friends sometimes report they are more likely to consume alcohol and/or drugs due to boredom, loneliness or lack of social activities.
- inadequate job design and training - unrealistic performance targets and deadlines, excessive responsibility, monotonous work or low job satisfaction may, in some instances, be risk factors. For example, symptoms of stress are sometimes associated with poor health, including alcohol and drug related problems. Inadequate training, supervision and communication may also contribute to this risk factor.
- inadequate supervision - jobs where there is inadequate supervision and performance management may increase the risk of alcohol and/or drug related problems. For example, inadequate supervision and communication about expected roles and behaviour on the job could allow impaired behaviour to continue and consequences of unacceptable behaviour to eventuate.
- extended working hours or shift work - illicit drugs, such as amphetamines or prescription medication, may be taken by workers to keep awake if they are working long hours or engaged in shift work.
- interpersonal factors - bullying at work may increase risks.

CHAPTER 22

SAFE PRACTICES IN USE OF REINFORCED CONCRETE AND STEEL CONSTRUCTION

Every year around the world, workers are seriously injured and lose their lives on construction sites whilst concreting and building structures with reinforced concrete and steel.

A culmination of factors often influences why accidents occur, including incorrect construction methods, a lack of training and supervision of workers, and using poor quality products and equipment.

This section aims to provide Principal Contractors and workers who work with concrete, reinforced concrete and steel with advice and information on how to minimise health & safety risks associated with using concrete, reinforced concrete and steel in the construction industry.

Principal Contractors should ensure that all workers have the opportunity to be fully involved in the development of procedures including hazard identification, assessment of risk and control of risk methodology.

Principal Contractors have a general duty to ensure the health and safety of workers while they are performing duties relating to concreting and steel structure construction.

In particular, they must take all practicable steps to:

- provide and maintain a safe working environment.
- ensure the risks associated with the set-up and use of concrete and concrete pumping equipment are controlled so as to be safe for workers.
- implement appropriate inspection and maintenance regimes for concrete pumping equipment.
- provide procedures to deal with emergencies that may arise while workers are working with concrete and steel structures.

Cement

Cement powder, when mixed with water, forms a paste. This paste acts like glue and holds or bonds the aggregates together.

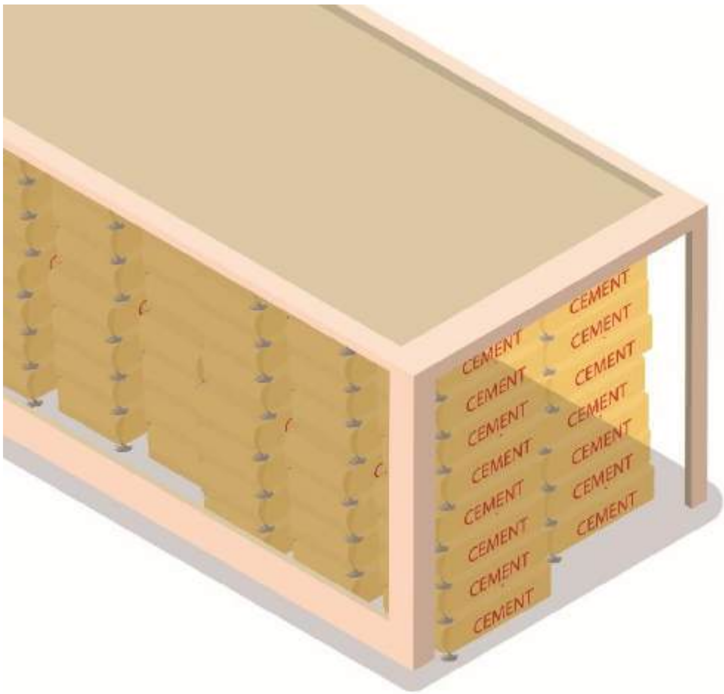
There are various types of cement with each type of cement producing concrete with different properties.

The most commonly used cements are Type GP (general purpose Portland cement) and Type GB (general purpose Blended cement).

Blended cements contain Portland cement and more than 5% of either fly ash, ground slag, amorphous silica (e.g., silica fume), or a combination of these.

Storage

Cement should be stored off the ground in a well-aired, clean, dry place. Wrapping the cement bags in plastic sheets gives extra protection. Bulk cement will normally be stored in silos.



Always store Cement in a dry clean place

Aggregates

Aggregates are of two basic types:

- COARSE: crushed rock, gravel or screenings.
- FINE: fine and coarse sands and crusher fines. Sand should be concreting sand and not brickies sand or plasterer's sand.

Storage

Aggregates should be stored where they will remain clean, separated from other materials and dry. If the aggregates are wet, less water should be used in the mix.

Water

Water is mixed with the cement powder to form a paste which holds the aggregates together like glue. Never try to make a mixture more workable by just adding more water because this lowers the strength and durability of concrete.

Water must be clean, fresh and free from any dirt, unwanted chemicals or rubbish that may affect concrete.

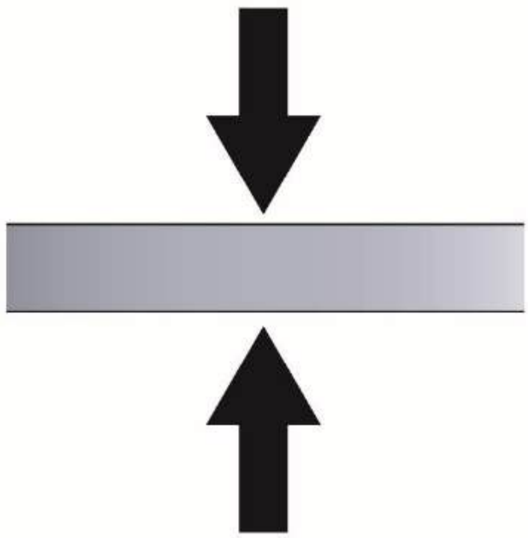
Many concrete plants now use recycled water. Always check bore water before use. Don't use sea water in reinforced concrete as it may rust the reinforcing steel.

If you can drink the water, it can be used to make concrete. **DO NOT** use Sea Water

Strength and durability of concrete

Well-made concrete is a naturally strong and durable material. It is DENSE, reasonably WATERTIGHT (impermeable), able to resist changes in TEMPERATURE, as well as wear-and-tear from WEATHERING and TRAFFIC.

Strength and Durability are affected by the density of the concrete. Denser concrete is stronger and more watertight (or less permeable). Concrete durability INCREASES with strength. Well-made concrete is very important to protect the steel in reinforced concrete. Strength of concrete in the hardened state is usually measured by the COMPRESSIVE STRENGTH using the Compression Test.



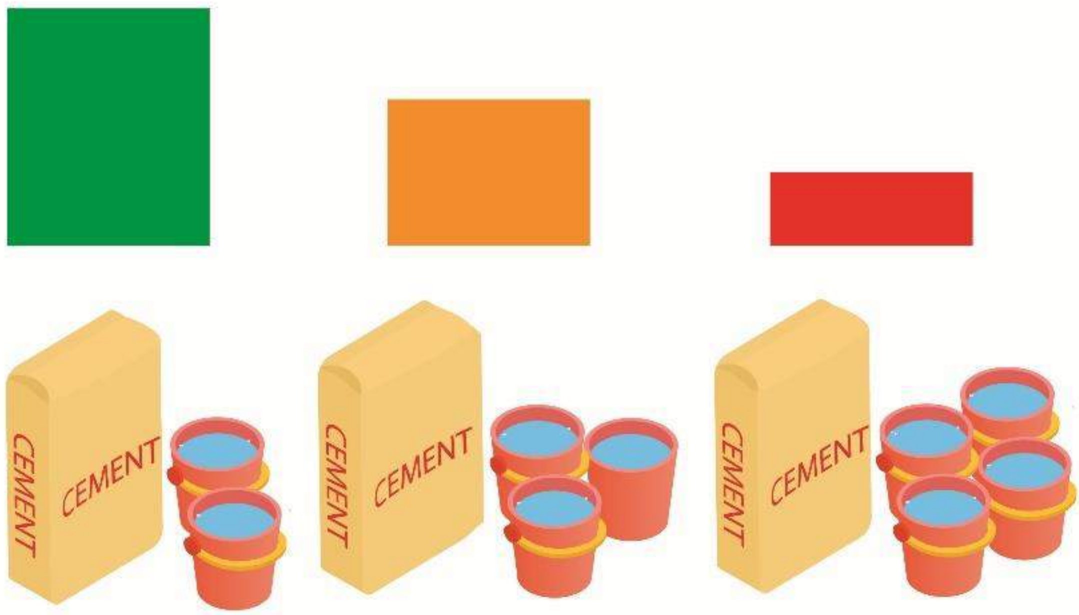
Concrete is very strong in compression

Strength and Durability are affected by:

- COMPACTION - compaction is removing the air from concrete. Proper compaction results in concrete with an increased density which is stronger and more durable.
- CURING - curing is keeping concrete continuously damp for a period, to allow it to reach maximum strength. Longer curing will give more-durable concrete.
- WEATHER - warmer weather will cause concrete to have a higher early strength.
- TYPE OF CEMENT - different types of cement will affect concrete properties, e.g., how quickly or slowly concrete gains strength.
- THE WATER TO CEMENT RATIO - too much water and not enough cement means concrete will be weaker and less durable. The water to cement ratio (W/C) is the weight of the water divided by the weight of cement. The lower the ratio, the stronger the concrete.

$$W/C = \frac{\text{Water}}{\text{Cement}} \quad \text{eg} \quad \frac{20 \text{ litres}}{40 \text{ kg}} = 0.5$$

Note: 1 litre of water weighs 1 kilogram



The compressive strength of concrete is measured in Megapascals (MPa)

The compression test

The compression test shows the compressive strength of hardened concrete. The testing is done in a laboratory off-site. The only work done on site is to make a concrete cylinder for the test.

The strength is measured in Megapascals (MPa) and is commonly specified as a characteristic strength of concrete measured at 28 days after mixing. The compressive strength is a measure of the concrete’s ability to resist loads which tend to crush it.

For methods on Compression Testing, see relevant Concreting Technical Manuals

Proportioning and mixing

A CONCRETE MIX is designed to produce concrete that can be easily placed at the lowest cost.

To be utilised safely, concrete must be workable and cohesive when plastic, then set and harden to give strong and durable concrete.

The mix design must consider the environment that the concrete will be in, i.e., exposure to sea water, trucks, cars, forklifts, foot traffic or extremes of hot and cold.

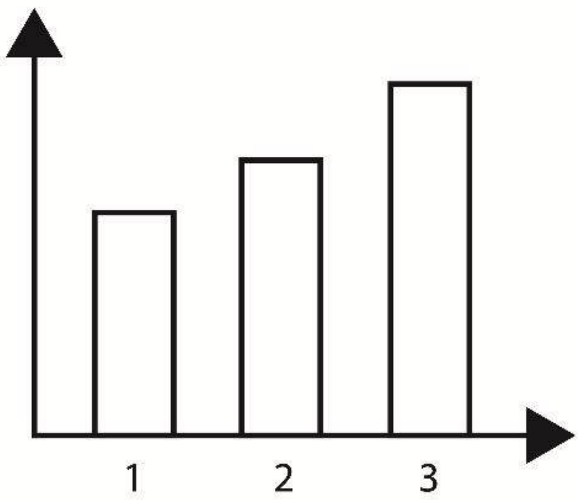
Proportioning

The proportions of each material in the mixture affects the properties of the plastic and hardened concrete.

These proportions are best measured by weight. Measurement by volume is not as accurate but is satisfactory for minor projects.

Cement content

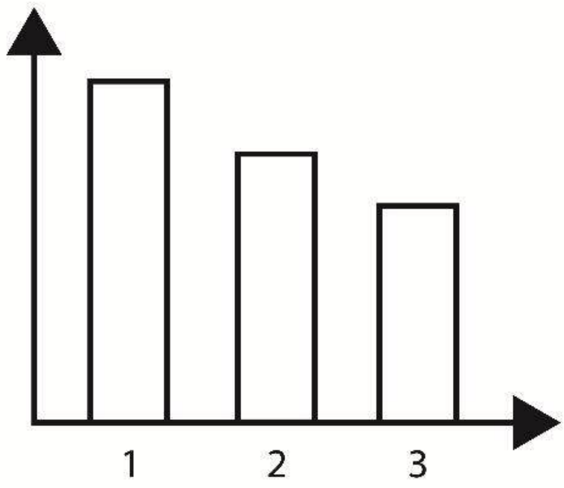
As the cement content increases, so does strength and durability. Therefore, to increase the strength, increase the cement content of a mix.



More cement = more strength

Water content

Adding MORE WATER to a mix gives a WEAKER hardened concrete. Always use as little water as possible, only enough to make the mix workable.



More water = less strength

Construction site safety

Workers who are mixing, pouring or using concrete should always wear protective clothing, strong boots, helmets and eye protection. Always avoid direct contact with cement and never kneel in or touch the plastic concrete directly.

Wear gloves and use barrier creams. Ensure that anyone using heavy equipment, such as screeds or vibrators, has been properly trained. For more information, see Chapter 4 Use of PPE.

Protect your head and eyes

Cement pouring equipment and related tools represent constant potential hazards to workers working in and around concreting processes. It is recommended that some sort of head protection, such as a hard hat or safety hat, be worn when working with or near any concreting works.

Proper eye protection is essential when working with cement or concrete. Eyes are particularly vulnerable to blowing dust, splattering concrete, and other foreign objects. On some jobs it may be advisable to wear full-cover goggles or safety glasses with side shields.

Sight is precious. Protect the head and eyes by using proper safety equipment and remaining alert.

Cement pouring can be harmful, especially to the eyes

Protect your back

All materials used to make concrete - Portland cement, coarse aggregate, sand, and water - are quite heavy even in small quantities. When lifting heavy materials, your back should be straight, legs bent, and the weight between your legs as close to the body as possible.

Do not twist at the waist while lifting or carrying these items. Rather than straining your back with a heavy load, get help. Remember to use your head, not your back.

Examples of correct lifting techniques with and without a partner

Let mechanical equipment work to your advantage by placing concrete as close as possible to its final position. After the concrete is deposited in the desired area by chute, pump, or wheelbarrow, it should be pushed - not lifted - into final position with a shovel. A short-handled, square-end shovel is an effective tool for spreading concrete, but special concrete rakes can also be used. Excessive horizontal movement of the concrete not only requires extra effort but may also lead to segregation of the concrete ingredients.

Protect your skin

When working with fresh concrete, care should be taken to avoid skin irritation or chemical burns. Prolonged contact between fresh concrete and skin surfaces, eyes, and clothing may result in burns that are quite severe, including third-degree burns and skin ulcers. If irritation persists consult a physician. For deep burns or large affected skin areas, seek medical attention immediately.

Ensure you wear appropriate PPE that will protect you from concrete burns and other harmful effects

The risk of workers having a reaction to concrete or to the additives in the concrete must be eliminated, so far as is reasonably practicable. If it is not reasonably practicable to eliminate the risk, it must be reduced so far as is reasonably practicable.

In many situations PPE and administrative controls are relied upon to reduce the risks of contact with concrete.

Administrative controls may include ensuring that:

- an appropriate first aid officer and first aid facilities are available.
- adequate water is available to thoroughly wash concrete off the skin before irritation and flush out eyes.
- all persons involved with wet concrete, including those in the over spray areas:
  - are informed, instructed or trained as necessary in the hazards, first aid and PPE requirements for the various exposure hazards.
  - use PPE when required.

- the work is supervised to the extent necessary to ensure:
    - the PPE is being used correctly.
    - the work is being done safely.

The A-B-C's of fresh concrete's effect on skin are:

- **A**brasive Sand contained in fresh concrete is abrasive to bare skin.
- **B**asic & Portland cement is alkaline in nature.
- **C**austic concrete and other cement mixtures are strongly basic (pH of 12 to 13). Strong bases-like strong acids-are harmful, or caustic to skin.
- **D**rying Portland cement is hygroscopic-it absorbs water. In fact, Portland cement needs water to harden. It will draw water away from any material it contacts-including skin.

Clothing worn as protection from fresh concrete should not be allowed to become saturated with moisture from fresh concrete because saturated clothing can transmit alkaline or hygroscopic effects to the skin. Exposure of the skin to cement can also cause both irritant and allergic dermatitis.

Irritant dermatitis occurs due to the nature of the substance being abrasive and drying. Allergic dermatitis is an allergic reaction to a component in the cement. Subsequent exposure to cement can lead to repeated episodes of dermatitis which in turn can lead to the person having to leave the industry.

Where components in the cement or any additives to the concrete mix are classified as hazardous substances, the supplier of pre-mixed concrete should prepare and provide, Material Safety Data Sheets (MSDS) which contain all relevant information.

Wet cement can also cause burns when trapped against the skin. Barriers intended to prevent contact, such as gloves or boots, must not allow wet cement to be held against the skin. Regular washing with soap and water is necessary to remove cement from the skin.

Waterproof gloves, a long-sleeved shirt, and long pants should be worn. If you must stand in fresh concrete while it is being placed, screeded, or floated, wear rubber boots high enough to prevent concrete from getting into them.

The best way to avoid skin irritation is to wash frequently with pH neutral soap and clean water.

Personal protective equipment for concrete pumping

Any person operating a concrete pumping machine should use appropriate personal protective equipment, which may include:

- eye and hearing protection (contact lens should not be used when working with wet concrete).
- safety helmets.
- sunglasses (safety type).
- sunscreen.
- appropriate high visibility or reflective safety vests.

- protective clothing, such as long sleeve shirts and long trousers or full coveralls. You may even use tight fitting or taped shirt sleeve cuffs.
- high sided protective impervious footwear (note: to prevent concrete entering boots the tops may need to be taped or gaiters worn).
- alkaline-impervious gloves with elasticised wrists.
- cartridge filter dust mask (P2 or equivalent) especially for a Nozzle-Man when shot-creting, and all other personnel in the overspray area, depending on drift caused by wind or restricted work area.
- any other PPE for site specific requirements.

Further information on PPE can be found in Chapter 4 Use of PPE.

Placing and finishing

Waterproof pads should be used between fresh concrete surfaces and knees, elbows, hands, etc., to protect the body during finishing operations. Eyes and skin that come in contact with fresh concrete should be flushed thoroughly with clean water.

Clothing that becomes saturated from contact with fresh concrete should be rinsed out promptly with clear water to prevent continued contact with skin surfaces. For persistent or severe discomfort, consult a physician.

This worker is risking severe health problems by not wearing the correct PPE

Preventing formwork failures

There have been many incidents on construction sites where workers have been injured or killed because formwork has failed during concrete pours. Formwork failure can result in concrete blowouts, falling formwork components or structural collapse, and has the potential to cause death or serious injury.

Formwork failures are often caused by:

- formwork not being designed by a competent person.
- formwork not constructed in accordance with the formwork design or specifications.
- onsite modifications to formwork due to site conditions not addressed in the design.
- damaged or sub-standard formwork components being used.
- removal of formwork before the concrete achieves adequate strength.
- overloading of the formwork during concrete pouring operations.

Formwork can be constructed to meet a custom design produced by a competent person or a proprietary system can be used in accordance with the manufacturer's recommendations.

Safe work method statement

Safe work method statements (SWMS) must be developed for all high-risk construction work that forms any part of the formwork erection, concrete pouring and formwork stripping processes.

SWMS assist Principal Contractors and workers to consider the hazards and risks associated with the high-risk construction work and choose effective control measures.

<u>Control measures</u>

Erecting formwork

- **Ensure** a competent person produces a formwork design capable of supporting the expected dynamic and static loads.
- Where proprietary formwork systems are used, **ensure** they are erected in accordance with the manufacturer's recommendations.
- Where a custom design is used, including when combining different formwork systems or using proprietary systems outside the manufacturer's recommendations, **ensure** the design is completed by an engineer experienced in formwork design (note: This does not apply where there is minimal risk to the safety of persons in the event of formwork failure, such as typical slab on ground formwork).
- **Inspect** formwork components before use, remove defective components from service and tag them out for disposal or repair.
- Before other trades access the formwork or the concrete is poured, **ensure** the erected formwork is inspected by a competent person to ensure it has been erected in accordance with the formwork design. The competent person should document the inspection and sign-off the formwork as ready for use.
- If the erected formwork does not comply with the formwork design:
    - **alter** the formwork so it does comply with the design, or

- **ensure** the designer inspects the formwork and verifies the changes don't compromise the structural integrity of the formwork.

Pouring concrete

- **Ensure** the structural integrity of the formwork has been verified before starting the concrete pour.

- **Establish** an appropriate exclusion zone to prevent people accessing the area under the formwork during the concrete pour and maintain the zone until the concrete reach's adequate strength.

- **Monitor** the formwork during the concrete pour to identify any early signs of failure. The monitors should not access areas under the formwork unless a risk assessment has been undertaken to determine it is safe to do so.

- **Ensure** the formwork is not overloaded during the concrete pouring operation.

Stripping formwork

Ensure the concrete has achieved minimum strength before formwork removal. This may be achieved by ensuring the minimum curing time specified in the formwork design has been achieved, or receiving appropriate certification following concrete specimen testing.

Concrete pumping

The pumping of concrete is an efficient method of moving and placing concrete. The basic process is used in the manufacture of pre-cast and tilt up panels, concrete formwork, slab construction, concrete paving and concrete spraying.

The construction and concrete pumping industries should be aware of the obligations to protect workers and members of the public.

Workers must take reasonable care for their own health and safety while at work and must also ensure that their actions do not harm or place others at risk. They must co-operate with their Principal Contractor on health and safety matters and must not interfere with or misuse anything provided by their Principal Contractor to protect health and safety.

Risk assessment

A risk occurs when a person is within the vicinity of a hazard and exposed to the possibility of harm. In order to assess risk, you must consider the likelihood of harm occurring and the possible consequence of that harm. When assessing the likelihood of harm occurring, factors such as how much, how often and over what time period a person is exposed, need to be considered.

The assessment should be made on the basis of knowledge and experience of the hazard. Risk is always present when handling, transporting, erecting and operating concrete pumping equipment. Although component failure is rare, the consequences are always significant.

Manual handling hazards

A Principal Contractor has a duty to identify any hazard, including hazardous manual handling tasks. These tasks must then be assessed and if a risk of injury is determined, control measures must be put in place. The general term used for a manual handling type injury is musculoskeletal disorder (MSD).

The tasks discussed below are some that have been recognised as likely causes of MSD. These and other manual handling tasks will have to be addressed:

- During set-up the pump workers are required to manually handle items such as timber pads, reducers, pipes and hoses. When handling these items, the terrain or the access to the work area may increase the risk.
- Clambering up formwork or over difficult terrain should not be allowed to occur, a safe means of access for all workers to the pour area must be provided.
- The use of hammers on clamps and the flapper box lever are tasks that if carried out in areas of restricted access may create an increased risk.
- The incorrect positioning of the pump, poor planning, ineffective boom placement, wind forces or oscillation due to pumping may cause the hose-hand to force and hold the hose in the required position to allow precise placement of concrete.
- The laying out of pipes is a task that can require carrying bulky objects. The risk presented by this task can be increased by long distances and the need to manoeuvre pipes around obstacles.
- Bending the back to move beneath objects and stepping over obstructions whilst carrying pipes also increases the risk.
- The location and design of the storage points on the truck for pipes, hoses, reducer, outrigger pads, etc. has a bearing on the postures used and the distance these items must be carried.

Noise hazards

Continuous exposure to noise, above the 85dB(A) sound pressure level for an 8-hour day, will cause permanent hearing damage. Exposure to louder noise 90dB(A) for a shorter period of 2.5 hours in a day can have the same effect. An indication that the noise level exceeds 85dB(A) is if normal conversation is difficult when standing one metre apart.

Where an assessment shows that noise exposure from all sources is above the limit equivalent to 85dB(A) for an 8-hour day the Principal Contractor must consider reducing time of exposure, increasing distance from the noise sources and providing hearing protection.

If workers in affected areas are provided with hearing protection to control exposure to noise, it must be worn at all times the noise level exceeds the limit. Audiometric testing is required when hearing protection is provided by the Principal Contractor to control exposure to noise.

Arrival on site

When arriving on-site the concrete pump operator should be shown the set-up area and the site conditions reviewed with the other workers involved in the pumping operation.

Where any of the conditions under which the pumping equipment is to operate are not satisfactory or if confirmation of the equipment's mechanical soundness is not available, rectification should occur before pumping commences.

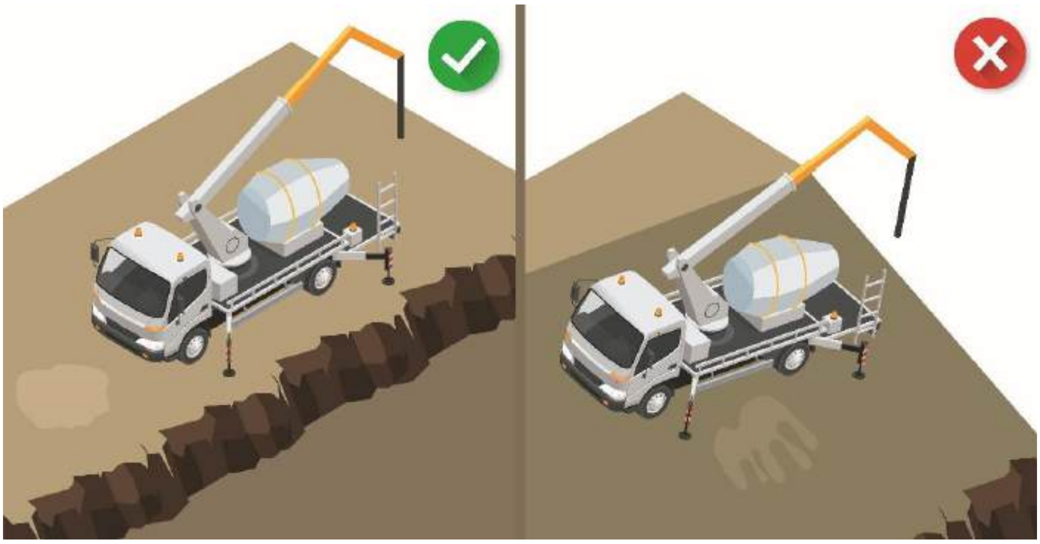
Pump setup

The concrete pumping area should be reasonably level, solid and free of obstructions, with careful attention paid to positioning of the pumping equipment and any stabilising devices:

- clear of excavations, trenches or holes in the ground.
- clear of inadequately compacted or soft ground.
- clear of cellars, basements, pits or back-filled ground, unless approved in writing by a qualified engineer.
- clear of overhead powerlines and fixed electrical equipment.
- to allow for the safe operation.
- to allow for the safe discharge of the concrete delivery trucks.

Boom system setup

The boom placement system should be set-up level or at no greater angle than recommended by the manufacturer as specified in the operator's instruction manual.



Outriggers

Where outriggers are fitted ensure:

- adequate packing of sufficient strength and load bearing area is available for the outrigger stabiliser pads. Packing may include engineered bog mats or suitable timbers. The use of loose softwood timbers is not recommended.
- before the boom is erected the outriggers are extended, lowered and locked in position.
- wherever possible the outriggers should be fully extended.

- if outriggers are not fully extended, the reduced safe operating radius must be known and recorded.
- the pads are clear of excavations, soft or filled ground or other obstacles liable to interfere with the safe operation of the machine.
- regular inspections of the outrigger pads to check for subsidence and loss of stability.
- the boom is folded in the travel position before raising the outriggers, when making any positioning adjustments.

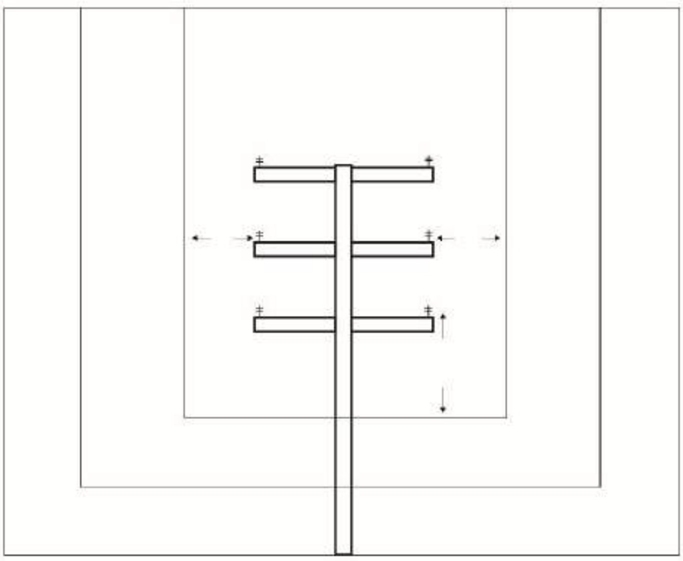
Placing boom

A concrete placing boom should not be:

- raised or left extended when winds exceed the maximum safe wind speed for operation, specified by the manufacturer.
- raised or left extended during an electrical or thunderstorm.
- used as a crane.
- used to pump concrete with the rams in tension, unless designed for this purpose.
- raised, lowered or moved when there is insufficient light to do so safely.

In addition, any truck-mounted placing boom should:

- have the earth safety chain deployed before operation.
- not be raised from the travel position if under a powerline, unless complying with safety procedures below.



Ensure the 'NO-GO-ZONE' rules are followed near powerlines

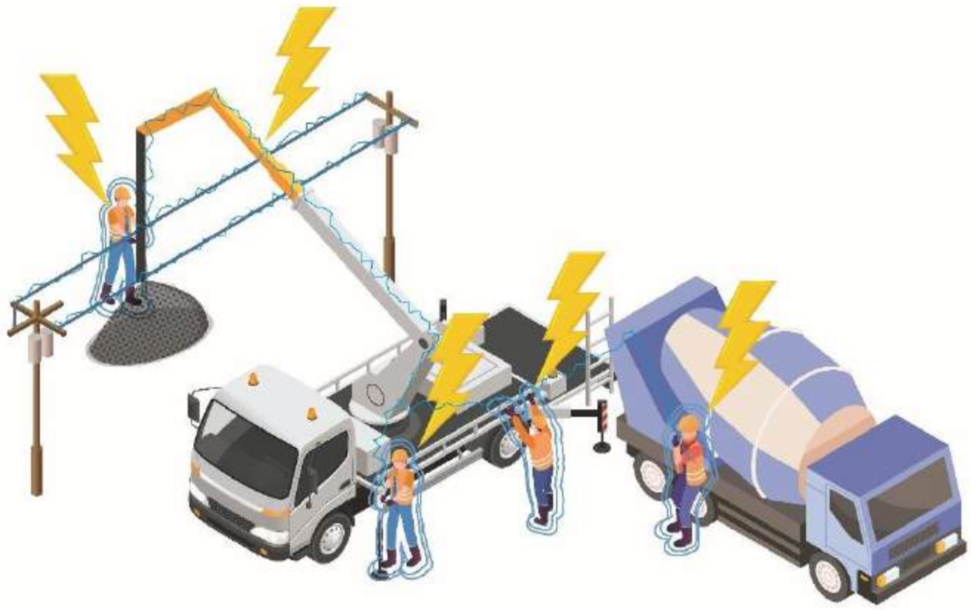
Where a concrete placing boom is to be set-up in the vicinity of aerial powerlines the principal and concrete pumping contractors must ensure, during all stages of the concrete pumping operation, no part of the concrete placing boom comes within 6.4 metres of pole mounted powerlines, unless complying with the requirements of the 'NO-GO-ZONE' rules.

The 'NO-GO-ZONE' rules are:

- the boom never be extended over any live aerial powerline.
- a trained spotter is in attendance when operating between:
  - 3 metres and 6.4 metres of a pole-mounted electricity cable.
  - 8 metres and 10 metres of a tower-mounted electricity cable.
- written permission from the local electricity distribution company, which contains any operating restrictions or conditions, is obtained before operating closer than:
  - 3 metres of a pole mounted electricity cable.
  - 8 metres of a tower mounted electricity cable.

When any type of concrete pumping is being undertaken, the following should be observed:

- allow adequate ground clearances around sub-stations, service pillars, lighting poles.
- the pump or delivery area should not be set-up under powerlines unless complying with this section.
- all powerlines and electrical equipment are considered 'LIVE' unless the distribution company states in writing the electricity has been isolated.



Always use caution when operating a boom near electricity

Enclosed setup area

If the concrete pumping equipment set-up is in an enclosed or semi-enclosed area, special attention should be given to hazards created by the build-up of dangerous exhaust fumes and high noise levels.

Fumes

Ensure that engine exhaust gases from the pump and the delivery trucks are directed away to the open air and a build-up of fumes cannot occur in the work area.

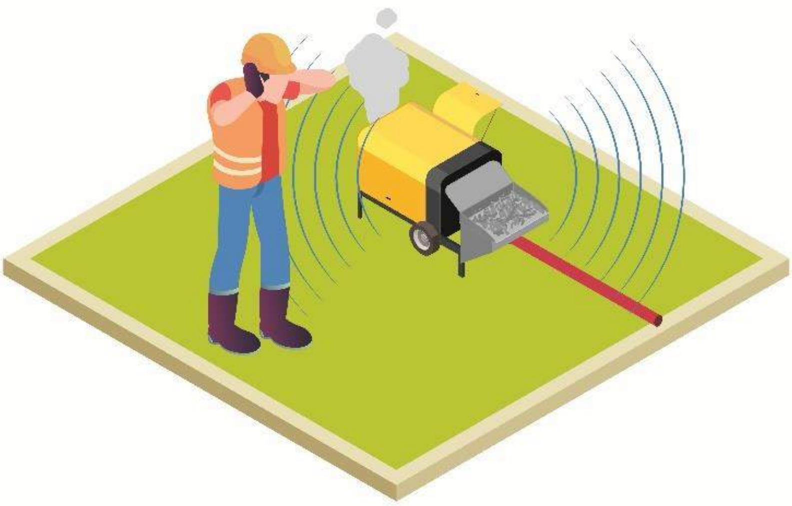
Noise

An increase to the normal operating noise level may occur due to sound being reflected back from other structures. Prolonged exposure to high noise levels causes permanent hearing damage.

Suitable control measures may need to be in place to ensure those persons affected are protected. Persons likely to be affected include:

- all workers in the affected area.
- the operator(s) of the concrete pump.
- the drivers of concrete delivery trucks.
- the operators of other associated equipment.

When positioning the pump, consideration should be given to minimising the effect of the surroundings on workers overall noise exposure.



Prolonged exposure to noise can cause long-term hearing loss

Receiving hopper

The concrete pump should be positioned so the receiving hopper is at a height that allows a gravity flow of concrete from the pre-mix delivery trucks into the hopper. The concrete pump should not be operated unless the opening of the hopper is fitted with a safety grille:

- upon which no one is allowed to stand.
- which prevents access to dangerous moving parts.
- constructed of parallel or mesh bars.
- which requires a tool to be removed, or
- which is connected to an interlocked cut-out switch designed to stop all moving parts if the grille is lifted.

Hopper guarding

A correctly fitted hopper grille reduces the risk of whole of body entrapment with the moving parts within the hopper. The grille, due to its design, cannot protect against all possible contact with the moving parts. Equipment manufacturers use a range of measures to limit the likelihood of entrapment, including:

- the provision of a safety grille.
- separating the operator's controls away from the moving parts.
- the height of the hopper lip from the ground.

When working in the vicinity of the hopper, the manufacturer's operating and safety instructions should be strictly observed.

Operational safety zone

Access to areas around the concrete pump and delivery pipeline may have to be restricted; the most appropriate method of isolating the area should be used.

The use of one or more of the following controls should be considered:

- covered walkways.
- barricades.
- posts and para-webbing.
- posts and danger tape or flags.
- appropriate signage.

Where the pumping or pipeline set-up is for a longer duration project, the isolation methods should be of a more permanent nature.

Other people

No person, other than those workers directly involved in the concrete pumping operation, should be in the operational safety zone during the concrete pumping operation.

Concrete delivery area

The concrete truck delivery area, including the area around the pump hopper, should be set-up to ensure:

- workers are safe from other vehicles.
- when pumping in non-daylight hours adequate lighting is provided.
- appropriate signage is posted.
- there is clear access for delivery trucks.

Where multiple concrete deliveries are expected and on-site traffic management is not provided, only one delivery truck can approach and discharge into the hopper at a time. When a designated on-site Traffic Controller is provided the following safety rules should be followed:

- all personnel connected with the discharging of concrete trucks are to wear appropriate high visibility or reflective safety vests.
- all concrete delivery trucks must have operational reversing beepers.
- the traffic controller and any truck driver discharging at the pump should be in positions which prevent them from being caught between the hopper and a reversing truck.
- before proceeding, the traffic controller should warn the driver at the pump of the presence of another truck being reversed into position.
- the traffic controller should be in a position visible to the reversing driver and where the hopper area can be observed.
- delivery drivers should ensure their vehicles remain clear of the discharge area, until signalled to reverse into position by the traffic controller.
- if the driver loses sight of the traffic controller when reversing into position, the driver should stop immediately.

Ensure you are visible to drivers at all times

Public areas

If concrete pumping equipment or the pipeline is in an area accessible to the general public then the construction site owner or Principal Contractor must provide adequate control measures to protect the public from any dangers associated with the pumping operation.

- **Pedestrian controls**

Where the general public can come into close proximity of any part of the concrete pumping operation, consideration should be given to:

- directing the public to an alternative footpath or providing an alternative pathway.
- the installation of protective screens to prevent concrete splashing on the public.
- the erection of barricades and warning signs necessary to comply with Government requirements.

For longer duration projects, pedestrian controls should be of a more permanent nature.

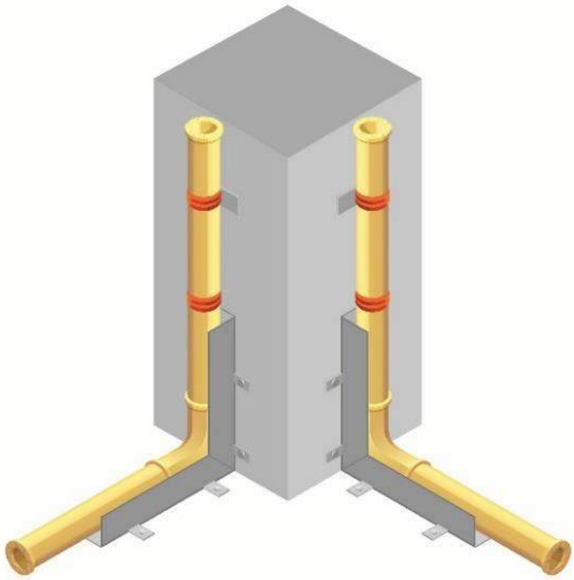
- **Traffic controls**

The construction site owner or Principal Contractor, in consultation with the pumping contractor, should provide adequate traffic control measures to comply with Government requirements. For more traffic control information, see Chapter 24 Traffic Control.

Delivery pipeline setup

When installing a pipeline system, all individual components must be compatible and comply with the pump manufacturer's specifications for minimum pressure rating and maximum diameter. A pipeline should be installed ensuring that:

- the pipeline can withstand the rated maximum concrete pressure of the pump during normal operations.
- unnecessary bends are avoided.
- each section of pipeline is adequately supported and secured to the building to avoid extra load on the pipe clamps.
- when changing from horizontal to vertical, the pipeline is fixed to stop movement of the bend or the vertical and horizontal lines which may cause the 90° bend to snap off at the clamps.
- cranes or hoist towers, scaffolding or formwork are not to be used to secure the pipeline unless designed for this purpose.
- all metal pipes and pipeline components are identified and inspected before installation.
- the designed pressure of the pipeline is compatible with the rated maximum concrete pressure of all pumps to be used on the pipeline during normal operations.



Ensure you install pipelines correctly and securely

Pipe clamps

All pipe clamps used on any pipeline system must be:

- able to sustain the maximum concrete pressure applied to the pipeline by the pump.
- regularly inspected by a competent person for signs of wear or fatigue.
- immediately replaced if deformed or damaged.

An example of a pipe clamp

Quick release pipe clamps may only be used if manufactured with the provision for locking pins and are visually checked prior to each pumping operation. Locking pins, R-type or equivalent, are to be fitted and engaged when quick release pipe clamps are used on fixed or vertical pipelines or:

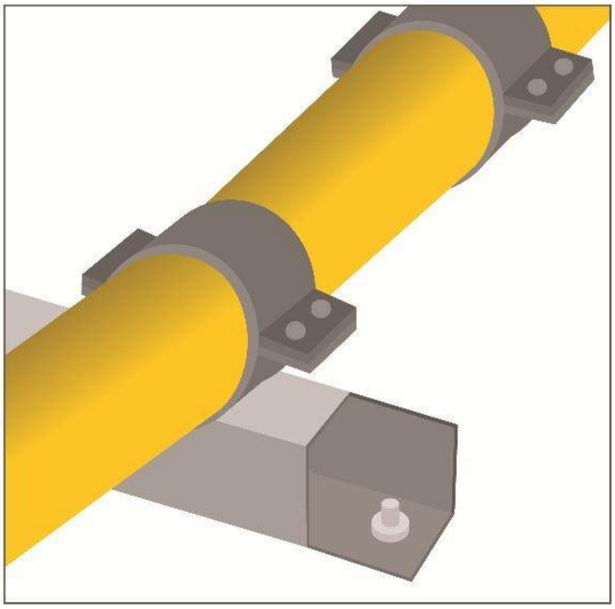
- where compressed air is used for cleaning pipelines.
- the rated maximum concrete pressure exceeds 40 Bar.

Pipeline movement

The pipeline should be adequately secured to the building or structure, with attention given to the reaction forces generated where high pump pressures are involved. The mounting system should be designed to ensure the pipeline remains in place.

Support brackets in a vertical pipeline should be spaced no more than 3 metres apart, expansion anchors of the high-load slip control type or other fixing methods of at least the same structural strength should be used if fixed to masonry.

The surging action of the pump should not cause excessive pipe movement. If required, additional anchor brackets or other suitable methods to restrict pipe movement should be used.



Unsecured pipes can cause serious injury

End-hose

The rubber delivery end-hose should:

- be inspected for excessive wear or damage prior to being fitted.
- where connected to a boom, secured by a safety chain, sling or other retaining device.
- not be longer than specified by the pump manufacturer.

Where concrete pumping has stopped and the hose is being manoeuvred over a work or public area, the operator must prevent concrete falling from the hose outlet. The hose should be fitted with a suitable stop or temporary end cap.

End-hose and reducer combination

If the delivery end-hose is replaced by a hose and reducer combination, only those combinations assembled to the manufacturer's instructions should be used, and:

- locking pins are to be engaged on all quick release pipe clamps in the assembly.
- each piece must be capable of withstanding the rated maximum pressure of the pump.
- each hanging piece is tethered by a safety cable, sling or chain.
- the combined weight of all pieces MUST NOT EXCEED the weight of the manufacturer's recommended end-hose.

Operating concrete pumping equipment

To operate safely any type of concrete pumping equipment it is necessary to have enough workers to control the pumping operation.

These workers need not be directly employed by the concrete pumping contractor but require their Principal Contractor's authorisation before commencing this work.

Communications

The effective passing of directions from the hose-hand to the pump operator is essential for the safe pumping of concrete. The following sample methods may be used:

- Non-verbal: A set of standard hand signals which cover all of the pump's operational functions.
- Verbal: Standard operational phrases and may include the use of a dedicated two-way radio system.

Standard Operating Phrases are vital for clear communication

Pump and boom operators

The operator of concrete pumping equipment should be trained in the operation of the type of machinery being used and:

- be familiar with the operator's instruction manual(s).
- be able to carry out the daily maintenance inspection.
- before pumping commences, carry out a visual inspection of the pipeline.
- not leave operating equipment unattended.
- not adjust the hydraulic pressure relief setting greater than specified by the pump manufacturer.
- know the maximum rated concrete pressure of the pump and pipeline to which the pump is connected.
- not pump concrete unless the hopper grille is in the closed position.

- not stand or allow any other person to stand on the hopper grille or beneath the raised boom.
- be located at the pump controls or if using a remote control have a clear view of either the hose-hand or the hopper.
- follow the directions of the hose-hand.
- if using hand signals and out of view of the hose-hand be assisted by another worker to relay directions.
- if out of view of the hopper have a worker positioned at the hopper to operate emergency systems and control the discharge process.
- report defects to the pumping supervisor without delay, if considered to be a hazard to safety, stop pumping operations until repaired.
- record daily inspections, defects and repairs in the logbook.

The concrete pumping operator should have a certificate of competency from a qualified training organisation when operating a truck-mounted concrete placing boom.

Pump operator/hose-hand

When fitted with remote control facilities, the operator of a mobile concrete pump may operate as hose-hand and also control the concrete pump under the following conditions:

- a worker is positioned at the hopper to operate the emergency systems and to control the discharge process.

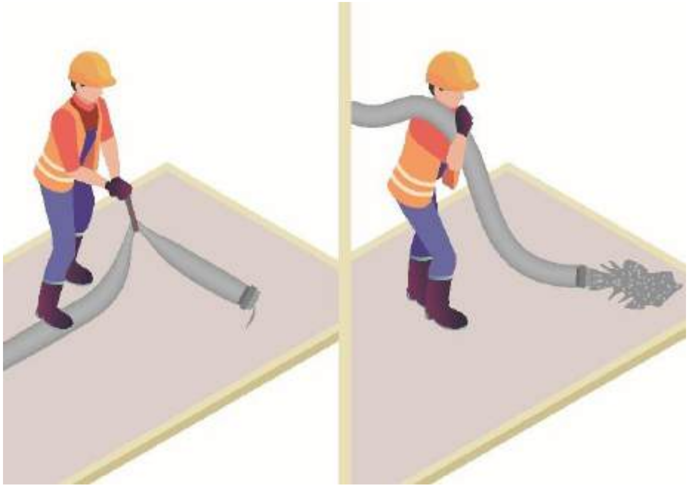
Where a mobile concrete placing boom is to be controlled these additional conditions should be followed:

- any risks, if the equipment is accessible to the public or other workers, have been addressed.
- the boom is visible to the operator and the pump is in audible range.
- there are no obstructions which the moving boom may contact during the pumping operation.

Hose-hand

The hose-hand should:

- be able to communicate with the pump operator at distance.
- inspect the delivery hose for wear or deterioration before use.
- be aware of the dangers and hazards of falling or tripping, particularly while manoeuvring the hose.
- if possible, avoid working directly beneath the raised boom by manoeuvring the hose from the side.
- be trained in the correct methods of manoeuvring the delivery hose.
- not allow other workers to stand directly in front of the delivery hose or beneath the boom.



Don't allow the hose to kink and let the boom do the work

Workers

All workers engaged in the pumping of concrete should be instructed in the concrete pumping SWMS. Where it is applicable to the tasks being undertaken, additional instruction may need to include:

- the equipment's emergency shutdown systems.
- manual handling procedures relating to concrete pumping.
- non-verbal communication if relaying directions.
- basic traffic management if directing reversing pre-mix concrete delivery trucks.

Only those workers who are appropriately trained in traffic management and road safety procedures should act as road traffic controllers.

Note: Generally, drivers of pre-mix concrete delivery trucks should not be considered workers for concrete pumping operations, unless trained to carry out this function and authorised to act in this capacity by their Principal Contractor.

Trainee workers

Trainee workers shall be under the direct supervision of a suitably trained or certificated worker who has been appointed to act as supervising worker by the Principal Contractor and can immediately take action to rectify a dangerous situation.

Concrete delivery drivers

When delivering to site it is essential that all concrete delivery drivers follow the directions of the worker(s) responsible for controlling traffic and the concrete discharge process. This is critical when multiple trucks are discharging or manoeuvring at the pump site.

The following actions should be undertaken by drivers working near concrete pumping operations:

- stand well clear of pump lines and couplings where practicable.

- wear all required personal protective equipment.
- immediately report any safety problems to the pump operator or site manager for action.

Cleaning of equipment

Cleaning out of residual concrete from concrete pumping equipment should only be carried out by trained workers in accordance with the manufacturer's procedures or the detailed written instructions developed by a competent person. When concrete pumping equipment is being cleaned out, ensure another person is in the immediate vicinity to provide help in an emergency.

Pipeline

When cleaning out any pipeline the following safety precautions should be observed in any clean-out procedure:

- the end-hose to be secured or removed before cleaning to prevent the hose whipping around.
- the discharge end of the pipeline to be fitted with a cage to safely catch the cleaning device but at the same time allow the concrete to flow.
- all workers are to be kept clear of the discharge end while the concrete is under pressure.
- never attempt to dismantle the pipeline while it is still under pressure.

When compressed air is used to clean the pipeline, the following safety precautions should be applied:

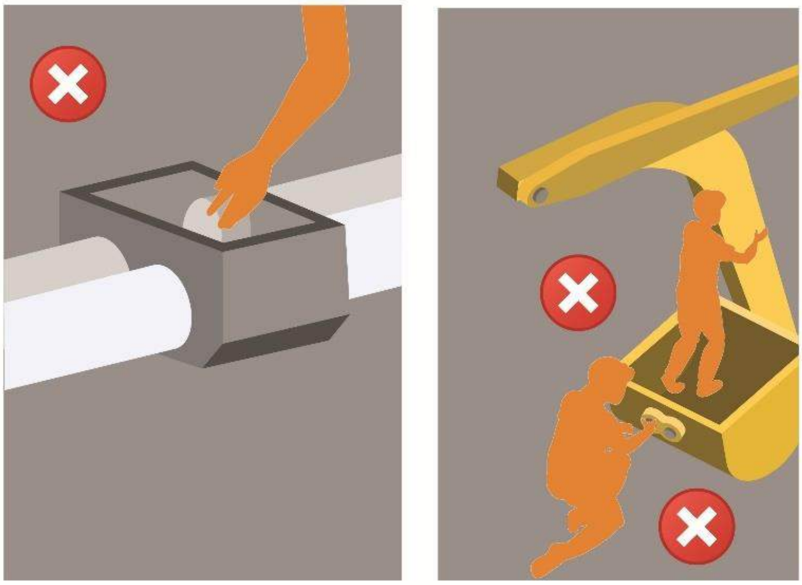
- the air entry point to the pipeline is to be fitted with:
    - a large diameter discharge air ball valve, to allow de-pressurisation (venting) of the line before the removal of the pipe sections.
    - a smaller air entry ball valve.
    - a pressure relief valve.
    - a pressure gauge, to show the air pressure in the pipeline.

Never attempt to repair, clean, or dismantle the pipeline when it is under pressure

Pump and hopper

When cleaning out the pump or hopper the operator should ensure the manufacturer's cleaning instructions are followed. To prevent the risk of entanglement the following should be considered:

- mechanically locking moving parts in position.
- shutting down the equipment.
- disengaging the hydraulic pumps.
- exhausting accumulated hydraulic or air pressure and allowing time for the pressure to be fully released from all systems.
- ensuring the pump is not under pressure before it is dismantled.
- not allowing any part of the worker's body to be placed into the pump or hopper while cleaning.



Do not put any part of the body into the hopper and ensure it has been completely shut down before attempting any maintenance. Note: Ensure a competent person completes all maintenance and repairs

Preparation for road travel

The manufacturer's instruction manual must always be followed and may include:

- the boom being folded and placed in the travel position before the outriggers are retracted and securely stowed in the travel position with locking devices engaged.
- any loose components (such as pipes, couplings and tools etc.), must be correctly stowed or restrained on the vehicle.
- all Power Take Off (PTOs) drives to hydraulic pumps for the concrete pump, boom and outriggers are disengaged and the controls put in the OFF position.
- before moving, visually inspect the vehicle to confirm everything is secured.

Ensure all safety precautions are taken during road travel

<u>Safe concrete cutting and drilling</u>

Developing safe procedures

Before any concrete cutting or drilling starts on a construction site, appropriate planning and preparation are necessary to ensure the work can be done safely. Planning and coordination must involve consultation with those engaged in the work and any health and safety representatives.

A safe work method statement (SWMS) should be prepared. It sets out how the work should be done safely at a particular site. If high-risk work is being done, a SWMS must be prepared before work can start.

High-risk work is construction work involving (but not limited to):

- a risk of a person falling more than two metres.
- demolition.
- the removal or likely disturbance of asbestos.
- structural alterations where some sort of temporary support will be used to prevent the structure from collapsing.
- tilt-up or precast concrete.
- confined spaces.
- tunnels.
- a trench or shaft deeper than 1.5 metres.
- work on or near pressurised gas distribution mains or piping.

- work on or near chemical, fuel or refrigerant lines.
- work on or near electrical installations or services.
- areas that may have a contaminated or flammable atmosphere.
- work on or next to roads or railways that are in use.
- construction sites where there is any movement of powered mobile plant.
- areas where there are artificial extremes of temperature.
- work in, over or near water or other liquids if there is a risk that someone may drown.

As well as covering the risks involved in cutting and drilling, a SWMS should also take account of issues such as weather conditions, access to the work site, barricades and warning signs, and the safe removal of any cut pieces or cores.

All concrete cutting or coring should be done in accordance with the principal contractor's permits and procedures where applicable.

Personal protective equipment for drilling and cutting concrete

Personal protective equipment (PPE) should be provided for all workers who are cutting and drilling concrete. All PPE should be consistent with the relevant Industry Standards. Workers should also be instructed in how to use the PPE correctly.

Operators working outside should also be provided with sunscreen and should wear hats, eye protection, long sleeve shirts and trousers. For more information on PPE, see Chapter 4 Use of PPE

Training and instruction

Principal Contractors have a duty to ensure all workers receive the instruction, training and supervision they need to do their work safely.

Principal Contractors must also ensure their workers have completed:

- national safety induction training.
- a site-specific induction.
- training on the safe use of machinery, including concrete cutting and drilling equipment.

Inverted cutting/drilling

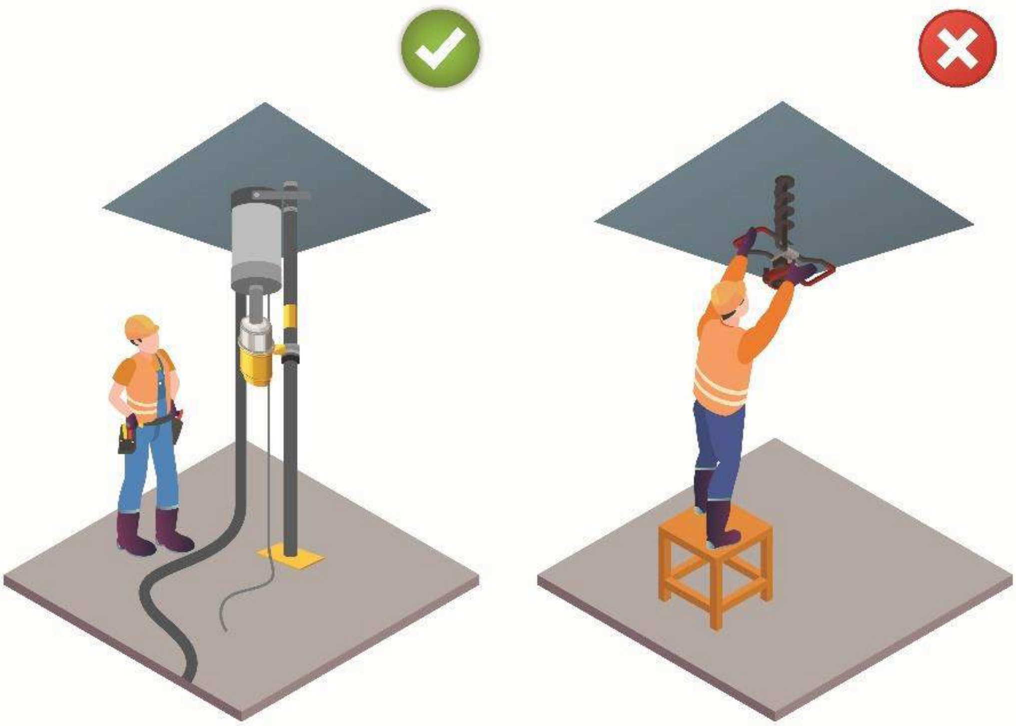
As the name suggests, inverted drilling is core drilling upside down through the underside of a concrete structure and is typically used in applications where access from above is restricted.

In most cases, it should be possible to make the cut from on top of the slab, without the need for inverted cutting.

If this type of work has to be done, it should only be performed by appropriately trained people. A hand-held saw should never be used for inverted cutting because the operator has little control of a cutting machine held above shoulder height.

Control the risk

- Attach a track-mounted wall saw to guide tracks bolted to the slab.
- Never use electric powered water-cooled saws for inverted cutting unless it is specifically designed for the purpose. If the saw is turned upside down, water can flood into the motor and cause the electricity to earth through the operator.



Never use a handheld drill or saw for Inverted Drilling or Cutting

Dust and gases

Concrete cutting and drilling can generate large amounts of dust, including respirable silica dust that can cause silicosis (a serious respiratory illness) if inhaled. Dry cutting and drilling are also unsafe as it can cause the blade to heat up and crack becoming a potential projectile.

Toxic exhaust fumes from equipment powered by internal combustion engines, including hydraulic power packs, can quickly reach dangerous levels when operated in enclosed or poorly ventilated areas. These engines can also rapidly consume the oxygen in the air.

Control the risk

- Where possible, use concrete and drilling equipment that is fitted with extraction devices to eliminate dust production at the source.
- Use wet methods to minimise dust production and ensure enough water or coolant is supplied.
- Remove slurry before it dries to prevent the dried material from generating dust that can be spread to other areas of the site.

- If it isn't practicable to use water suppression or dust extraction equipment, liquid nitrogen (e.g., in furnaces) or dry ice (e.g., in cool rooms) may be appropriate.
- Consider using slower cutting and drilling equipment which produces less dust.
- Provide extractor fans in confined spaces or poorly ventilated areas.
- Use respiratory protection. Appropriate respirators should be selected taking into account the work to be carried out. Additional ventilation should also be provided.
- Use hydraulic, pneumatic or electric powered saws and drills, rather than petrol-driven equipment in confined spaces.
- If chemicals or other hazardous substances are used as aids in cutting or drilling operations, make sure they are used in accordance with information supplied by the manufacturer on the material safety data sheet (MSDS).
- If possible, workers should change out of their work clothes at the site to prevent the spread of silica dust.

Noise when drilling or cutting

Excessive noise from concrete cutting and drilling can damage an operator's hearing and the hearing of other people in the vicinity. Hearing damage can result from very loud noise over a relatively short period or by exposure to a lower level of noise over a longer period.

During normal use, concrete cutting and drilling equipment create excessive noise levels for the operator and others nearby.

Control the risk

- Obtain information on the noise output of different models from manufacturers and suppliers before purchasing or hiring equipment.
- Assess the suitability of using noise-reduced saw blades for a particular job.
- Select the quietest suitable model and blade available.
- Keep people not directly involved in cutting or drilling away from excessive noise areas.
- Where practicable, erect temporary acoustic barriers around cutting and drilling areas to further reduce the spread of noise.
- Provide training and instruction about the effects of excessive noise on hearing, noise control measures and the proper use and maintenance of hearing protectors.
- Provide operators and nearby workers who need to be in excessive noise areas with hearing protectors.

Vibration from drilling or cutting

Vibration transmitted from cutting and drilling equipment can cause damage to the spine and the peripheral nervous and vascular systems. Operators may also suffer from fatigue, headaches and gastrointestinal problems.

Hand and arm vibration can lead to Raynaud's Disease (or white finger), resulting in the loss of the sense of touch, heat, numbness and loss of grip strength. Other effects can include damage to tendons, bones and joints in the hands, wrists, arms, elbows and shoulders, and carpal tunnel syndrome.

Control the risk

- Purchase or hire equipment that does not have to be held or manually supported or vibrates less.
- Equipment should be well-balanced, as light as possible and capable of being held in either hand (or in different sized hands).
- Ensure the equipment has vibration-absorbing handles or an even surface on the handles to distribute gripping force.
- Consider wrapping metal handles with soft resilient rubber lagging to effectively reduce vibration exposure.
- Provide gloves that allow equipment to be gripped more effectively (note that some industrial gloves are unsuitable and can actually make gripping more difficult). Gloves also help to keep the hands warm, increasing blood flow to the fingers. Gloves, however, have a minimal effect on vibration exposure.
- Where practicable, use concrete cutting or drilling equipment rather than hand-held jackhammers.
- If hand-held jack hammers need to be used, make sure they are used as little as possible and for no more than 30 minutes a day.

Hazardous manual handling

Concrete cutting and drilling involve a range of hazardous manual handling tasks that can cause injury. Lifting and operating equipment that typically weighs up to 30kg can result in sprains and strains, including back injuries. Operators are also at risk if they are required to hold a saw in the same awkward position for an extended period.

Slips and trips while handling equipment or materials are common causes of injury. Serious injuries can also be caused by sudden violent reactions by a saw (kick-back, pushback or pull-in) when the blade strikes a hidden obstruction or resistance or is pinched or jams in the cut.

Control the risk

- Suspend or support cutting and drilling equipment in a frame to reduce the forces and to avoid the need for awkward and static working positions.
- Select lighter equipment, such as smaller diameter blades, where possible.
- Reduce the range of movement of the equipment to minimise the effect or forces needed to guide or control it.
- Ensure operators receive appropriate training in safe systems of work for handling the equipment and materials involved.
- Avoid kick-back, push-back and pull-in situations by pre- checking blades and other saw components for wear and tear, assessing materials to be cut, locating hidden steel reinforcing and other obstructions, and avoiding hazardous cutting situations.
- Provide gloves that allow equipment to be gripped more effectively.

Working at heights when concreting or drilling

Using concrete cutting and drilling equipment at height is dangerous. Heavy equipment cannot be used safely on an unstable platform and portable equipment should never be used while standing on a ladder.

Control the risk

- Carry out work at height from a safe working platform, preferably personnel scaffolding.
- Use appropriate mobile scaffold, taking into account stability and loading issues.
- Use elevating work platforms where scaffolding is not practicable.
- Never operate concrete cutting and drilling equipment while standing on a ladder.
- Access to and egress from working platforms should be by a walkway or stairway, or a temporary work platform such as an elevating work platform, scaffold or personnel cage on a forklift.

Electricity

There is a risk of electrocution if extension leads, plugs and electric powered tools are used around water. Electrocution can occur if hand-held equipment is inverted when drilling. Specialist three-phase equipment is available that can be used for wet cutting.

Any damaged equipment that could involve an electrical risk must be replaced or repaired. Principal Contractors must also have appropriate work systems to prevent inadvertent energising of equipment that has been isolated but not physically disconnected from the electrical supply (e.g., lockable covers over safety switches could be installed).

For more information on electrical safety, see Chapter 8 Electrical Safety Throughout Construction.

Control the risk

- Never use electrical cutting or drilling equipment for inverted cutting unless it is specifically designed for the purpose.
- Remove pooled water (such as coolant water used in concrete or masonry cutting and drilling) with a wet and dry vacuum cleaner before any electrical equipment is used in the area.
- Keep extension leads, plugs and electric powered tools away from dry cutting equipment or drilling water or slurry that cannot be easily removed.
- Never use electric equipment for wet cutting unless it is specifically designed for the purpose - use hydraulic, pneumatic or petrol engine powered equipment instead.
- Map out the location of existing electrical or other services (e.g., gas, water and sewerage) before work begins.
- Use a power supply fitted with residual current devices (RCDs) for portable electrical equipment to protect against earth leakage shock. Test portable RCDs regularly to ensure they are working properly.
- Inspect and tag all electrical equipment used for cutting or drilling operations.

- Suspend cords and extension leads above head height on stands and use waterproof connectors where there is water.

Damage to structures

Operators and others can be at serious risk if stressed components or components that affect the integrity of a building are damaged during cutting or drilling.

Control the risk

- Confirm the location of any structural components or services within the slab or wall.
- Seek advice from a structural engineer for all alterations.
- Ensure a competent person supervises the work.
- Carry out a risk assessment if components such as stressing tendons must be cut.
- Locate and mark all components that will affect the strength of a structure if cut.
- Seek advice and supervision from a structural engineer for all cuts to structural components.

Damage to services

All precautions must be taken to avoid cutting through gas, electricity or water services at the construction site. In addition to the risk of personal injury, the financial and social costs of damaging underground services can be extremely high.

Control the risk

- Locate and mark all services during initial safety planning by contacting the local government authority.
- Consult the original drawings of the services and conduct a search for any 'as constructed' drawings in case there has been a change of location of services during installation (e.g., services located in floors, walls and cavities).
- If the services have been moved, use specialist equipment (e.g., a cable locator) to accurately determine where the services are now located prior to any cuts being made.
- Disconnect any services that need to be cut through.
- Ensure disconnections are confirmed and tagged by the relevant service personnel before the work begins.
- After the work has finished the service personnel should reconnect the service and, if safe, remove the tags.

Loss of vacuum pressure

Operators using a vacuum assembly to anchor a core drill stand to a surface risk being injured if the vacuum pump fills with slurry. This can cause loss of vacuum and can result in the drill stand breaking free and rotating round the drill.

Control the risk

- Use bolt down stands where practicable.
- If a vacuum attachment must be used, ensure the surface to be cut is able to maintain an adequate vacuum.
- Monitor the equipment to ensure the vacuum pressure is maintained.
- When a vacuum system is used to secure a drill stand to concrete, the compressor should have a receiver tank to ensure the operator has time to take action (if power is cut to the compressor) before the drill loses it hold.

Working alone

There is a greater risk of injury when an operator is working alone because of difficulties in setting up and relocating equipment on site, the nature of the work and the absence of a back-up person in case of an emergency. If possible, work plans should be arranged so there is no need for workers to work alone.

A worker is considered alone when they cannot be seen or heard by another person and cannot expect a visit from a supervisor, another worker or a member of the public for some time.

Control the risk

- Avoid situations where operators need to work alone.
- Carry out a risk assessment and consider supervision and emergency response procedures when developing safe systems of work.
- Provide communication systems to enable an operator to call for assistance if anything goes wrong.

Entanglement

Workers can receive horrific injuries if machinery is fitted with effective guarding. An operator's hair, beard or loose clothing can get caught in moving saw blades, drill bits and other moving parts if precautions aren't taken.

Control the risk

- Ensure all machinery is fitted with appropriate guarding.
- Fit blades saw correctly.
- Ensure workers tie back long hair and don't operate machinery while wearing loose fitting clothing, including reflective safety vests.

Managing risk with prefabricated concrete

What is prefabricated concrete?

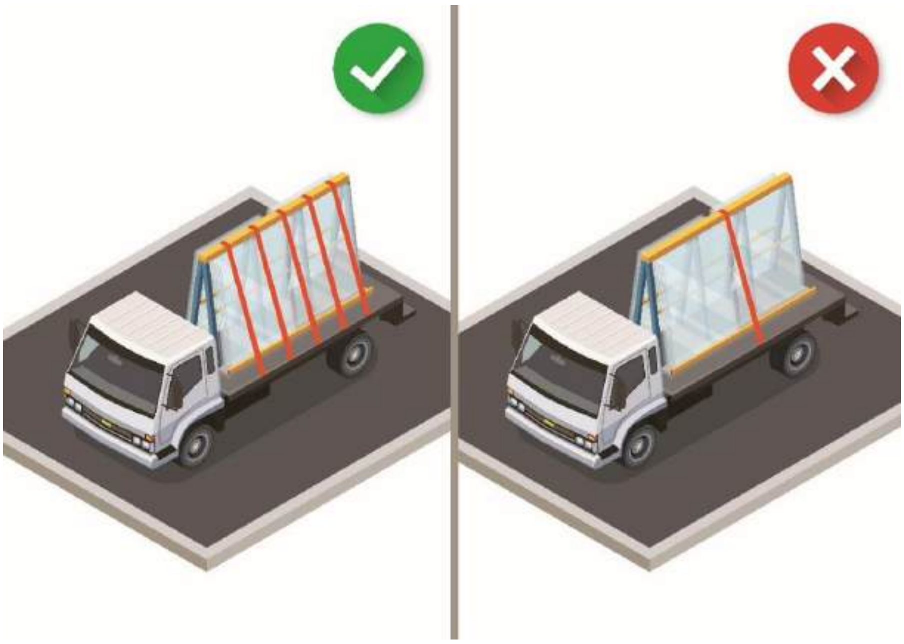
Prefabricated concrete is a concrete element that is manufactured somewhere other than its final place of installation. Examples of prefabricated concrete elements used in construction include wall elements, columns, beams, flooring and facade units, concrete pipes, bridge beams or culverts.

Prefabricated concrete construction is a method of prefabricating concrete in discrete elements and erecting and incorporating them by crane into their final position in the building structure.

Planning on-site movement

The construction site owner or manager is responsible for planning the on-site movement of prefabricated concrete elements. This should be done taking into account the WHS management plan and erection design to eliminate or, if elimination is not reasonably practicable, minimise risks to health and safety. Relevant considerations include:

- whether the work area will be appropriately secured.
- where safe entry and exit points will be.
- whether exclusion zones are required.
- if a construction zone will be established on a public street.
- if the erection crew will be competent and suitably qualified.
- what emergency arrangements are.
- whether working at height will be necessary, and if safe systems are required.
- how machinery will be operated safely, especially near overhead electric lines, and
- required inspections and maintenance for all equipment.



The correct and incorrect method of fastening prefabricated concrete for transport

Unloading

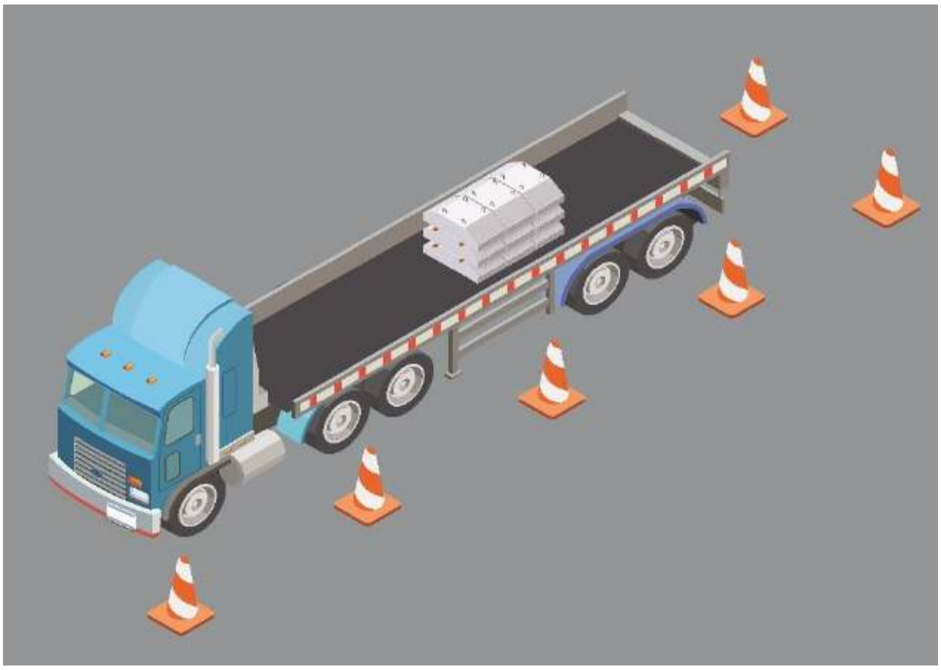
Unload prefabricated concrete elements in accordance with the erection documentation. Before unloading, check the:

Element quality

- the manufacture certificate of compliance matches the prefabricated concrete elements.
- confirm that the concrete strength for lifting has been achieved, and
- no damage has occurred during transport.

Site

- an exclusion zone has been established.
- the delivery vehicle and crane are stable and on level ground, and
- the wheels of the delivery vehicle are chocked, and the park brake is applied.



Make sure there is an exclusion zone around the delivery vehicle

Lifting equipment

- the lifting inserts are not damaged and are compatible with the lifting system clutches being used.
- the nominated brace fixing bolts are available on-site, and
- any strong backs have been correctly placed.

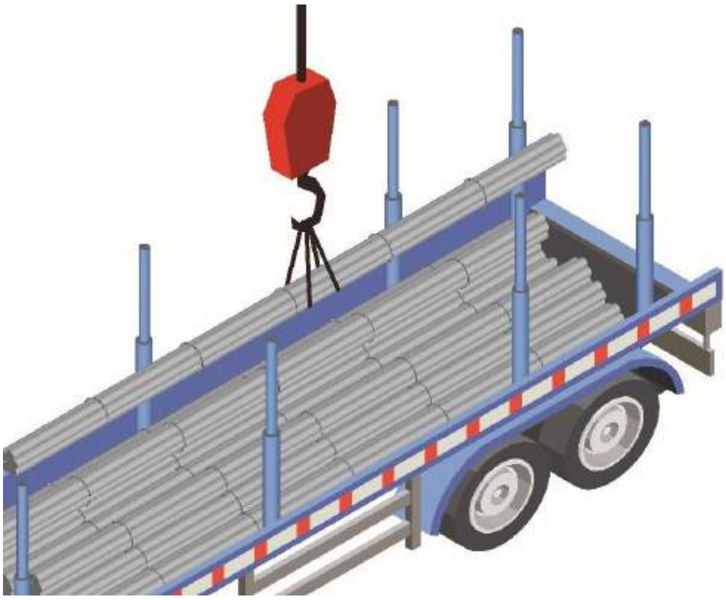
Only people who are involved in unloading the prefabricated concrete elements should be within the vicinity of the delivery vehicle. Do not stand near the vehicle in an area where an element would fall if the vehicle was knocked or moved, or if rigging was to fail.

Particular care should be taken when unloading elements to ensure the load and frame remains stable. Semi-trailers should be stabilised by lowering the support legs onto a firm base. Where unloading cannot take place on a firm level surface, the loading configuration must be checked to ensure that removing individual elements does not result in instability of the load or the vehicle.

Check any identified hold points and witness points have been met before unloading prefabricated concrete elements.

If a prefabricated concrete panel has been damaged during transport, the in-service design engineer and erection design engineer should provide approval before the panel is unloaded from the delivery vehicle.

When unloading, only release each prefabricated concrete element once the crane has taken the initial load, to minimise the risks of dropping the element. Individually secure each element, as the unloading sequence can lead to load instability.



Each lift of material should be secured to prevent it from falling loose

Storage

Store prefabricated concrete elements in accordance with the SWMS and the erection documentation. The way prefabricated concrete elements are stored will depend on the type of prefabricated concrete element.

If the erection documentation requires prefabricated concrete elements to be stored in a location where vehicles are used, erect bollards or other physical barriers and appropriate warning signs to minimise the risk of a collision.

If prefabricated concrete elements cannot be stored in accordance with the erection documentation (for example due to poor weather impacting planned erection), the erection design engineer should provide instructions about how to store the prefabricated concrete elements safely.

Prefabricated concrete elements should not be stored horizontally or on a suspended floor slab or beam unless approval and written instructions have been provided by the erection design engineer.

If the erection design engineer has not provided their approval, prefabricated concrete elements should be stored at ground level.

When prefabricated concrete elements are stored off-site (for example at a manufacturing facility), store them in a way that will not compromise their quality.

Erection process

Erecting prefabricated concrete elements is a complex process. Manage risks by undertaking checks pre-erection, implementing controls during erection, and inspecting and maintaining temporary supports.

Pre-erection

Before erection commences, consider the qualifications of the erection crew, set up an exclusion zone, and complete a pre-erection checklist.

Erection crew

All members of the erection crew should be trained and qualified in how to erect prefabricated concrete safely. The crane operator must hold a licence appropriate for the type and capacity of the crane in use.

The erector should nominate one person in the erection crew to be responsible for the implementation and coordination of the erection process. This person should hold an intermediate or advanced rigging licence.

Make sure that all members of the erection crew have access to the erection documentation and PPE that functions according to the relevant standard. Ensure that the erection crew understand the engineering assumptions that have been made, such as for wind loads and when work should be stopped.

Exclusion zone

Set up exclusion zones to minimise the risk of prefabricated concrete elements and cranes striking people, or people being caught between a prefabricated concrete element and another hard surface.

The size of the exclusion zone will depend on the associated risk assessment. Only allow people directly involved with the lifting of prefabricated concrete elements to access an area where lifting is taking place and plan the zone so that loads will not be suspended over, or travel over, a person.

Depending on the construction site and local regulations, the construction site owner or site manager should consider installing appropriate signage, barriers and perimeter fencing to establish an exclusion zone. The construction site owner or manger should consider whether any common boundaries or public footpaths, roads or access ways will interact with the exclusion zone and take this into account in planning how to communicate the exclusion zone.

Where a footpath, road or other access way is located in an exclusion zone, ensure members of the public and traffic will be prevented from passing through the zone while prefabricated concrete element construction work is being undertaken.

Pre-erection checks

The erection sequence will be different for each project because different factors will impact each construction site. Before commencing erection, review the SWMS, WHS management plan and erection documentation, check the site is prepared appropriately and that the prefabricated concrete elements are not affected by deficiencies

Elements should not be erected on site within three (72 hours) days of casting unless the concrete in the specific elements has been tested to confirm that the design strength for erection has been attained. Test results must be available on site prior to erecting the element.

Crane setup and operation

Crane and rigging equipment will be needed to move prefabricated concrete elements. This will often involve working at height. Industry standards state that these activities are high risk construction work and there are specific precautions that must be taken to manage risks to health and safety. For more information, see Chapter 13 Safe Use of Cranes.

Preparation

The construction site owner or manager should check that riggers and crane operators are experienced and have the correct high risk work licence for the work to be undertaken.

To choose the most appropriate crane, identify hazards and conduct a risk assessment. Consider:

- the construction site, including any overhead power lines.
- where on the site the crane will be located.
- the necessary clearance for the crane.
- the required lifting capacity of the crane.
- the rigging system that will be used, and
- the potential impact of wind.

The erection documentation should outline the wind speed that the prefabricated concrete elements have been designed to withstand.

Operating cranes

Prefabricated concrete elements must be lifted in accordance with the SWMS. The erection documentation and the plan developed by the construction site owner or manager should also be followed. Cranes should only be operated in accordance with the manufacturer's instructions.

When a prefabricated concrete element is required to be rotated about an edge, such as when tilting up a panel that has been cast on-site, the prefabricated concrete element should not lean towards the crane.

If part of the lifting system fails while a suspended prefabricated concrete element is leaning toward a crane, the element can fall against the crane and may cause the crane to overturn.

When a prefabricated concrete element is required to be rotated mid-air, such as when a prefabricated concrete panel is being lifted from a vehicle, multiple cranes or a single crane with two hoists should be used.

When multiple cranes are used, the load is shared between both cranes. The load on each crane changes as the element is rotated. Before commencing any lifts, the maximum load share on each crane should be calculated and a lift procedure developed to ensure each crane remains within rated capacity throughout the lift.

When the main and auxiliary hoists of a single mobile crane are used simultaneously, the load is shared between the two hoists. The load on each hoist changes as the element is rotated. The auxiliary hoist should be able to take 70-75 per cent of the weight of the panel during a rotation. A lift procedure should be developed to ensure the crane remains within rated capacity throughout the lift. The procedure should ensure the element is supported by the main hoist after its rotation.

During any mid-air rotation, at least one of the crane ropes will deviate from the vertical. Take care to ensure any resulting fleet angle does not exceed any limits specified by the crane manufacturer. Cranes should be orientated relative to the element in a manner that prevents side loading of sheave booms.

The crane and rigging should be designed to lift the prefabricated concrete elements. Do not use a crane that does not have the required capacity or is not designed to lift prefabricated concrete elements.

If the crane will be set up on the ground, obtain written certification of the ground bearing capacity from an engineer with specific experience in soil engineering. The engineer should identify and assess backfilled excavations, trenches and soak wells, make any necessary recommendations, and assess their implementation. For example, timber mats may be needed to ensure any backfilling can support the crane and load.

Choose lifting manoeuvres based on the type of crane being used, the construction site and the specific elements. Make sure that cranes are operated, inspected and maintained by a competent person in accordance with the manufacturer’s directions

During erection

Everyone involved in the erection of prefabricated concrete elements should be aware that it is a potentially hazardous activity. Handle each prefabricated concrete element in accordance with the erection documentation.

Double-check the erection documentation with the erection design engineer when:

- precast concrete is supported on formwork or even cantilevered formwork (e.g., balcony panel so the slab can tie into panel).
- vertical propping is expected to take weight of the panel (e.g., acrow prop could dislodge).
- if there are less than 2 dowel bars (method of restraint at the base of the panel), or
- there is no strongback over a door, opening or thin section.

Grouting should occur as soon as possible after erection to lock in the base and prevent movement.

Movement of workers and loads

Prefabricated concrete elements should not travel over a person while suspended.

People permitted within the exclusion zone should avoid being in a position where they can be struck in the event of a prefabricated concrete element falling, a crane collapsing, or being caught between a prefabricated concrete element and any other hard surface.

Where the need to carry out work at height has not been eliminated during planning and design, the construction site owner or manager must minimise the risk of falls and maintain a safe system of work. This should include providing a fall prevention device (such as secure fencing, elevating work platforms or scaffolding), or if that is not reasonably practicable, a work positioning system or a fall arrest system.

Ensure that no one works on a prefabricated concrete element that is leaning towards them and no one is placed between a concrete element being lifted and another wall or object.

Modifying prefabricated concrete elements

Prefabricated concrete elements should not be modified in any way during erection without the express approval of the erection design engineer, in consultation with the in-service design engineer. This includes physical modifications to the concrete element as well as modifications to the erection process such as using different lifting points, different erection sequence or changing rigging configurations.

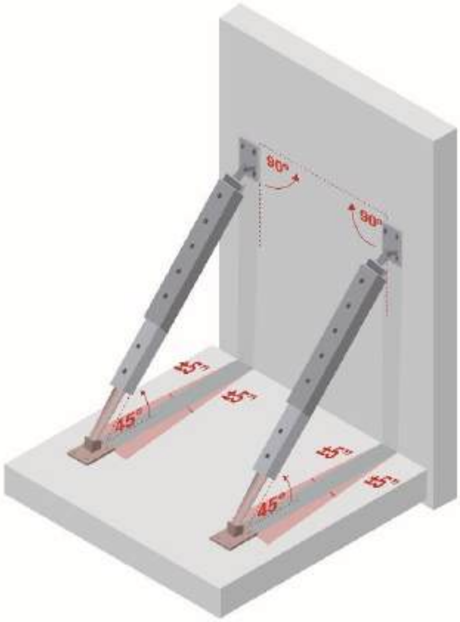
Approval should be provided in writing to the construction site owner or manager before modification takes place. Relevant documentation such as shop drawings, should be updated and re-numbered where necessary, and previous versions clearly labelled that they are no longer valid. Alterations or additions to the prefabricated concrete element should be communicated to all persons involved in the erection and installation processes.

Installation of temporary supports

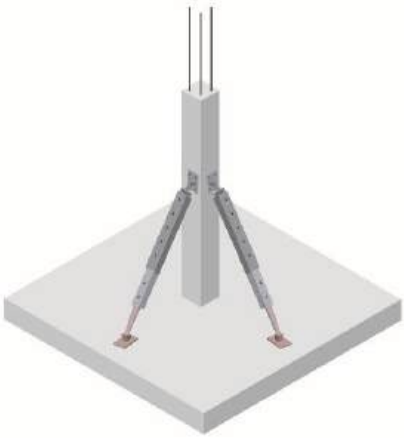
Ensure temporary supports and braces are installed in accordance with the erection documentation. Double-check the erection documentation with the erection design engineer, when:

- fewer than two or three or more temporary supports are to be used for a prefabricated concrete element.
- braces are to be installed at an angle of less than 45 degrees or more than 60 degrees.
- braces are skewed more than five degrees and are not perpendicular to the prefabricated concrete element.
- a brace already connected to one prefabricated concrete element is to be connected to another braced prefabricated concrete element for support, or
- levelling shims are more than 40 millimetres high or are located less than 200 millimetres from the end of the prefabricated concrete element.

Do not deviate from the erection documentation unless prior written approval is obtained from the erection design engineer.



When bracing thin prefabricated concrete elements, it may only be possible to use one brace in each direction. Implement additional precautions to protect those braces from impacts (See figure below).



In the event of adverse weather conditions, it may be necessary to stabilise incomplete structures using measures considered as part of the initial design and forming part of the designed erection sequence. This should not be an ad-hoc means of stabilisation. Where a prefabricated concrete element cannot be stabilised overnight, it should be stored at ground level, unless the erection design engineer approves an alternative storage method.

When temporarily erected

Prefabricated concrete element structures are susceptible to progressive collapse, so it is essential that the failure of a single prefabricated concrete element does not lead to the complete collapse of the structure. Manage risks when using temporary supports by inspecting regularly, removing support safely and only storing verified loads.

Inspection of temporary supports

The erection design engineer and construction site manager should establish a plan to ensure the stability of the structure is monitored and maintained while temporarily erected. Braces and bracing inserts, propping, fixings and connections should be verified weekly and after major weather events to ensure the stability of the structure is maintained. The stability of the whole structure should also be checked at each stage of the erection process. Confirm the correct setting torque for all cast-in components with the supplier and ensure brace anchor installations are completed with a calibrated torque wrench to ensure the correct torque is achieved.

Storing objects

Objects, including prefabricated concrete elements, should only be stored on the structure if the erection design engineer has verified the loads can be supported. Consult the erection documentation for information on where materials and mobile plant can be stored or operated, the maximum allowable loads, the relative locations of the storage areas, and any additional temporary supports required to carry these loads.

Post-erection

Incorporation into final structure

Follow the structural drawings and the instructions of the in-service design engineer when attaching prefabricated concrete elements to other structural elements. The erection design engineer should also approve any variations to the design specifications.

Prior to incorporating prefabricated concrete elements into the final structure, consider site specific safety factors such as how the prefabricated concrete elements will be fixed to the structure, the effect of impact loads on the existing structure when positioning the elements, and the effect of wind loading on the structure in its partially completed state.

Removal of temporary supports

Only remove temporary supports in accordance with the instructions provided by the in-service design engineer.

Ensure all hold points have been met before removing any temporary supports. Before removing temporary supports, a competent welding inspector should confirm any structural welds have been completed in accordance with the structural drawings and the relevant technical standards. The in-service design engineer should provide written confirmation that the temporary supports can be removed.

Skewed panel braces can be dangerous

Construction site managers must ensure that the braces supporting concrete panels meet specific conditions and are not skewed when in use.

Safety issues

Skewed braces are weaker than those installed in a plane perpendicular to that of the panel (when viewed in plan). This is because they have less capacity to bear load, which can affect the stability of the precast panel.

Recommended control measures

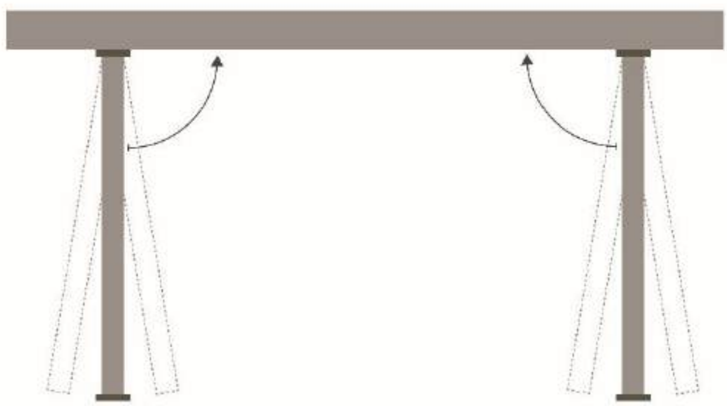
Brace manufacturer and supplier load charts specify that braces must:

- be inclined no less than 40 degrees and no more than 60 degrees to the horizontal.
- be installed in a plane perpendicular to that of the panel (when viewed in plan).

Industry standards will typically not recommend braces skewed more than five degrees on either side of the plane perpendicular to the plane of the panel.

Where braces cannot comply with these two conditions, the design and installation must consider factors such as induced lateral or torsional forces. The proposed brace design must then:

- be verified by the erection design engineer.
- clearly specify the limit of the skew, and
- be shown clearly on shop drawings.



The erection design engineer must verify shop drawings

Shot concreting of retaining walls for excavations

Shot concreting or Shotcreting is a process of spraying concrete onto a surface using compressed air. The process allows construction of a cast in-situ retaining wall. Shotcreting is commonly used in basement construction and is usually done in conjunction with other preparation work such as excavation, piling and concreting.

Site restrictions often result in the sides of an excavation not having the required structural integrity during construction, creating the risk of collapse. If the side of an excavation collapses, anyone installing temporary supports or constructing the retaining wall is exposed to risk of serious or fatal injuries. These collapses can also expose the public to risks.

Shotcreting uses a high-pressure hose to spray concrete onto surfaces

Hazards and risks

Tasks involved in the work that often create hazards include:

- detailed excavating of the face for the wall.
- excavating the footing at the base of the wall.
- constructing pad and strip footings at the base of the wall.
- drainage works.
- pouring a concrete slab.
- stabilisation of the wall.
- reinforcing the wall with a retention system.
- applying shotcrete.
- finishing the surface.

Key hazards that could result in serious injury or fatality include:

- collapse of the wall substrate during preparation for, or during, shotcreting or finishing.
- falls from height.
- being struck by machinery.

The shotcrete application process itself has hazards, including:

- exposure to cement and concrete additives.

- the high-pressure air used to spray the shotcrete mixture.
- overspray when directing the mixture onto the surface via a handheld nozzle.
- mist generated by high pressure air forcing the mixture through the spray nozzle.

Risks from the application process hazards include (but are not limited to):

- being struck by high pressure air or concrete mixture (e.g., abrasions, tissue damage, eye injury).
- being struck by unsecured hoses (e.g., bruising, lacerations, fractures, concussions).
- inhaling concrete mist (e.g., silicosis).
- injuries from skin or eye contact with the concrete mixture (e.g., chemical burns, contact dermatitis).
- slips, trips and low height falls.
- lacerations and abrasions.
- sprains and strains from hazardous manual handling.
- hearing damage from excessive noise.

Control measures: excavation collapse

Eliminate the risk to workers undertaking shotcrete work from excavation collapse by:

- installing basement walls before excavating the basement:
  - boring and pouring concrete piers.
  - excavating a trench and pouring a reinforced wall.
- excavating a larger area and building a retaining wall outside the fall shadow of the excavated wall and then backfilling.

If it is not reasonably practicable to eliminate the risk of excavation collapse, it can be reduced by ensuring adequate ground support is provided before anyone approaches the wall of the excavation. This can include:

- battering excavation walls to an angle of 45 degrees.
- benching excavations walls.
- stabilising or securing excavation walls with rock nails or ground anchors.
- ensuring excavation walls without ground support are self-supporting (stable) by:
  - obtaining written verification of stability from a suitably qualified person (e.g., geotechnical engineer) before work commences.
  - monitoring the condition of the excavation wall while the excavation face remains exposed, especially when there is a change in conditions (e.g., weather).
  - obtaining a reassessment of stability by the suitably qualified person if the excavation face is exposed for more than 48 hours.

Falls from height

Eliminate the risk of workers falling from height by:

- undertaking the work from stable and level ground.
- undertaking the work from a solid construction.
- using specialised plant with hydraulic shotcreting boom.

If it is not reasonably practicable to eliminate the risk, the risk to workers can be reduced by ensuring adequate fall protection controls are implemented in line with hierarchy of control for the prevention of falls above 2 metres. For shotcreting work, passive fall protection devices should be used, such as:

- personnel scaffolding.
- guard railing.
- elevating work platforms.

Ground conditions should be taken into account when selecting the fall protection controls to ensure the controls can be installed correctly or the equipment has the stability for the conditions.

Struck by plant

Eliminate the risk to workers being struck by powered mobile machinery by:

- removing all powered mobile plant from the excavation site while shotcreting works are being undertaken.
- using a concrete line pump rather than a boom pump.

If it is not reasonably practicable to eliminate the risk, reduce any remaining risk to workers by ensuring controls and site traffic management are implemented in line with the hierarchy of risk control for construction work.

- Isolate persons from the machinery, substitute for safer machinery or use engineering controls or a combination of all, such as:
  - establishing a large exclusion zone around the area of shotcreting works, including locating the concrete pump and concrete trucks outside the shotcreting works area.
  - using physical barriers to prevent vehicles entering the shotcreting area if the area is not large enough for an adequate exclusion zone.
- If a risk remains it must be controlled by administrative controls, such as:
  - warning signs and warning devices such reversing beepers.
  - establishing vehicle entry and exit points.
  - traffic controllers and plant spotters.
  - induction (site rules), training and supervision.
- If a risk remains it must be controlled by use of personal protective equipment (PPE), such as:

- high visibility clothing.
- protective footwear.
- safety helmets.

Note: Where isolation, substitution and engineering controls are used they should be supported by administrative controls and PPE.

Site planning

Protecting workers and contractors from hazards and risks associated with shotcreting, such as wall collapse, starts with a thorough site assessment and design review to ensure tasks can be done safely. An assessment should consider the length of time the work schedule allows the wall surface to be left exposed after excavation, what is known of the site conditions as a result of the geotechnical work, neighbouring structures, and any conditions that are likely to be encountered during the work.

Site conditions

The following conditions should be reviewed during the site assessment to determine any impact on the wall and retention system:

- load from adjacent buildings.
- impact of utility services within and outside the site boundary (e.g., poorly compacted trenches, leaking or damaged water pipes).
- past uses of the site (e.g., underground tanks, services, contaminated soil).
- geotechnical factors (e.g., specific material or soil/ ground type, presence of groundwater or hidden seams within rock).
- excessive vibration by passing traffic or site mobile plant.

It is vital that as much as possible is known about the site conditions before work starts. However, contamination, underground tanks and services could still be found during the work. Flexibility in construction methods, schedules and regular monitoring of site conditions is recommended to detect any new conditions that could affect the work and expose workers to risk.

Minimising exposure of the wall

Minimise the exposure time of an excavated wall to reduce the risk of wall collapse or partial collapse due to weathering (e.g., drying, cracking and seepage) and weather (e.g., heavy rain, excessive heat). Consideration should be given to the following when developing work processes to reduce the workers' exposure to the excavated wall, including during shotcreting:

- stability of the soil and ground (e.g., sandy soil collapses easily, clay dries and cracks in sections, and rock may be unstable if it has unfavourable bedding planes/joints).
- type of wall retention system (necessary to provide effective ground support, e.g., soil nail type - (see Picture below).
- maximum drop, bench heights and excavation.

- positioning of mobile plant such as excavators, trucks, height access equipment and concrete pumps to eliminate any additional load conditions on the excavation.
- the thickness of the applied shotcrete. Exceeding the design requirement for the wall could cause collapse of shotcrete during or immediately after spraying.
- changes in wall thickness as a result of earlier soil collapse or over excavation.

Excessive vibration may contribute to a collapse of either the unsupported wall or the shotcreted wall. This also depends on the geological composition of the wall (i.e., sandy, clay or rock). Sources of possible vibration include other plant working in the area (e.g., excavators using rock hammers, concrete pump or concrete delivery trucks that are often set up above the area being sprayed).

It’s always recommended to have a worker assist the person shotcreting

Ongoing monitoring

When planning for the work, allow for changes that may be required during the course of the work. Changes to the shotcreting process could be due to changing site conditions, weather conditions, increased vibration from other site work or from outside the site, design modifications, new ground conditions, revised construction schedule, sequence or methods.

Changed circumstances should trigger a revised site assessment and review of risk controls. Any changes or corrective actions should be communicated to the affected construction site personnel, including contractors and their workers.

Safe work method statement

Safe work method statements (SWMS) must be developed for all high-risk construction work that forms any part of the formwork erection, concrete pouring and formwork stripping processes.

Safe erection of structural steel for buildings

Principal Contractors have a general duty to ensure the health and safety of workers at work. Principal Contractors involved in construction work also have specific duties to control any risk associated with construction work as far as reasonably practicable.

This industry standard provides practical guidance for the design, fabrication, transportation and erection of steel members for buildings, to eliminate or reduce the risk to the health and safety of:

- workers and contractors involved in structural steel erection.
- the public in the vicinity.

The main hazards risking the health and safety of workers in structural steel erection are:

- falls from heights.
- falling objects.
- collapse of the structure.
- plant used in the work.

What is steel construction work?

Steel construction is any work to erect assembled portions and single components of structural steel, such as:

- columns.
- beams.
- bracing.
- rafters.
- purlins.
- girts.
- bridging and fly bracing.
- trusses.
- other related steelwork, for example, free standing structures.

Planning to control risk

Planning is an effective control measure for preventing the risk of injury or death arising from steel construction. Designers, construction site owners & managers, steel erectors and fabricators have an important role in planning the work.

Licences for high-risk work

The erection of structural steel is “high risk work”, involving the operation of a variety of machinery and the use of certain skills. Those workers operating cranes and other particular machinery must have the appropriate licence before anyone can perform high risk work.

Anyone who is being trained, in order to obtain a licence, must be directly supervised if operating the relevant equipment or carrying out specific works without a licence, to ensure that the work is carried out safely.

Below are the Industry Standard Licences required for high-risk work used in steel erection.

Licence code	High-Risk Work
LF	Forklift Truck Operation
DG	Dogging A licence is required if: • there is a need to apply slinging techniques that require judgement to be exercised. • there is a need to direct a crane or hoist operator in the movement of a load when the load is out of the operator's view.
RB	Basic Rigging Work involving: • movement of machinery and equipment. • steel erection. • particular hoists. • placement of pre-cast concrete. • safety nets and static lines. • mast climbers. • perimeter safety screens and shutters. • cantilevered crane loading platforms.
RI	Intermediate Rigging In addition to the work associated with basic rigging, this work involves the rigging of: • use of load equalising gear. • cranes, conveyors, dredges and excavators. • all hoists. • tilt slabs. • demolition. • dual lifts.
RA	Advanced Rigging In addition to the work associated with intermediate rigging, this work involves:

	• the rigging of gin poles and sheerlegs. • flying foxes and cableways. • guyed derricks and structures. • suspended scaffolds and fabricated hung scaffolds.
CT	Tower Crane Operation
CN	Non-Slewing Mobile Crane Operation (greater than 3 tonnes)
CV	Vehicle loading, crane operation (greater than 10 metre tons; the operation of crane trucks will usually be limited to the delivery of steel members to site)
C2	Slewing Mobile Crane Operation (up to 20 tonnes)
C6	Slewing Mobile Crane Operation (up to 60 tonnes)
C1	Slewing Mobile Crane Operation (up to 100 tonnes)
C0	Slewing Mobile Crane Operation (over 100 tonnes)
WP	Boom-Type Elevating Work Platform Operation (boom length greater than 11 metres)

Competency and training

In addition to the licences listed above, Principal Contractors must also ensure that their workers have completed:

- construction induction training (such as a 'construction induction card' or equivalent).
- training in the use of machinery that does not require a licence for high-risk work to operate - for example, a boom-type elevating work platform (boom length 11 metres or less), telehandler or non-slewing mobile crane less than 3 tonnes.
- a site-specific induction.
- training on how to work in accordance with the SWMS developed for the task.
- training on how to eliminate or control specific hazards and risks involved in the work which are not covered by a SWMS, for example, manual handling and UV-protection.

Where relevant, training for harnessed-based work positioning and fall protection systems may also be required.

Factors to be considered in planning steel construction

The Designer, Construction site Owner and Manager, Fabricator and the Erector must consult, cooperate and coordinate with each other about the structure to be erected.

Consultation should address the hazards, associated risks and control measures that will be implemented during the steel construction work and cover all phases of the project. In addition to the risks of falls from heights, falling objects and the stability of structure, the consultation should consider other factors such as the sequence and the method of erection, in particular:

- access to work areas where erection is taking place.
- location of other trades relative to the erection work.
- restricted areas and the need for barricades.
- criteria for safety (e.g., sequential erection).

Designers

It is critical that the Designer considers the safe erection of the steel structure and provides guidance to the steel erector. This is particularly important with modern designs where 'limit state' design techniques are used by the Designer.

In this system the design engineer considers the structure in its completed form with all the members and bracing installed.

The structure can then withstand much higher loads (e.g., wind and other live loads), than when the structure is in the construction stage. With this in mind it is necessary for the Designer to provide guidance to the steel erector on how the structure will remain standing as it is built.

An effective planning process enables a Designer to eliminate risks at the design stage before steel construction work starts. Designers should, for example, take into account the safe work methods to be used during erection. Areas that should be considered at each design stage include:

- The stability at all stages of erection of the assembled portions and single components.
- Maximum permissible wind speed for erecting the steel structure.
- The effect of the erection sequence on stability.
- An assessment of loadings at all stages of construction.
- The safe access and working environment.
- The ease of connecting components, for example the provision of landing cleats.
- Clear instructions for the requirement of temporary bracing. Where it is recognised by the design engineer that temporary bracing will be required, it should be detailed on the drawings so that the erector can make provision for such bracing and riggers do not have to access an unstable structure.
- The handling, lifting, storing, stacking and transportation of components depending on their size, shape and weight. Identifiable lifting points and component weights should be specified. For sub-assemblies, it is critical that overall weight and lifting points are identified on all drawings for example, design drawings and as-built drawings.
- The requirement for specific lifting arrangements to be detailed on structural member drawings to facilitate safe lifting.
- The information required for safe erection of the structure. This information should include any special conditions. Special conditions relating to the safe erection of the structure should be highlighted on all documentation at the pre- contract stage, for example, the need for temporary bracing/guying or the use of mobile access platforms.
- If the erection technique involves the use of a 'rigger's post system', verification that the structure can withstand the loadings that may be applied by these.
- The grades of steel including bolts and means for fabrication of components such as welding, are in accordance with relevant 'Standards'.
- Consider the option of assembling the unit on the ground to reduce the number of fixings or connections made when working at heights.

Construction site Managers

Factors that should be considered by the Construction site Manager when planning the project include:

- **The number of contractors.** Where a number of workers are to be employed on the project and there is a likelihood of injury because of the actions of any one worker, planning should provide for sufficient physical or time separation to ensure the work by each worker can be carried out safely.
- **The scheduled time frames for steel construction**. The scheduled time frames should provide enough time for the steel to be constructed in a safe manner.
- The frequency of site meetings to discuss health and safety issues on site. The timing of site meetings should ensure safe working practices are developed, implemented and maintained by all contractors as the various phases of the project are reached.
- How any modifications to the structural building layout, or any other additions, substitutions or remedial work considered necessary, will affect the WHS management plan, and

Fabricators

A Fabricator is a person who fabricates structural steel components for buildings and other structures. When planning the work, the Fabricator should take into account:

- The sequence for delivery of each stage of the structural steel.
- The need for locating numbers to be clearly marked on steel components. This will allow the components to be easily identified for the sequence of erection. Consideration should also be given to identifying the lifting points on steel components to allow loads to be lifted in a safe manner.
- How members will be supported, and their ends tied and held to prevent uncontrolled movement of the steel while it is being loaded, transported, unloaded, moved and located, and
- Marking of steel members with their mass - steel to be marked should be determined after consultation between the steel erector and the steel fabricator.

Erectors

An Erector is a worker on a construction site who is responsible for erecting structural steel components for buildings. When planning the work, the Erector should take into account:

- The method to be used when erecting the structure. The method should be developed in accordance with the drawings, specification following discussions with the designer and the principal contractor.
- How the structure will be erected paying particular attention to bracing bays and temporary bracing.
- Machinery to be used for the work. Consideration should be given to indicating the size, type, position and coverage of the proposed erection crane(s) on a site plan. In addition, locations such as unloading points and storage areas (if any) should be shown. Consideration should be

given to the required crane usage in the overall plan including access, working radii and boom clearances.

- The stability requirements for all components of the structure.
- The proposed methods for handling components.
- The possibility for pre-assembly, on the ground, of members prior to installation and the movement and location of heavy members, and
- That ground conditions are suitable to allow plant to be moved and used in a safe manner at the construction site. For example, in muddy conditions an operator may lose control of a mobile crane when driving to a new location at the site.

Work systems

Prioritise control measures

The primary risks to the health and safety of persons involved in steel construction work are falls from heights, falling objects, collapse of the structure and machinery engaged in the steel construction work. Risk management plays an important role in the management of workplace health and safety. It is a logical and systematic approach which can result in a reduction in the incidence of injury and illness.

The control measures implemented to address these risks should be implemented in priority order. This is called the 'Hierarchy of Control'.

The primary task is to determine whether the risk can be eliminated. Where this is not possible, substitution for a less hazardous method should be considered. If this is not possible, consideration should be given to each of the other controls, isolation/engineering controls, administrative controls and as a last resort; the use of personal protective equipment (PPE). These should be considered in turn, starting with substitution and working down to the use of PPE. This should occur until a control or combination of controls are identified which can then achieve the required reduction in risk.

Working at heights during steel construction

A person may be exposed to the risk of injury and death from a fall of any height and construction site owners, managers and Principal Contractors all have duties under work, health & safety to reduce the risk of workers falling from height.

Controls to prevent falls from heights

The control measures to prevent death or injury from a fall should be in place before work commences. Persons carrying out steel construction at a height may be exposed to the risk of death or injury from falling. Several control measures are available in these circumstances, and more than one control measure may be necessary. Ground level prefabrication should be considered as a fall prevention strategy. To reduce the need to work at heights, some alternative means of erection are:

- Construct as much of the steelwork as possible at ground level or from erected floor slabs or decks in the structure. This should be taken into consideration when planning the work.
- Where possible, the lifting sling or device should be released from floor level by the use of long slings, remote release shackles or other suitable devices.

- The use of fall-arrest harnesses is not the preferred control measure for persons working on steel construction as these do not actually prevent a fall from occurring. Wherever possible and practicable the use of a method which reduces the risk of a person falling (e.g., perimeter guardrail, elevating work platforms), should be selected.

Control measures that may prevent the risk of death or injury from falls from heights include:

- work Platforms.
- fall Prevention Devices.
- fall Arrest Systems.
- edge Protection Systems.
- fall Protection Covers.

Work platforms

Fabricated working platforms

These platforms can be used in many locations as they can be designed to fit a variety of beam and column configurations.

A work platform should be secured against uplift or displacement to a structure and installed with edge protection systems. The area of the platform should be of a size and strength to carry the tools, materials and persons required to work from it.

Working platforms should be designed by an engineer and should not be less than 450 mm in width or length.

An example of a working platform

Elevating work platforms (EWPs)

An elevating work platform means a telescoping, scissor or articulating device or any combination thereof used to position personnel, equipment and materials at work locations, and to provide a working area for persons elevated by and working from the platform.

EWPs include scissor lifts, boom lifts and truck mounted EWPs (travel towers). EWPs are primarily designed so that a person may work at an elevated position, on a structure from within the confines of the EWP platform or basket.

EWPs are regularly used for steel construction. They provide an efficient access system and are preferable to other methods that involve the use of fall-arrest systems, because they reduce the risk of a fall occurring. Both boom lifts and scissor lifts are used in steel erection.

EWPs are used as access for workers to help position steelwork as it is being lifted by a crane. They are also used by workers when installing and tightening bolts. EWPs are not specifically designed for a person to move from the platform to gain access onto another elevated surface, although they are sometimes used in this application instead of other more conventional forms of access, such as scaffold stair access towers.

In some situations, EWPs may not be suitable for providing access/egress onto a roof or structure due to factors such as the following:

- The number of workers required to access the roof/structure may be in excess of what an EWP could safely transport in the event of having to provide emergency evacuation from the roof/structure.
- The platform on the EWP can move as the person gets in and out with the potential for the person to fall through the gap – when the platform is beside the roof/structure.
- There is a possibility that the EWP can be removed from the access area while persons are located at height.
- The stability of the unit relies on firm and level ground. This is not the case on some construction sites, and
- In comparison with stair access, an EWP is not available for access at all times because it takes time to raise and lower persons. This issue becomes a greater problem when more workers are required to work on the roof or structure.

Where an EWP has been selected to provide access for workers onto a roof/structure the system of access should be safe. Factors that should be ensured include the following:

- The EWP should not be used for any other purpose and should not be driven away from the building.
- The area around the EWP should be free of vehicular traffic.
- The ground condition should be suitable for the use of the EWP.
- The EWP should not be used near live electrical power lines.
- Boom-type EWPs with a boom length of 11 metres or more require a licensed operator to operate the unit, or the operator should be directly supervised by the holder of a licence.
- All operators of EWPs should be competent and adequately trained.

- A competent person should be available at ground level to lower the platform in case of malfunction.
- Where the EWP platform is raised so that it is next to the roof/structure edge, the gap between the landing and the platform should not exceed 100 mm.
- The platform should be secured against sideways movement as necessary (i.e., the platform should not move as workers get on and off – this may be more of an issue with smaller EWPs). Where the platform is secured, it is preferable to use a restraint system that does not snag on the building when the platform is lowered and
- Safe access and egress should be provided by either one of the following:
  - A guardrail system at roof/structure level that extends at least 1.5 metres either side of the gate on the platform of the EWP. The gate on the EWP should be inward opening so that workers are not required to climb over the top of the guardrail.
  - The use of a safety harness by workers, or a system that will prevent a worker, who is entering or leaving the EWP, from falling off or through the structure. This may require the use of a 'double lanyard' system. On a steep roof a worker should be provided with a means to prevent them sliding down and/or off the roof.

All persons in boom-type EWPs should wear a full body harness and energy absorber type lanyard attached to an anchorage point in the basket of the EWP.

In some situations, EWPs may be used to lift lighter steelwork (e.g., purlins, girts and bridging), where the EWP manufacturer states that this is an acceptable practice.

The following points should be noted when lifting steelwork with an EWP.

- Total load on the EWP including workers and materials must not exceed the 'rated capacity', sometimes referred to as 'safe working load' (SWL), of the platform.
- Steelwork must not be loaded so that it will damage the EWP in any way or become imbalanced.
- Where an EWP is used to lift steel components, the steelwork should not be loaded onto the EWP guardrails, as this may damage the guardrails or allow the steelwork to roll off the platform. A 'purpose built' cradle to hold the steelwork should be used. Cradles should be designed by a competent person and not make the operation of the EWP unsafe in any way.
- A 'purpose built' cradle, used in conjunction with a crane, should be considered to install steelwork.
- The EWP must never be used to force the steelwork into place, this places excessive load on the unit.
- The working surface for the EWP must be level, firm, have clear access and no step up or step down on the floor slab.
- EWPs used for steel erection must be rated for outdoor use and the effects of wind loading must be considered.
- Workers in boom type EWPs must use full-body harness with an energy absorber type lanyard attached to an anchorage point in the basket of the EWP.

An example of an Elevated Work Platform

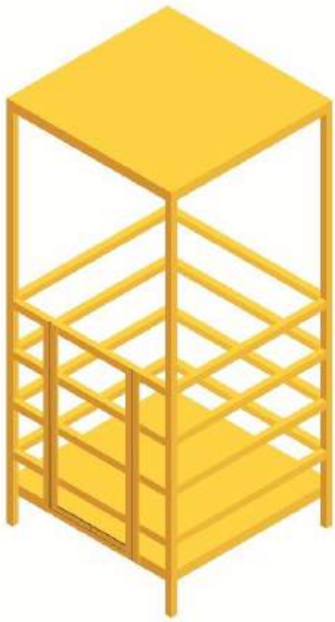
Temporary working platforms

These platforms can be fitted to members at ground level before erection or lifted into position following the erection of steelwork.

Work boxes

A work box is a personnel-carrying device designed to be suspended from a crane, which provides an elevated working area for persons working from the box. Persons using a workbox should be attached, at all times, by a full body safety harness, lanyard and energy absorber to a suitable anchorage point located within the workbox or to the main sling ring above the workers heads. Fall arrest attachments must not be placed in the throat of the lift hook.

Where a workbox is used, at least one person in the workbox must be competent in crane signals, for example a dogger.



An example of a workbox

Workboxes should be specifically designed for that purpose and:

- have slings permanently attached by locked shackles or a hammer lock device.
- have a factor of safety of each suspension sling of at least 8 for chains and 10 for wire rope.
- be marked with the safe working load (SWL), tare mass and design registration number of the workbox (e.g., on a data plate).
- have sides with a height of at least one metre in height.
- if provided with a door, should be inward opening only, self-closing and be provided with a latch to prevent accidental opening.
- should only be used to lift persons and their equipment.

Where a crane is used to lift work boxes, the crane should:

- be fitted with a hook that has a spring-loaded operable latch to prevent inadvertent release of the load.
- be fitted with a functioning over hoisting device such as an anti-two-block.
- be equipped with a dead-man control on power lowering to produce self-centring and automatic brake engagement.
- be equipped with a lockout control on the crane free fall function to prevent free fall of the lift box and its contents.
- at the maximum radius of the task to be performed, have a minimum ‘rated capacity’ of 1000kg, and
- have a minimum ‘rated capacity’ of at least twice the total load of the workbox and its contents, at the maximum radius for the task to be performed.

Where a crane is used to lift work boxes, the crane operator should:

- remain at the controls of the crane at all times while the work box is occupied by a person.
- ensure that the work box and its contents are moved under powered conditions, at all times.

Lift boxes

A lift box is a container suspended from a crane or hoist to transport machinery and/or steel materials. It should be fully sheeted and enclose the load.

Securing the load

Wire ropes, chains and lifting slings

Chains and auxiliary fittings should be thoroughly cleaned and periodically inspected to determine whether any defects exist. A chain, ring, shackle, swivel, wire rope or similar gear should not be used for lifting any load if:

- the wear on any part exceeds an amount specified by the manufacturer, or
- any part is deformed, nicked, cracked, split or otherwise damaged.

Wire ropes should not be exposed to high temperatures because of the potential for heat to adversely affect the core. All lifting equipment should be stored according to the manufacturer's instructions.

Safe storage and handling of steel work

Steel work should be stored on site in such a way that it cannot fall on workers or cause damage to buildings or plant. Where steelwork is stacked, the stacks should be stable and safe access should be available when workers are required to sling a load.

The effect of wind and the potential for mobile plant to come into contact with the stored steelwork should also be considered when deciding how and where steelwork is to be stored.

Where steelwork is strapped together caution should be exercised when releasing the strapping. The strapping may whip back and cause an injury, or the bundle can fall apart and injure workers.

Lifting steel work

Consideration should be given to the marking of the mass of steel members together with their protective coatings, if any, by the fabricator. This is particularly important where it is difficult to estimate the mass of the steel member and will enable the erector to select correctly designed lifting gear of appropriate capacity as well as the selection of a crane with adequate capacity. In situations where the material thickness cannot be easily determined (e.g., pipe that has its ends covered), the weight should be marked on by the fabricator.

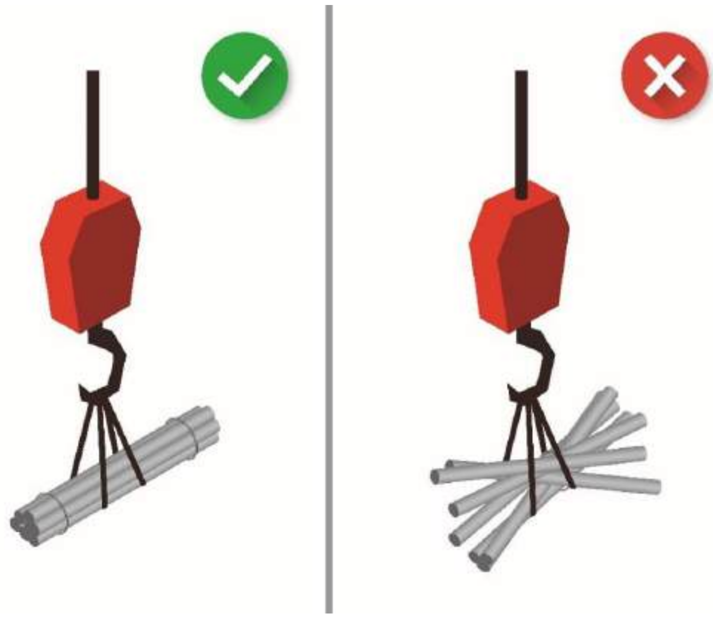
Before lifting any steel work, the rigger/dogger should sling the load to be lifted and, where appropriate, fix tag lines (to the ends of the load. When transferring lifts from a horizontal to a vertical position, care should be taken to avoid unrestrained movement of the lower end. The use of lifting beams may be necessary during lifting and positioning of some members to ensure member stability.

Fix tag lines to the end of the load before lifting

Lifting bundles of steel work

The lifting of more than one steel member or bundles of steel at the same time, to one or more levels should only be undertaken where:

- lifting slings are designed to avoid steel members becoming entangled or dislodged from a bundle, or
- cradles for bundles of steel or decking are used.



When lifting bundles of steelwork, always secure them properly

Erecting steel components – columns

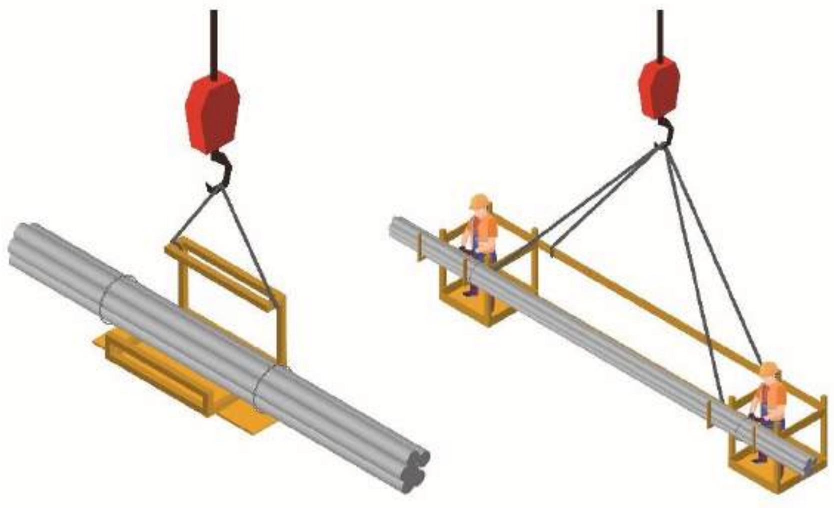
Free-standing single columns or column assemblies should be secured by bolting the column base plate onto the column footing. Once the column has been securely anchored and is in as close to perpendicular position as possible and stabilised against overturning, the column lifting gear can be released.

Where possible, the lifting sling or device should be released from floor level by the use of long slings, remote release shackles or other suitable devices. The use of an EWP may also be considered.

Erecting steel components – purlins

The preferred method for erecting purlins is by the use of riggers working from EWPs. Where this is not practicable and the method chosen requires riggers to work from the rafter steelwork this could be carried out with the use of a recognised, correctly installed and tested fall-arrest system, (e.g., a rigger's post system). Where it is chosen to work from the rafter steelwork (normally on buildings with a short frame spacing), individual purlins can be carried into position from the purlin bundle previously deposited at the base of the rafter slope. Purlins should always be carried up the rafter slope rather than down, as this is both easier and safer. Carrying purlins into position will normally involve two riggers, each attached to a fall-arrest system, working from adjacent rafters. Alternatively, where purlins cannot be safely carried into position, individual purlins may be lifted into position using mechanical equipment.

Where purlins cannot be erected directly from the rafter steelwork, an alternate method such as a crane can be used to raise and place them on the rafter beams. With this method, there is no need to unsling the bundle; each purlin can be lifted off individually at each cleat location so that there is no need to carry individual purlins along the rafter tops, riggers can then locate and attach the purlins working from an EWP or purlin cradle.



2 methods of lifting steel components

Erecting steel components – girts

Girts should be erected by a rigger working from within an EWP or combined access and lifting cradle. Individual girts should not be carried by hand; rather they should be lifted into position by mechanical equipment.

To prevent girts falling from the structure, mobile scaffold towers or a combined access and lifting cradle should be used. With the latter, the crane or hoist will need to have a cradle designed for the intended load and be suitable for a person to ride. A crane or hoist used in this manner should be:

- fitted with a hook that has a spring-loaded operable latch to prevent inadvertent release of the load.
- fitted with a functioning over hoisting device that stops the relevant crane motions (e.g., motion cut-out anti-two-block).
- equipped with a **'dead-man'** control on power lowering to produce self-centring and automatic brake engagement, and
- be equipped with a lockout control on the crane free fall function to prevent free fall of the lift box and its contents.

Clearly marked working load limits should be displayed at each end of the cradle, preferably in terms of the number of workers and the total mass of girts allowed, as well as the total working load limit in kilograms.

Erecting steel components – bridging

Girt and purlin bridging, and any associated sag rods may be erected from an elevating work platform. Bridging should be lifted from the ground by the rigger using mechanical equipment. Care should be taken to ensure it does not get tangled while being lifted.

Erecting steel components - roof and wall bracing

A crane should be used to lift bracing members. Bracing should be assembled on the ground when this is possible. The weight of a bracing member may permit it to be safely lifted by hand. The rigger should do this:

- while working from an elevating work platform, preferably, or the steelwork, with suitable controls in place to prevent falls from heights.
- using a hand line to lift the bracing from the ground.

In the case of wall bracing, where it can be safely lifted by hand, this should be done by the rigger working from an elevating work platform and using a hand line to lift the bracing member from the ground.

Exclusion zones

Bunting or barricades and suitable signage may be erected around the perimeter of an exclusion zone to exclude personnel from the area under which the riggers are erecting steelwork, reducing the risk of being hit by falling objects.

For more information on Exclusion Zones, see Chapter 13 Safe Use of Cranes.

CHAPTER 23

PROTECTION OF SURROUNDING AREAS

A Construction site owner has obligations to protect adjoining properties, roads and utilities from potential damage caused from building works at their construction site.

If your construction site is close to or adjacent to adjoining property boundaries, then you may be required to carry out protection work relating to the adjoining property. This is to ensure that the adjoining property is not affected or damaged by your building work.

Adjoining property is considered to be land at risk of significant damage from building work and may include any road, highway, footpath, right of way, public space and park area.

Protection work

Protection work provides protection to adjoining property, roads and utilities from damage. Protection work may include:

- underpinning of footings, including vertical support, lateral support, protection against variation in earth pressures, ground anchors, and other means of support for the adjoining property.
- shoring up and overhead protection.
- other work designed to maintain the stability of adjoining property from damage from building work.
- construction of temporary site entries/exits to protect roads and drains.
- construction of temporary structures to protect utilities including powerlines, gas pipes, water pipes and other public services.

Common types of protection work include:

- retaining walls.
- bored piers.
- a gantry or other overhead barriers to prevent material from falling on a roof or other part of the adjoining property.
- propping of party walls or common walls.
- underpinning of existing footings.

You may need to build a retaining wall to protect neighbouring property from damage

The distinction between protection work and building work

Protection work is work conducted to protect an adjoining property. It can be done on an adjoining property or on the building site where the building work is occurring, or both. Where protection work needs to be done on the adjoining property, construction site owners and/or managers must consult with the owners of the adjoining property before undertaking the required protection work.

Building work is the work being done that gives rise to the need for protection work. Building work can only be done within the boundaries of the building site for which a building permit is issued.

Sometimes building work is designed in a way which requires access to adjoining property to carry out the building work. For example, building materials may need to be lifted onto the building site with a crane that must swing over adjoining property; or the preferred construction of masonry walls on boundaries is to construct or finish them from outside the property boundary of the building site.

Where the construction process requires access to the building site via an adjoining property, this is not protection work. The protection work process does not entitle an owner to access an adjoining property to undertake building work. Access to an adjoining property to conduct building work must be arranged by agreement with the owner of the adjoining property.

Implementing a safe system of work to protect surrounding areas

Implementing a safe system of work before you commence works on your construction site will greatly reduce the risk of damage being caused to surrounding areas, structures and utilities.

A safe system of work sets out how all work to be carried out on your construction site will be completed safely, in compliance with relevant legislation and minimise damage to surrounding areas.

Safe system of work – identify hazards

The first step in the risk management process is to identify hazards which could cause damage to surrounding areas. A good hazard identification process is the key to risk management.

Identify hazards and controls before the work starts. It may not be possible to control all hazards before work starts – so identify the controls and implement them when required.

For example, consider:

- surrounding walls and structures falling into an excavation.
- surrounding walls & fences falling into an excavation.
- objects from your construction site falling onto surrounding areas.
- construction works damaging roads, footpaths and utilities.

To manage the risks, consider all relevant matters including the:

- nature of the excavation work to be carried out.
- nature of construction work to be carried out.
- types of machinery to be used on your construction site.
- types of surrounding structures and proximity to your construction site.
- setup of entry and exit points from public roadways to your construction site.

Complete and monitor hazard identification regularly to make sure controls are working and that no new hazards have been introduced.

Hazard identification and control methods

Identify hazards by:

- physical inspections:
    - inspect the construction site and assess where damage can occur by construction works and excavation activities.
    - consider hazards that may be created by other users, entering the construction site (e.g., vehicles and machinery).
    - liaise and consult with workers and people working or living near your construction site.

Assess the risks by considering:

- how likely the hazard or risk is to happen.
- what degree of damage the hazard or the risk might cause.
- how much is known about the hazard or risk and how to eliminate it.
- what ways are available to eliminate or minimise the risk.

- what ways are suitable to eliminate or minimise the risk.

Control the risks

Some controls are more effective than others. Controls can be ranked from the highest level of protection and reliability to the lowest. This ranking is known as the Hierarchy of Controls.

Use the following controls to minimise the risk of damage to surrounding areas by one or a combination of the following:

- **Substitution**: substituting methods of construction, for example, using a smaller digging machine when digging near fences rather than a large excavator.
- **Isolation**: Isolate means preventing contact or exposure to the risk. For example, using concrete barriers or temporary retaining walls to separate walls and fences from mobile machinery works.
- **Engineering controls**: for example, benching, battering or shoring the sides of the excavation to reduce the risk of ground collapse.

Review your controls

Regularly review controls on site to make sure they are still effective in protecting surrounding areas.

Review, and if necessary revise controls:

- when the control is not effective in controlling the risk to damage (e.g., if there has been an incident or near miss).
- before a change at the construction site that is likely to give rise to a new or different risk that the control may not effectively control.
- if a new hazard or risk is identified.
- if the results of consultation indicate that a review is necessary.
- if a damage to surrounding areas has occurred and a review is recommended.

Common review methods include construction site inspections, consultation, testing and analysing on-going works. If problems are found, go back through the risk management steps, review the information and make further decisions about controls.

Planning construction work

Planning involves identifying the hazards, assessing risks and deciding suitable controls in consultation with everyone involved in the work including other workers, competent people, machinery operators, contractors and owners of surrounding areas.

Consider the site factors, hazards and the unique characteristics of the site. The nature of the excavation work will affect the selection of an excavation method and a safe system of work. The ground conditions will have a significant impact on what excavation method to select and the controls to use.

Safe system of work

Implement a safe system of work before excavation or construction work starts to make sure the work happens in the right location, with the right machinery and equipment and with the right workers with relevant competencies.

A safe system of work should include:

- assigning responsibilities.
- a task analysis.
- consulting a competent person regarding any temporary works design.
- identifying any health and safety hazards and risks.
- carrying out a risk assessment.
- describing how you will control any identified risks.
- describing how controls will be implemented, monitored and reviewed.
- damage investigation and reporting methods.
- emergency procedures if damage occurs.

In the event of any reactive construction or excavation work needed due to damage caused to surrounding areas, establish a safe system of work and communicate this to your workers.

The Table below provides some information to consider before starting construction or excavation work so that damage to surrounding areas is minimised.

Site issues	Possible factors	Minimum considerations
Ground conditions	• soil types • stability • ground water • other soil and rock properties • contaminated soils • potential for seismic hazards (such as fault rupture, liquefaction and rock fall)	• inspecting to find out what might affect the stability of the excavation (an excavation face can appear stable for 24 hours, but may be unstable) • weather conditions • dewatering plan • confirming if there are Hazardous Activities • testing soil and water
Site conditions	• surcharges • underground and above ground services • ground slope • adjacent buildings and structures • water courses (including underground) • trees • local weather conditions • environmental conditions • proximity to existing trench lines	• checking with the local authorities on whether you are permitted to work or not • local planning and resource consent requirements • works access permits • consent from service owners

Site issues	Possible factors	Minimum considerations
The excavation	• excavation depth • length of time the excavation will be open • ground support • if excavation may cause ground shift • the planned height of the excavated face • if there will be other construction activity nearby that may cause vibration	• static and dynamic loads near the excavation • consulting a competent person • deciding on a support solution • identifying all existing overhead and underground services • managing pedestrians and traffic with a traffic management plan (TMP) • securing barriers or fencing to keep members of the public and other site workers away from the excavation site
Work methods	• specialised machinery or work methods required • the method(s) of transport, haul routes and disposal • what exposures might occur, such as noise, land falls or hazardous chemicals • workers will need to follow good practice for conducting works • number of workers involved • possibility of unauthorised access to the work area • safe access and egress	• implementing a safe system of work or safety management system • identify hazards, assess and control risks • build in interaction with other trades • adequate facilities • emergency procedures • accident and incident procedures • contractor management • testing and checking for machinery, equipment, and materials requirements • inducting and training all workers • exclusion zones where powered mobile machinery will operate

Establish where the utility services are

Before any excavation or construction takes place workers should know what is underground and what is overhead. Consider services present until it is proven they are not there.

- Liaise with all local authorities as there are often multiple services and multiple owners.

- Some service owners may provide on-site assistance to help identify services; use this assistance where available.
- Make sure plans and relevant locates and mark-outs are available, get plans and mark out the services.
- Accurately trace and mark out underground services. Drawings and service plans may be different from what is underground.
- Keep copies of current services plans on site.
- Use detection equipment that can detect services. There may be a need to use multiple types.
- Knowledge about what energy sources the services actually carry is essential. Service markings and colours can vary from current national standards and the service owner should be able to provide specific information.
- Check service depths as they may vary from the plan (e.g., the ground cover may have been altered since the service was laid). Pothole to determine service location and depth.
- Make sure mobile machinery access and egress is safe by checking the proximity of overhead services and the ground strength for access routes (e.g., check for underground drainage pipes, service ducts, soak wells, and storage tanks).

Always identify the location of utilities before digging

Nearby buildings or structures

Excavation work may seriously affect the stability of any structure near the excavation. This may lead to structural failure, or ground collapse depending on the site's ground conditions.

Consider the excavation's zone of influence on the stability of any nearby structure and make sure the excavation does not remove any nearby structure's ground support.

The zone is normally at an angle from the base of the excavated face to the surface. The zone's angle will depend upon site-specific factors, for example soil strength and density.

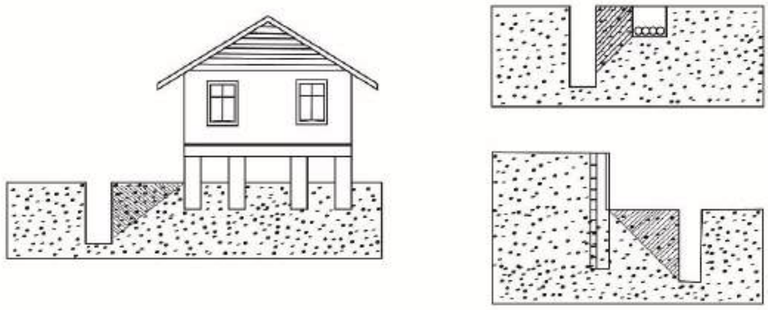
Local regulations or resource consent conditions may also stipulate other controls for excavating near existing structures.

A competent person should:

- assess any excavation near or below the footing of any structure, including retaining walls.
- determine if any supports to brace the structure are required.

Make sure other structures near the excavation site are not adversely affected by vibration or concussion during the work. If hospitals and other buildings with equipment sensitive to shock and vibration are nearby, consider the need for special precautions.

The zone of influence's angle will depend upon site-specific factors, for example soil strength and density.



When digging, always consider nearby structures and what affect your digging will have

Fences and protection work

Building work on boundaries may involve the demolition of walls which give rise to the requirement for a new fence between properties. Work may also involve the construction of new walls on boundaries which requires the removal of an existing fence. The removal and replacement of fences is not considered protection work.

In all situations, consultation with owners of property surrounding your construction site must be conducted prior to commencement of any construction work or excavation.

Costs and damages

Owners of property and structures, including utility owners that surround your construction site may take legal action to recover both repair costs and costs of lost business from the party responsible for any damage caused by construction or excavation works. Further individual businesses who suffer loss through the interruption to a service may seek to recover such losses from the responsible party.

Careful planning and constant monitoring of all works will ensure you reduce the risk of damage to surrounding areas.

Fumes

Vapour, gas, smoke and other fumes from the construction site can put the public and people working and living in surrounding areas at risk.

Construction work can produce a range of fumes, depending on the construction site and the materials used. These include but are not limited to:

- asphalt.
- dust.
- diesel fumes.
- chemicals.

Exposure to these and other fumes is dangerous and can cause serious lung disease.

Construction Site Managers must always look to eliminate the risk to people in surrounding areas. Where you're not reasonably able to, then you need to consider what you can do to minimise the risk.

This might mean doing a job differently or using a less toxic material. Here are some other examples to consider:

- Reduce the risk of exposure to fumes by improving ventilation.
- Use water suppression to control dust.
- Schedule work for a time when fewer people are present.
- Post warning signs.
- Ensure safe work procedures are clearly displayed.
- Ensure workers have been trained on how to protect surrounding areas from fumes.

Always ask workers for input on identifying health and safety risks, and when choosing solutions. People are more likely to take responsibility and make good choices if they've been involved in the conversation.

Workers are the eyes and ears of your business. They could suggest practical, cost-effective solutions.

CHAPTER 24

TRAFFIC CONTROL

Working around traffic, including machinery and vehicles, can pose significant health and safety risks at a construction site.

Traffic management measures must be used to control the health and safety risks associated with working around traffic.

Traffic management is the planning and control of traffic from one location to another. It focuses on creating and managing an orderly and efficient movement of persons and goods, creating a safe environment for all users. It includes the organisation, arrangement, guidance and control of both stationary and moving traffic, including workers, pedestrians and all types of vehicles.

Managing traffic at a construction site is an important part of ensuring the construction site is without risks to health and safety. Vehicles, including powered mobile machinery, moving in and around a construction site, reversing, loading and unloading are often linked with death and injuries to workers and members of the public.

Traffic includes cars, trucks and powered mobile machinery like forklifts & cranes, and pedestrians like workers and visitors.

This section outlines what safety measures Construction Site Owners, Principal Contractors, Workers, pedestrians and vehicle uses should abide by around construction sites. It covers topics such as:

- common hazards with traffic management on construction sites that can lead to people being crushed by moving plant or road traffic.
- how Constructions Site Owners have duties to manage traffic safety on construction sites.
- how to establish construction site loading zones.

Only trained workers should assume the role of traffic controller

Work, health and safety duties

Construction Site Owners have a duty to ensure, so far as is reasonably practicable, that any person who works on or goes near a construction site, is not exposed to health and safety risks arising from the construction site. This duty includes implementing control measures to prevent people being injured by traffic and moving vehicles at the construction site.

Officers, such as company directors, have a duty to exercise due diligence to ensure a construction site is safe. This includes taking reasonable steps to ensure the construction site has and uses appropriate resources and processes to eliminate or minimise risks from traffic at the construction site.

Other people at the construction site, like visitors, must take reasonable care for their own health and safety and must take care not to adversely affect other people's health and safety. They must comply, so far as they are reasonably able, with reasonable instructions issued to them when they visit a construction site.

Information, training, instruction and supervision

Construction Site Owners must provide any information, training, instruction or supervision necessary to protect all persons from risks to their health and safety on a construction site, so far as is reasonably practicable.

This includes ensuring workers, including contractors, visiting drivers and others are provided with information, training and instruction about the designated safe routes, parking areas, pedestrian exclusion zones and speed limits for the construction site. This could include using an induction process, signage and other written information and verbal instruction provided at entries.

Visiting drivers should be aware of restrictions on vehicle sizes or types, entries and exits, and other safety procedures before entering the construction site.

Information, training and instruction given to workers must take into account the nature of the work carried out by the worker, associated risks and measures implemented to control the risks. Training must be easily understood by the worker. This may require providing information and training material in different languages or using visual aids for people who can't read.

Workers must ensure, so far as is reasonably practicable, workers have the necessary training, qualifications or licenses to operate the vehicles, plant and attachments they use, for example by:

- checking for licensing, qualifications and fitness for work when engaging drivers or operators or when hiring contractors.
- managing the activities of visiting drivers, and
- training drivers and operators.

Incidents can also occur when untrained or inexperienced workers drive construction vehicles. Access to vehicles should be managed and workers alerted to potential risks.

Visitors to the construction site should also be aware of the site traffic safety rules and procedures. Visiting drivers should be aware of restrictions on vehicle size or type and where they are to make deliveries before going to the construction site.

Information and instruction for workers involved in work on or near public roads must include the contents of traffic management plans and SWMS (Safe Work Method Statement). Workers engaged to carry out high risk construction work must always have access to the relevant SWMS at the construction site.

Traffic controllers have a responsibility to carry out traffic control in accordance with the requirements of the relevant road authority. The requirements for training and accreditation of traffic controllers should be confirmed with the relevant authority.

Site-specific health and safety rules must be included in the WHS management plan.

Before any traffic control occurs, the local authorities must be contacted

Ways to control traffic risks

Construction Site Owners must do all that is reasonably practicable to eliminate risks. Where reasonably practicable, Construction Site Owners must eliminate traffic hazards from the construction site, for example by removing powered mobile plant and other vehicles.

Where this is not possible, traffic risks must be minimised so far as is reasonably practicable. For example, consider:

- substituting the hazard for something safer, for example replacing forklifts with other load shifting equipment.
- isolating the hazard from people, for example, using barriers to physically separate traffic controllers from vehicles, and
- using engineering controls such as speed limiters on mobile plant, presence sensing devices or interlocked gates.

If risk still remains, consider the following controls in the order below to minimise the risk, so far as is reasonably practicable:

- use of administrative controls such as warning signs or schedule delivery times to avoid or reduce the need for pedestrians and vehicles to interact, and
- use of personal protective equipment (PPE), such as high visibility clothing.

A combination of the controls set out above may be used if a single control is not enough to minimise the risks. Key issues to consider for managing traffic at construction sites include:

- keeping pedestrians and vehicles apart, including on site and when vehicles enter and exit the construction site.
- minimising vehicle movements.
- eliminating reversing vehicles or minimising the related risks.
- ensuring vehicles and pedestrians are visible to each other.
- using traffic signs, and
- developing and implementing a traffic management plan.

Make sure workers involved in traffic control have radios to communicate

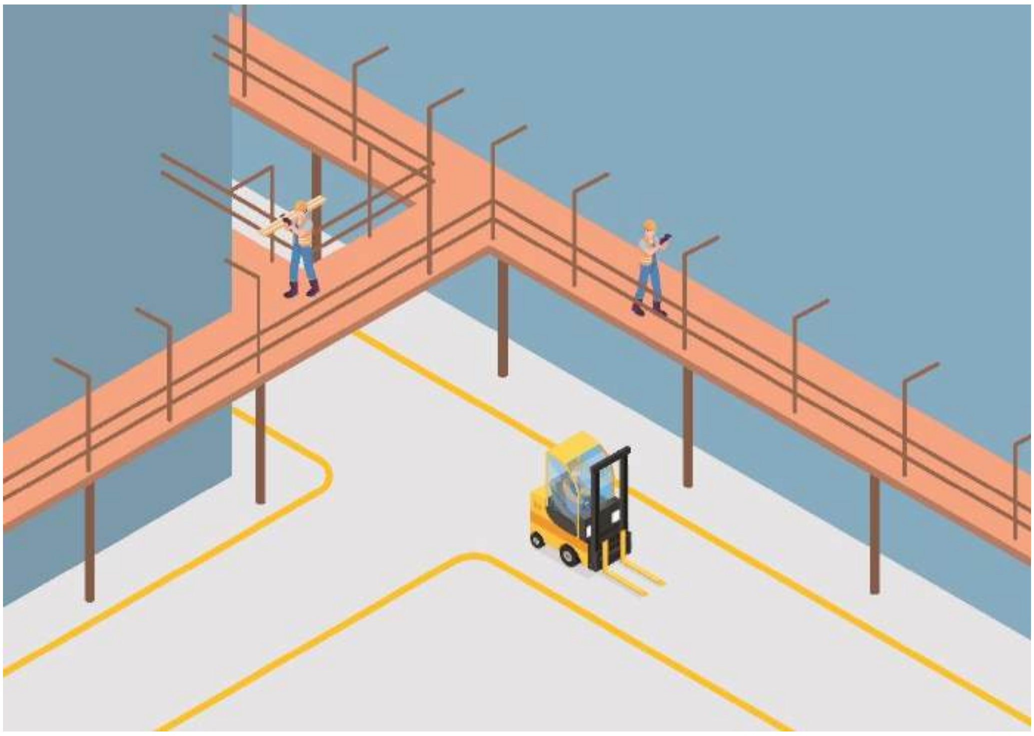
Keeping people and vehicles apart

The best way to protect people on or near a construction site is to make sure people and vehicles cannot interact. Where powered mobile machinery is used at a construction site, a Principal Contractor must ensure it does not collide with people or other powered mobile machinery.

This can be achieved by not allowing vehicles in pedestrian spaces or not allowing pedestrians in vehicle operating areas, for example by using overhead walkways.

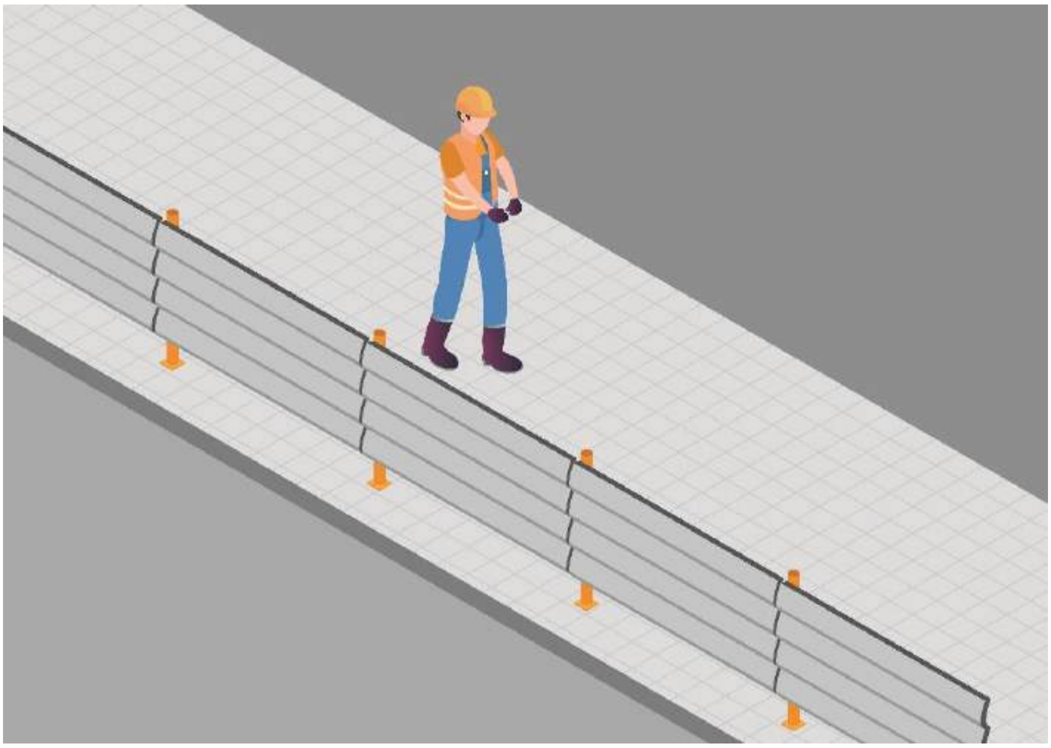
Consider implementing the following control measures to keep people and vehicles apart at the construction site and when vehicles enter or exit the construction site:

- Using overhead walkways.
- Providing separate traffic routes for pedestrians and vehicles.
- Providing separate clearly marked pedestrian walkways that take a direct route.
- Providing barriers or guardrails at building entrances and exits to stop pedestrians walking in front of vehicles.
- Creating vehicle exclusion zones for pedestrian-only areas, for example around tearooms, amenities and pedestrian entrances.
- Installing barriers, traffic control barricades, chains, tape or bollards to create exclusion zones for pedestrians.
- Ensuring a competent person with the necessary training or qualifications directs powered mobile machinery when it operates near workers or other machinery.
- Designating specific parking areas for workers' and visitors' vehicles outside the construction area.
- Providing clearly signed and lit crossing points where walkways cross roadways, so drivers and people can see each other clearly.
- Using traffic controllers, mirrors, stop signs or warning devices at site exits to make sure drivers can see or are aware of people before driving out onto public roads.
- Avoiding blocking walkways so people do not have to step onto the vehicle route.
- Scheduling work so vehicles, powered mobile plant and pedestrians are not in the same area at the same time.

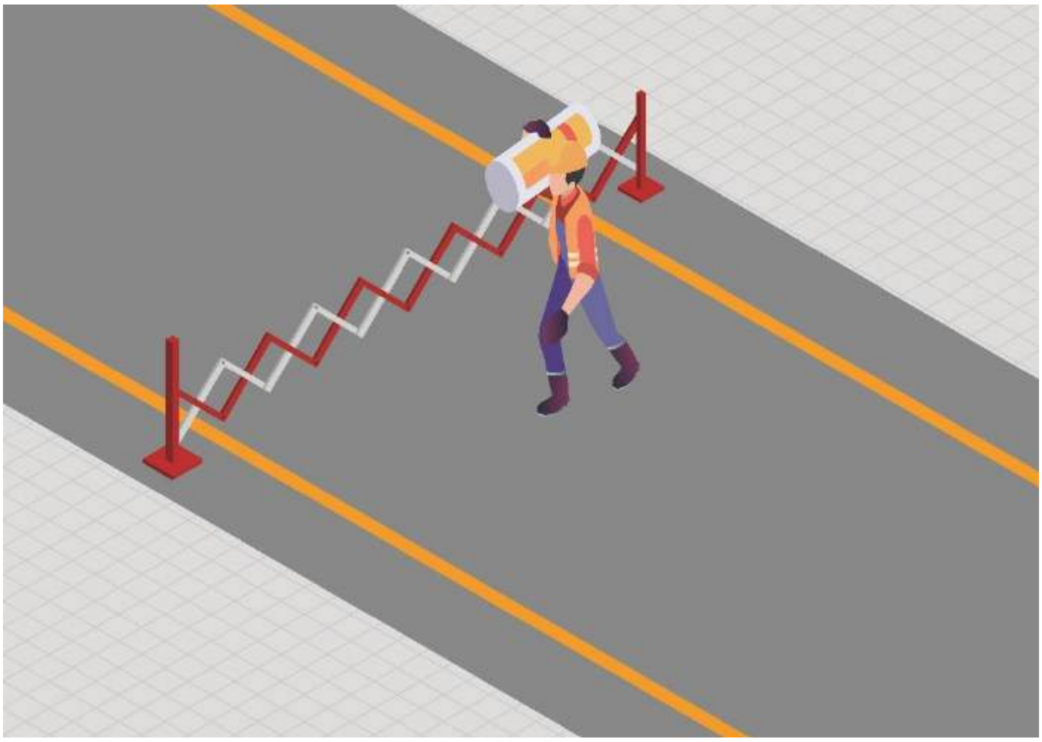


Overhead guardrail

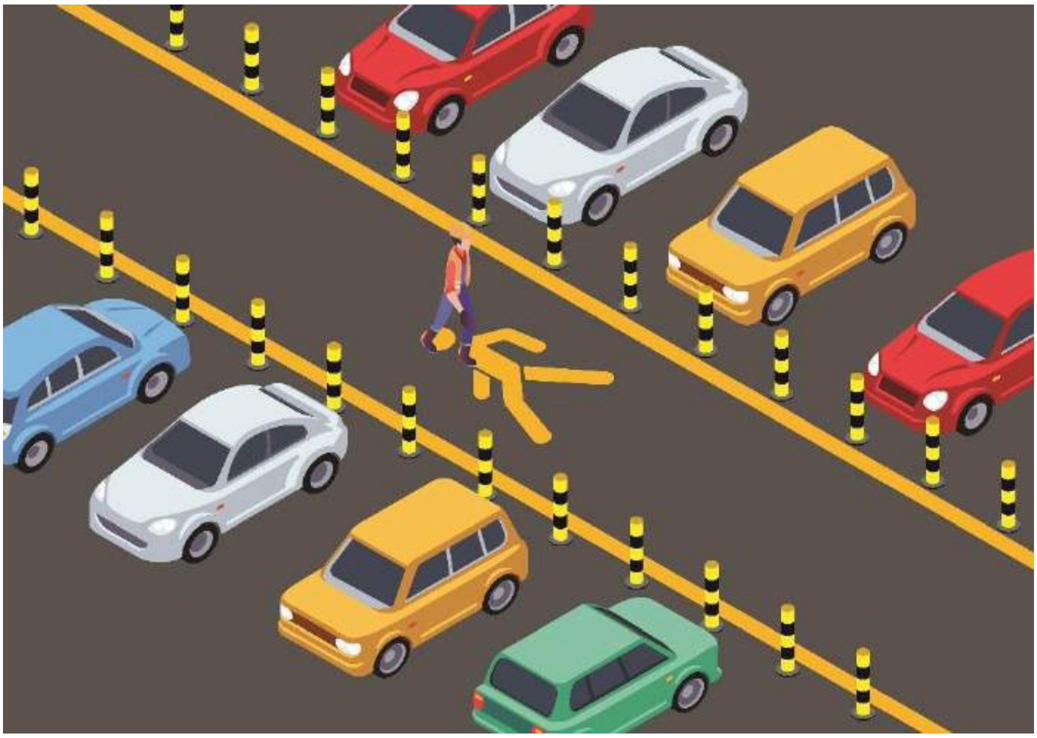
Guardrail at an exit



High impact barrier



Temporary barrier separating pedestrians from mobile powered plant



Pedestrian walkway in a car park

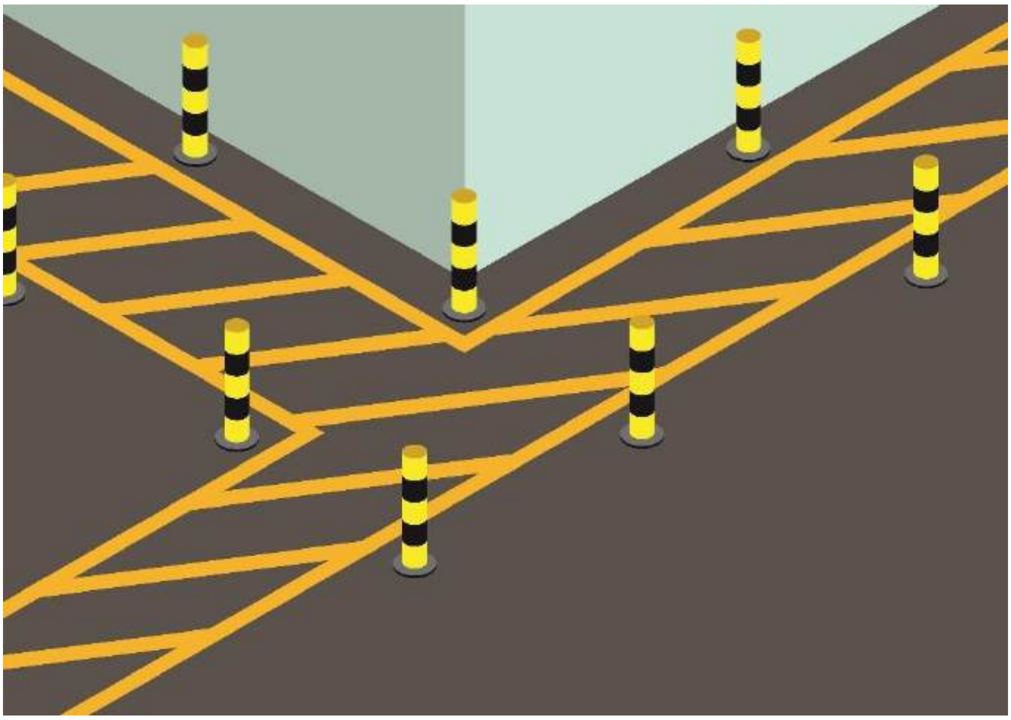
Administrative control measures - vehicle and pedestrian routes

Examples of administrative control measures for vehicle and pedestrian routes include:

- providing separate, clearly marked footpaths or walkways. For example, using lines painted on the ground or different coloured surfacing, and
- not allowing vehicles in pedestrian spaces or not allowing pedestrians in areas where vehicles operate.

Pedestrian routes and intersections should be clearly marked, unobstructed, well maintained and well lit.

Vehicle routes at the construction site should have a firm and even surface, be wide and high enough for the largest vehicle using them and be well maintained and free from obstructions. They should be clearly sign-posted to indicate speed limits, traffic calming measures like speed humps and parking areas.



Walkways marked with lines and bollards

Minimising vehicle movements

Planning can help minimise vehicle movement around a construction site. To control vehicle interaction and limit the number of vehicles at a construction site consider:

- planning storage areas so delivery vehicles do not have to cross the site.
- providing vehicle parking for workers and visitors away from the work area.
- controlling entry to the work area e.g., by using boom gates, and

- scheduling work to minimise the number of vehicles operating in the same area at the same time.

Parking

Parking may be needed for workers, visitors, trucks and other vehicles used in the construction site. Consider setting out the construction site so parking areas:

- are located away from busy work areas and traffic routes.
- have walkways leading to and from parking areas which are separated from vehicles or vehicle routes, for example by using physical control measures like barriers or bollards to prevent vehicles from crossing into walking areas.
- are on level ground, where possible to prevent parked vehicles from rolling by, preferably in a designated parking area with the brake firmly applied. Where this is not possible, consider installing wheel humps in parking areas to prevent vehicles from rolling.
- allow drivers who are not needed during loading and unloading, safe access to amenities away from loading areas or other vehicular traffic. This will minimise their exposure to traffic and other risks, including inadvertent drive-offs, and
- have barriers, traffic lights or other stop signals where necessary so drivers are aware of when it is safe to leave.
- have site access and egress designed to eliminate the interaction of machinery, vehicles and people. Consider the potential risks to people and other vehicles associated with how vehicles or machinery enter the parking area from a public road, particularly if entering vehicles and machinery are required to slow significantly in order to safely park.

Reversing vehicles

Where possible, avoid the need for vehicles to reverse as this is a major cause of fatal incidents.

One-way road systems and turning circles can minimise risks, especially in storage areas. Where this is not possible other control measures should be considered, including:

- using mirrors, reversing warning alarms, sensors and cameras.
- ensuring a signal person wearing high visibility clothing assists the driver who cannot see clearly behind their vehicle—the driver should always be able to see the signaller.
- ensuring workers and other people are familiar with reversing areas and these areas are clearly marked, and
- ensuring machinery operators are aware of workers who may be in the vicinity of the swing radius, articulation points and overhead load movement of their vehicle.

Ensure all workers in the vicinity are aware of a reversing vehicle

Crane loading and unloading

Injuries are common at construction sites during the loading and loading of large vehicles. Ways to stop vehicles from moving during loading and unloading activities at a construction site include using:

- vehicle or trailer.
- using speed-limiting devices.
- braking alarms or automatic braking systems fitted to heavy vehicles to alert the driver if the brake is not applied when exiting the vehicle.
- dock locks.
- air brake isolation interlock devices.
- systems for controlling access to vehicle keys or the cabin, and
- a combination of audio and visual warning devices like alarms, horns and flashing lights and ensuring these are working when the plant is operating.

If drivers are not needed during loading and unloading, they should be provided with safe access to amenities away from loading areas or other vehicular traffic. This will minimise their exposure to traffic and other risks, including inadvertent drive-offs.

Cranes

Operating a crane (or any other powered mobile plant) on a construction site, including the unloading of materials, is high risk construction work (HRCW). HRCW must not be performed unless a safe work method statement (SWMS) is prepared, and the work must be performed according to the SWMS. A SWMS must:

- identify work that is HRCW.
- state the hazards and risks of that work.
- describe control measures and how those measures are to be implemented.
- be set out and expressed in a way that is accessible and comprehensible to the persons who use it.

Construction Site Owners must consult affected workers when identifying hazards and determining risk control measures and must ensure that Workers are trained and provided with information and instruction in relation to the risk controls.

Visual line of sight of a load

The crane operator should have clear line of sight of the load and travel path and ensure that the load is under control. Where a crane operator does not have line of sight or the load is not visible at any stage and the operator requires direction in the movement of the load then a dogger is required.

Exclusion zones

Exclusion zones should be established for the lifting and landing areas and the load's travel path. When determining the size of exclusion zones, all risks arising in relation to the work should be taken into consideration, such as when lifting and manoeuvring loads of large dimensions in restricted areas, or near incomplete or temporarily braced structures.

Designated lifting areas should be prepared to enable the crane to be set up as per the manufacturer's recommendations, for example, ensuring adequate space to set up the outriggers.

Falling objects

The risk of falling objects causing injury to workers and other people must be eliminated, or minimised, so far as reasonably practicable including preventing objects from falling freely or providing a system to arrest the fall of the object.

Loads should not be lifted over public access areas including footpaths, roads, highways, railways, waterways and buildings. If there is a risk of people being hit by falling objects control measures like exclusion zones or suitably designed gantries should be used to prevent people being hit by falling objects during lifting operations.

Where possible, site access should be restricted to people who are directly involved with crane activities. Movement of people and mobile plant at the construction site should be minimised while lifting is taking place.

Training and licensing

The vehicle loading crane operator needs to be appropriately trained and competent for the type of plant being operated and, where required, hold the appropriate high risk work licence. Vehicle loading cranes with the capacity of 10 metre tonnes or more require a high-risk work (HRW) licence. Other plant used on construction sites may also require a HRW licence.

Always have traffic control if a crane is operating on a public street

Signs, warning devices and visibility

Signs should be used to alert workers and pedestrians to potential hazards from vehicles entering and exiting the construction site and other requirements like pedestrian exclusion zones.

Traffic routes should be clearly signed to indicate restricted parking, visitor parking, headroom, speed limits, vehicle movement, key site areas and other route hazards. Standard road signs should be used where possible and speed limits should be implemented and enforced.

If there is a possibility of powered mobile machinery colliding with pedestrians or other powered mobile machinery, the person with management or control of the machinery must ensure the machinery has a device to warn people at risk from the movement of the machinery.

Construction Site Owners must also ensure, so far as is reasonably practicable, lighting is provided to allow workers to carry out their work without risk to health and safety. Bad weather, shadows from machinery and blind spots can reduce visibility.

The following control measures should be considered to manage risks:

- installing mirrors, reversing cameras, sensors and alarms to help drivers see or be aware of movement around the vehicle.
- installing visual warning devices like flashing lights and high-visibility markings for powered mobile machinery.
- implementing safe systems of work to stop loads being carried forward where they impair clear vision.
- appointing a trained person to control manoeuvres.

- ensuring high-visibility or reflective clothing is worn by workers, machinery operators and pedestrians at the construction site.
- using communication methods like:
    - radio - however ensure a back-up communication process is in place if it fails, and
    - line of sight communication e.g., hand signals or cap lamp light signals. The person receiving the message should acknowledge the message has been received and understood.

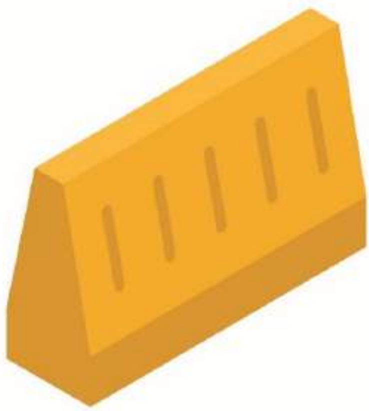
Ensure relevant safety signs are erected inside and outside of the site

Public roads surrounding construction sites

On a public road surrounding a construction site, the installation of detour routes can help guide the traffic around or though the construction site. Barriers and warning devices, such as lights on powered mobile machinery, can be used to ensure workers and vehicles stay separated. For example, consider:

- crash barriers that physically separate the construction site from the moving traffic and provide protection for workers, for example fixed and vehicle mounted crash attenuators.
- warning devices - including flashing arrows and electronic variable message signs, and
- anti-glare screens to reduce the light glare from work machinery and other vehicles.

Contact your relevant Ministry for advice on the installation and use of traffic control devices on a public road near your construction site.



Safety barriers that separate traffic from the work site are recommended

Speed management

Temporary speed zones may be implemented where the consequence of speed through a work zone is not apparent to drivers and operators of machinery and, therefore, they are unlikely to reduce speed to a safer level.

The speed limit selected for the work zone depends on several factors, such as the degree of vehicle and pedestrian conflict, the type and extent of the work, the characteristics of the road, and the separation between workers and the passing traffic lanes.

To be effective, work zone speed limits should:

- not be used alone or in place of more effective means of traffic control, rather they should be used in combination with such controls.
- be used in conjunction with other signs or devices required by the site conditions, and
- only be used while work is being undertaken or temporary road conditions exist that are hazardous to safety.

Approval from the relevant Ministry is required when changing speed limits on a public road surrounding a construction site.

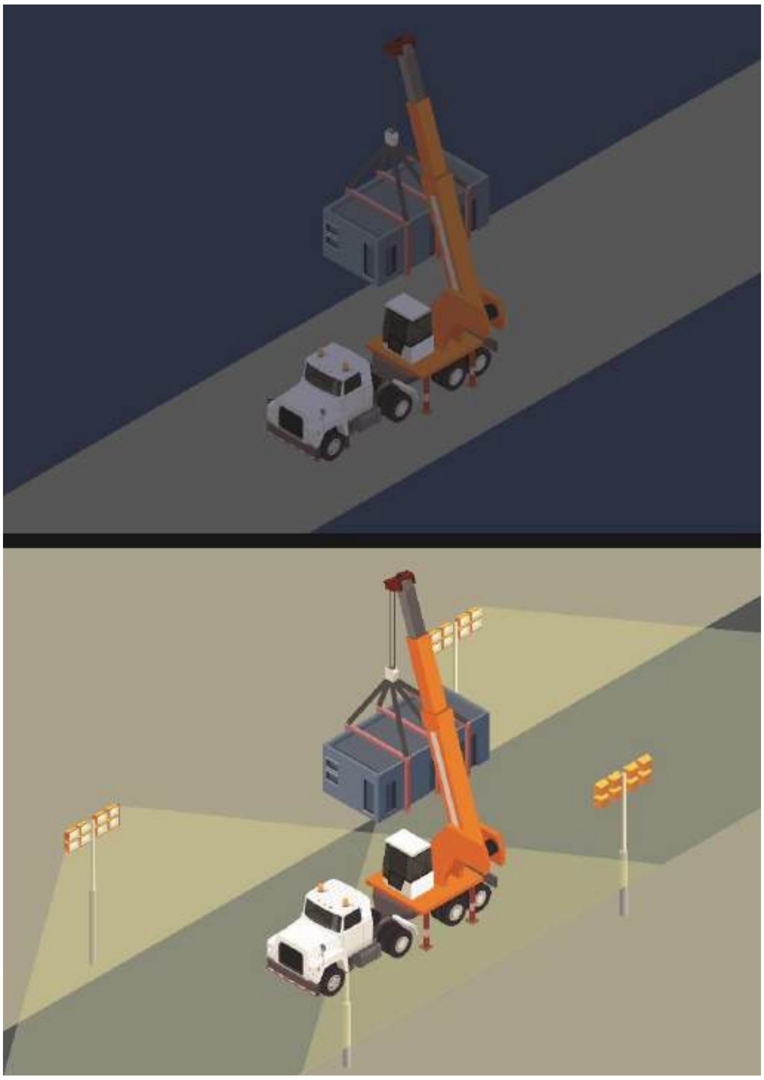
Ensure the traffic controller is also in the safest possible position

Working at night

Work may be carried out at night on a construction site due to operational requirements or because of decreased traffic volume, particularly when working on a public road. However, working at night can also introduce new hazards, including reduced visibility of the workers and construction site. When carrying out work at night, you should consider the following:

- All signs, devices, and clothing should be appropriately reflective.

- Traffic controllers, the construction site and the workers should be well illuminated at all times by portable floodlights, lamps, street lighting, etc.
- The light source should be angled or shielded to minimise glare to approaching traffic, and
- Traffic controllers should use a luminous wand when controlling traffic.



Always have appropriate lighting on the construction site

Traffic management plans

A traffic management plan documents and helps explain how risks will be managed at the construction site. In preparing the traffic management plan, a map or sketch of the construction site and traffic area layout can help a Worker, site designers and other authorised workers identify hazards and risks. This may include details of:

- designated travel paths for vehicles including entry and exit points, haul routes for debris or plant and materials, or traffic crossing other streams of traffic.
- pedestrian and traffic routes.

- designated delivery and loading and unloading areas.
- travel paths on routes remote from the construction site including places to turn around, dump material, access ramps and side roads.
- how often and where vehicles and pedestrians interact.
- traffic control measures for each expected interaction including drawings of the layout of barriers, walkways, signs and general arrangements to warn and guide traffic around, past or through the construction site or temporary hazard.
- on a public road, detail of the layout of signs and devices including temporary speed zones and the location, spacing, length and location of tapers. Consider pedestrian and cyclist routes to ensure the protection of the public.
- requirements for special vehicles like large vehicles and mobile cranes, and
- requirements for loading from the side of road onto the site.

A traffic management plan could also set out:

- the responsibilities of people managing traffic at the construction site.
- the responsibilities of people expected to interact with traffic at the construction site.
- instructions or procedures for controlling traffic including in an emergency, and
- how to implement and monitor the effectiveness of a traffic management plan.

The traffic management plan should be monitored and reviewed regularly including after an incident to ensure it is effective and takes into account changes at the construction site.

Workers must be aware of and understand the traffic management plan. Construction Site Owners must ensure workers are given suitable information, instruction, training and supervision on the application of the traffic management plan, in a manner that is easily understood.

CHAPTER 25

FIRST AID

All Workers must be provided with first aid facilities, equipment and access to first aiders. This section provides advice on what you need to consider when deciding what first aid equipment and facilities you need at your construction site and suggests ways to help you organise your first aid kits, facilities, and first aiders.

What is first aid?

First aid is the immediate and basic care given to an injured or sick person before a doctor, other health professional or emergency services take over their treatment. It focuses on preserving life and minimising serious injury. For example, maintaining breathing and circulation, stopping bleeding, and stabilising broken arms or legs.

As a Worker or Construction Site Owner, it is not only your responsibility to provide a safe construction site, but it is your responsibility to provide immediate and effective first aid to Workers or others who have been injured or become ill at the construction site.

There are three main things you need to think about when deciding what first aid equipment and facilities your construction site needs:

- Do you have enough first aid kits and facilities (for example, some construction sites may need a first aid room as well)?
- How many first aiders do you need? First aiders are Workers who have been trained to give first aid.
- What type of information do you need to give Workers about first aid?

It is important to remember that you abide by all legal requirements governing first aid provision for Workers and on construction sites.

Training workers in first aid is vital to the safety of a work site

First aid requirements for your construction site – what to think about

A construction site is any place where a Worker goes or is likely to be while at work, or where work is being carried out or is customarily carried out.

When considering what first aid equipment, facilities and first aiders you need, consider the nature of the work carried out on your construction site as well as the physical locations where the work is done.

All Workers, including those working night shifts or outside of usual working hours, and all visitors to your site, must be able to access first aid equipment, first aiders, and the first aid room (if your construction site has one).

When considering how to provide first aid, Workers must consider all relevant matters including:

- the nature of the work being carried out at the construction site.
- the nature of the hazards at the construction site.
- the size, location and nature of the construction site.
- the number and composition of the Workers at the construction site.

The nature of the work and construction site hazards

Certain work environments have greater risks of injury and illness due to the nature of work being carried out and the nature of the hazards at the construction site. For example, factories, motor vehicle workshops and forestry operations have a greater risk of injury that would require immediate medical treatment than offices or libraries. These construction sites will therefore require different first aid arrangements.

Hazard	Potential harm
Manual Tasks	Overexertion can cause muscular pain
Working at height	Slips, trips, and falls can cause fractures, bruises, lacerations, dislocations, and concussion.
Electricity	Potential Ignition source could cause injury from fire. Exposure to live electrical wires can cause shock, burns, and cardiac arrest
Machinery and equipment	Being hit by moving vehicles or being caught by moving parts of machinery can cause fractures, amputation, bruises, lacerations, and dislocations.
Hazardous chemicals	Toxic or corrosive chemicals may be inhaled, contact skin or eyes causing poisoning, chemical burns, and irritation. Flammable chemicals could result in injuries from fire or explosion.
Extreme temperatures	Hot surfaces and materials can cause burns. Exposure to heat can cause heat stress and fatigue. Exposure to extreme cold can cause hypothermia and frost bite.
Radiation	Welding arc flashes, ionizing radiation and lasers can cause burns.
Violence	Behaviours including intimidation and physical assault can cause nausea, shock, and physical injuries.
Biological	Infections and allergic reactions.
Animals	Bites, stings, kicks, and scratches.

Listed above are Injuries associated with common construction site hazards that may require first aid

Records of injuries, illnesses, 'near miss' incidents and other information that has already been obtained to assist in controlling risks at the construction site will be useful to make appropriate decisions about first aid.

You should check the safety data sheets (SDS) for any hazardous chemicals that are handled, used or stored at your construction site. The SDS provides information about the chemical, possible health effects, controls that may be used to reduce exposure and first aid requirements.

Size and location of the construction site

In relation to the size and location of the construction site, you should take into account:

- the distance between different work areas.
- the response times for emergency services.

First aid equipment and facilities should be located at convenient points and in areas where there is a higher risk of an injury or illness occurring.

A large construction site may require first aid equipment to be available in more than one location if:

- work is being carried out a long distance from emergency services.
- small numbers of Workers are dispersed over a wide area.
- access to a part of the construction site is difficult.
- the construction site has more than one floor level.

Where there are separate work areas (for example, a number of buildings on a site or multiple floors in an office building), it may be appropriate to locate first aid facilities centrally and provide first aid kits in each work area. This may include portable first aid kits in motor vehicles and other separate work areas, as well as Automated External Defibrillators (AED's).

The distance of the construction site from ambulance services, hospital and medical centres should be taken into account when determining your first aid requirements. For example, if life-threatening injuries or illnesses could occur and timely access to emergency services cannot be assured, a person trained in more advanced first aid techniques (such as the provision of oxygen) will be needed.

If the construction site is remote or isolated, aerial evacuation may be needed

Additional first aid considerations may be necessary for Workers in remote or isolated areas. For example, where access is difficult due to poor roads or weather conditions, arrangements may need to include aerial evacuation.

The number and composition of workers and other people

When considering the size of your workforce, you should include any contractors, subcontractors, and volunteers you engage. This may mean the size of your workforce may vary over time. For the purposes of deciding who requires access to first aid, you should consider the maximum number of Workers that you may engage at any one time. Generally, a larger workforce requires more first aid resources.

You should also consider.

- the particular needs of Workers who have a disability or a known health concern.
- others who visit your construction site who are not your workers.

First aid kits

All Workers must be able to access a first aid kit. This will require at least one first aid kit to be provided at their construction site.

Content of Kits

The first aid kit should provide basic equipment for administering first aid for injuries including:

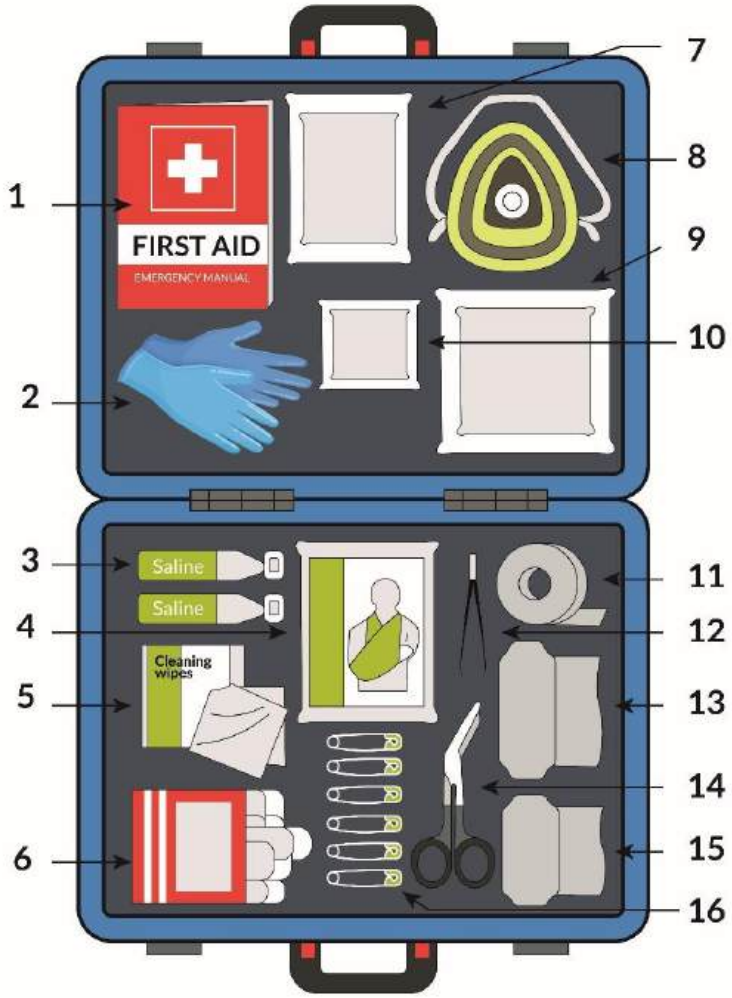
- cuts, scratches, punctures, grazes and splinters.
- muscular sprains and strains.
- minor burns.
- amputations and/or major bleeding wounds.

- broken bones.
- eye injuries.
- shock.

The contents of first aid kits should be based on a risk assessment. For example, there may be higher risk of eye injuries and a need for additional eye pads in a construction site where:

- chemical liquids or powders are handled in open containers.
- spraying, hosing or abrasive blasting operations are carried out.
- there is any possibility of flying particles causing eye injuries.
- there is a risk of splashing or spraying of infectious materials.
- welding, cutting or machining operations are carried out.

Additional equipment may be needed for serious burns and remote construction sites.



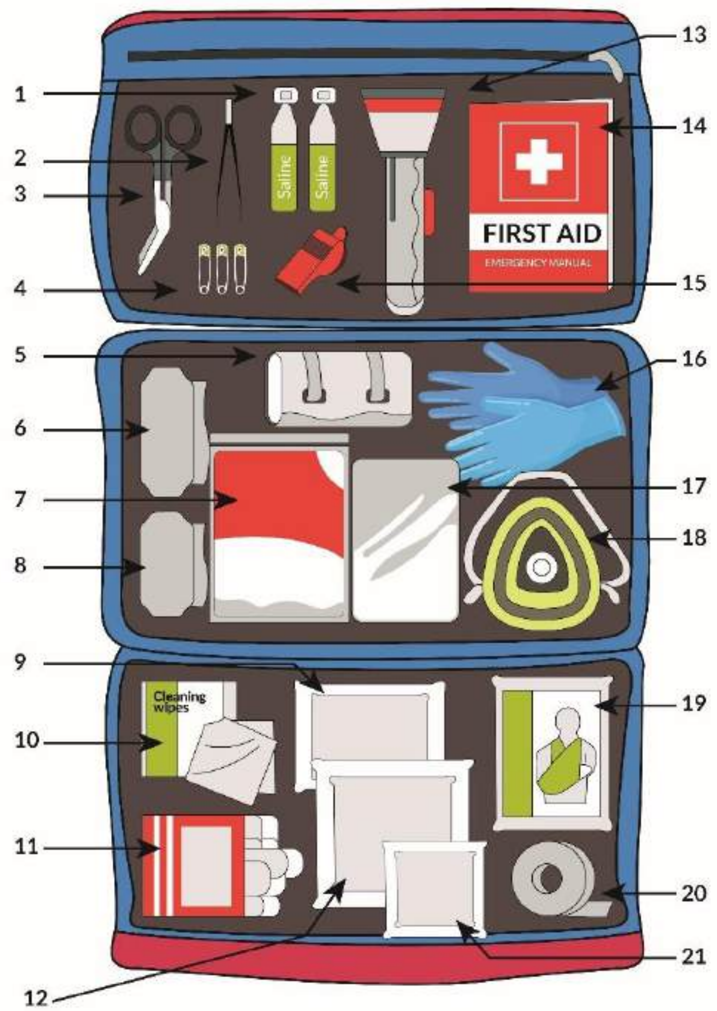
The contents of a simple first aid kit on a construction site:

1	First Aid instruction book
2	2 pairs of disposable nitrile gloves
3	8 x 15ml saline
4	2 x triangular bandages
5	10 x Centrimide BP wound cleaning wipes
6	50 x adhesive dressing strips
7	3 x 7.5cm x 10cm (medium) non-adherent dressing/pad
8	Resuscitation mask or face shield
9	Non-adherent dressing/pad
10	6 x 5cm x 5cm (small) non-adherent dressing/pad
11	2.5cm wide roll of non-stretch hypoallergenic adhesive tape
12	Tweezers
13	3 x 7.5cm wide conforming cotton bandage
14	Scissors
15	3 x 5cm wide conforming cotton bandage
16	6 x safety pins

Design of kits

First aid kits can be any size, shape or type to suit your construction site, but each kit should:

- be large enough to contain all the necessary items.
- be immediately identifiable with a white cross on green background that is prominently displayed on the outside.
- contain a list of the contents for that kit.
- be made of material that will protect the contents from dust, moisture and contamination.



The contents of a more advanced first aid kit on a construction site:

1	8 x 15ml saline
2	Tweezers
3	Scissors
4	6 x safety pins
5	10cm crepe bandage
6	3 x 7.5cm wide conforming cotton bandage
7	1 x large sterile burn dressing
8	3 x 5cm wide conforming cotton bandage
9	3 x 7.5cm x 10cm (medium) non-adherent dressing/pad
10	10 x Centrimide BP wound cleaning wipes
11	50 x adhesive dressing strips
12	1 x 10cm x 10cm (large) non-adherent dressing/pad
13	Torch
14	First Aid instruction book
15	Whistle
16	2 pairs of disposable nitrile gloves
17	1 x Rescue blanket
18	Resuscitation mask or face shield
19	2 x triangular bandages
20	2.5cm wide roll of non-stretch hypoallergenic adhesive tape
21	6 x 5cm x 5cm (small) non-adherent dressing/pad

Location of kits

In the event of a serious injury or illness, quick access to the kit is vital. First aid kits should be kept in a prominent, accessible location and able to be retrieved promptly. Access should also be ensured in security-controlled construction sites. First aid kits should be located close to areas where there is a higher risk of injury or illness. For example, a carpentry workshop should have first aid kits located in these areas. If the construction site occupies several floors in a multi-storey building, at least one kit should be located on every second floor. Emergency floor plans displayed in the construction site should include the location of first aid kits.

A portable first aid kit should be provided in the vehicles of mobile Workers if that is their construction site (for example, couriers, taxi drivers, sales representatives, bus drivers and inspectors). These kits should be safely located so as not to become a projectile in the event of an accident.

Ensure first aid kits are in a visible area with clear signage

Restocking and maintaining kits

A person in the construction site should be nominated to maintain the first aid kit (usually a first aider) and should:

- monitor access to the first aid kit and ensure any items used are replaced as soon as practicable after use.
- undertake regular checks (after each use or, if the kit is not used, at least once every 12 months) to ensure the kit contains a complete set of the required items (an inventory list in the kit should be signed and dated after each check).
- ensure that items are in good working order, have not deteriorated and are within their expiry dates and that sterile products are sealed and have not been tampered with.

First aid signs

Displaying well-recognised, standardised first aid signs will assist in easily locating first aid equipment and facilities. Explanation of first aid signs should be provided to Workers and to visitors during an induction to ensure they understand the meaning of all first aid signage on the construction site.

Ensure there is visible directional signs pointing to the location of first aid equipment

Other first aid equipment

In addition to first aid kits, consider whether you need other first aid equipment.

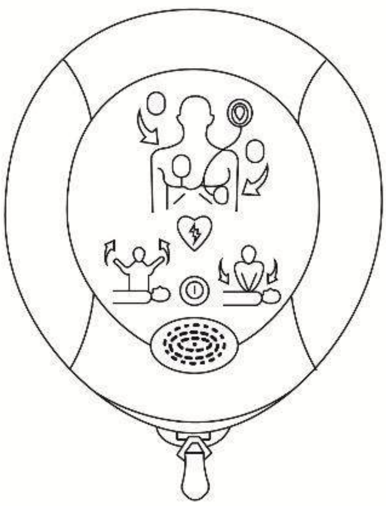
Automated external defibrillators

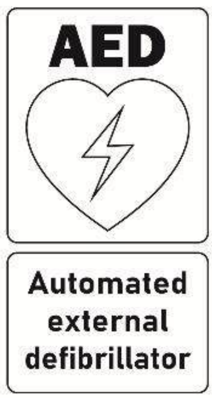
Cardiopulmonary resuscitation (CPR) can prolong life, but an Automated External defibrillator (AED) is the only way to restore the heart's normal rhythm.

Consider providing an AED if there:

- is a risk to your Workers of being electrocuted.
- is likely to be a delay in an ambulance arriving at your construction site (for example, because of distance), or
- are large numbers of members of the public at your construction site.

AEDs can be used by trained or untrained people. They should be located in an area that is clearly visible, accessible and not exposed to extreme temperatures. They should be clearly signed and be maintained according to the manufacturer's instructions

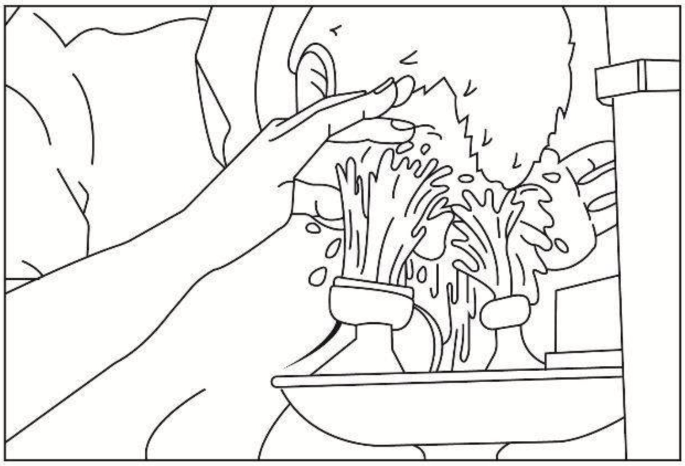




AED's are simple to use however workers require training to understand what situations require their use

Emergency eyewash equipment

Provide emergency eyewash equipment if Workers could be splashed in the eye with chemicals or infectious substances. Eyewash stations can be permanently fixed or portable, depending on the needs of your Workers. Use according to the manufacturer's instructions.



Emergency eyewash stations should be placed near where eye injuries may occur and need to be clearly signed

Emergency shower equipment

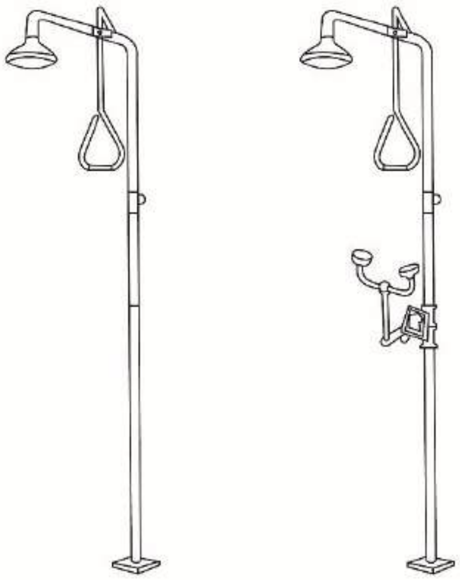
Provide emergency shower equipment or facilities if workers are at risk of:

- being exposed to hazardous chemicals that can be absorbed into their skin.
- being contaminated by infectious substances.
- burns to a large area of their face or body.
- chemical or electrical burns or burns that are deep, in sensitive areas or larger than a thumb-width.

Shower facilities could be a:

- deluge shower (pictured below).
- permanent hand-held shower hose, or
- portable plastic or rubber shower hose that can easily be attached to a tap spout. This could suit small, relatively low-risk construction sites where a fixed deluge facility would not be reasonably practicable, but where there is a risk of serious burns (for example, a kitchen).

Shower equipment can be permanently fixed or portable, depending on the needs of your Workers.



Deluge showers can also come with a foot pedal

First aid facilities

A risk assessment will help determine the type of first aid facilities needed. For example, a clean, quiet area within the construction site that affords privacy to an injured or ill person may be suitable and practicable for some construction sites.

Access to a telephone for contacting emergency services or an emergency call system should be provided as part of all first aid facilities.

First aid rooms

A first aid room should be established at the construction site if a risk assessment indicates that it would be difficult to administer appropriate first aid unless a first aid room is provided.

For example, Workers who carry out work at construction sites where there is a higher risk of serious injury or illness occurring that would not only require immediate first aid, but also further treatment by an emergency service, may benefit from having access to a dedicated first aid room.

Cambodia Law states that the following construction sites must apply applicable first aid facilities:

- All enterprises and sites employing 50 or more Workers shall have a permanent infirmary on the site.
- All enterprises and sites employing 20 to 50 Workers shall have a first aid room on site.
- All enterprises and sites employing less than 20 Workers shall have a fully stocked first aid kit on site.

The contents of a first aid room should suit the hazards that are specific to the construction site. The location and size of the room should allow easy access and movement of injured people who may need to be supported or moved by stretcher or wheelchair.

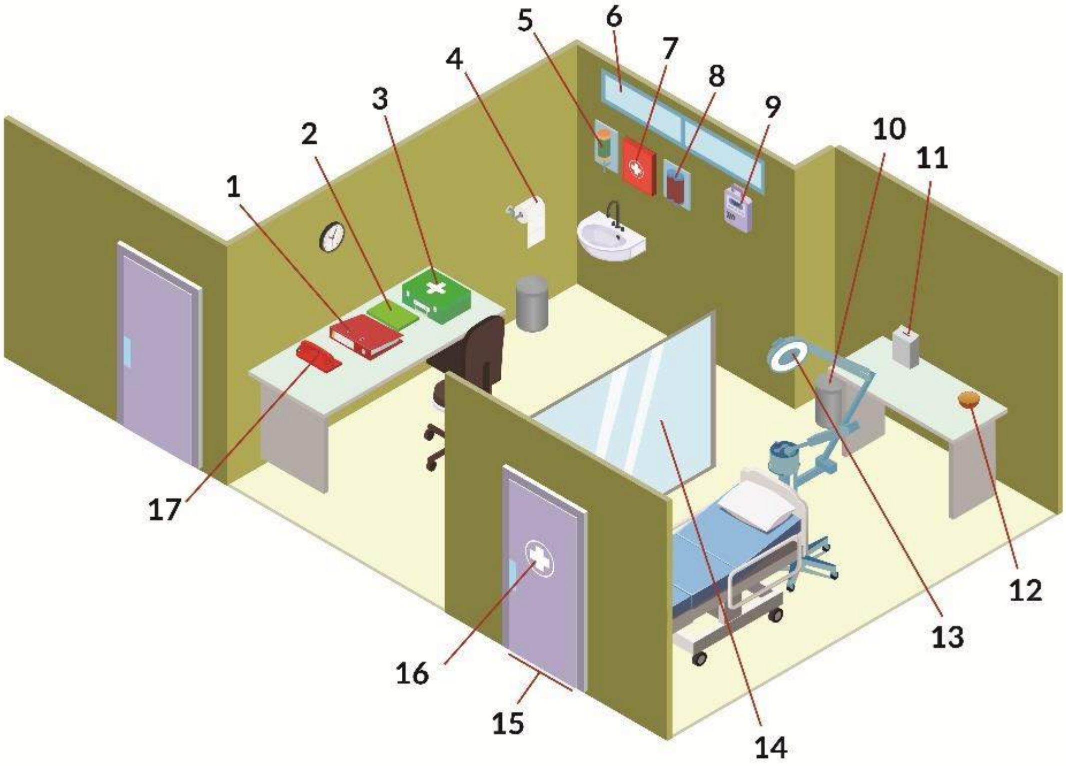
The following items should be provided in the room:

- A first aid kit appropriate for the construction site.
- Hygienic hand cleanser and disposable paper towels.
- An examination couch with waterproof surface and disposable sheets.
- An examination lamp with magnifier.
- A cupboard for storage.
- A container with disposable lining for soiled waste.
- A container for the safe disposal of sharps.
- A bowl or bucket (minimum two litres capacity).
- Electric power points.
- A chair and a table or desk.
- A telephone and/or emergency call system.
- The names and contact details of first aiders and emergency organisations.

A first aid room should:

- be located within easy access to a sink with hot and cold water (where this is not provided in the room) and toilet facilities.
- offer privacy via screening or a door.
- be easily accessible to emergency services (minimum door width of 1 metre for stretcher access).
- be well lit and ventilated.
- have an appropriate floor area (14 square metres as a guide).
- have an entrance that is clearly marked with first aid signage.

Maintaining a first aid room should be allocated to a trained occupational first aider, except where this room is part of a health centre or hospital.



A typical first aid room for a construction site with 20 to 50 workers will consist of the following:

1	Contact details
2	Accident report book
3	First Aid Kit
4	Paper towels
5	Hand cleaner
6	Ventilation
7	Medicine cabinet
8	Eyewash dispenser
9	Defibrillator
10	Bin with disposable lining
11	Disposable container for sharps
12	Bowl
13	Examination lamp with magnifier
14	Privacy screen or curtain
15	Entrance with door (min width 1m)
16	Appropriate door signage
17	Telephone

Removing first aid waste

First aid waste should always be disposed of correctly and not thrown openly into general rubbish. Place items with blood or body substances into plastic bags and securely tie or seal the bag. Dispose of the bag as part of your usual waste disposal.

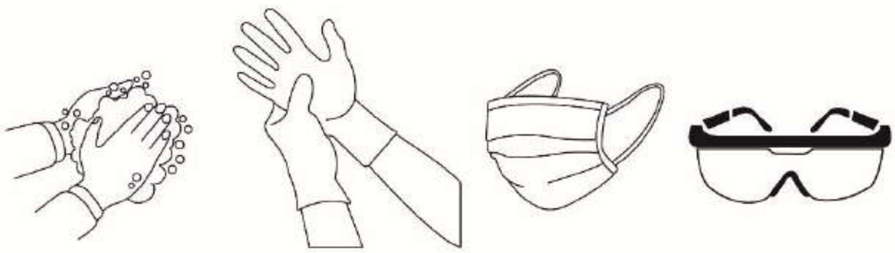
Dispose of needles or other sharp instruments in a sharps disposal container and arrange for its collection by a sharps waste disposal service.

Ensure medical waste is disposed of in the correct manner

Handling/cleaning up blood or body substances

When providing first aid to an injured or ill person, first aiders could come into contact with blood or body substances. These can transfer infections to the first aider or other people they treat.

First aiders should wash their hands with soap and water or apply alcohol-based hand rub before and after administering first aid. First aiders should also wear PPE, including disposable gloves, to prevent contact with blood and body substances. Eye protection, a surgical mask and protective clothing may also be necessary if splashes of blood or body substances are likely to occur.



As a First Aid Responder, it is important to also protect yourself as well as the patient

First aiders

First aiders are Workers trained to give first aid. You must provide your own first aiders at the construction site or provide your Workers with access to other trained first aiders (for example, from nearby businesses). It is recommended that all Workers should have at least basic first aid knowledge.

When thinking about how many trained first aiders you need, consider:

- the number of Workers at the construction site at any given time.
- the nature of the work they do and its risks.
- the likelihood of people being hurt, and how serious the injuries might be.
- the physical size of the construction site and whether Workers are scattered across different parts of it.
- the location of the construction site and its distance from ambulance services, medical centres and hospitals.
- whether other people (for example, members of the public) visit the construction site.

Allow for some of your first aiders to be absent on planned or unplanned leave, such as sick leave.

Types of first aid training

First aiders should hold internationally recognised first aid qualifications issued by a Registered Training Organisation (RTO).

Provide first aid - provides competencies required to recognise and respond to common life-threatening injuries or illnesses, including life-support using cardiopulmonary resuscitation (CPR), and to manage the casualty and incident until the arrival of medical or other assistance.

In low-risk construction sites, first aiders are sufficiently trained if they can perform CPR and treat minor illnesses and injuries.

Provide advanced first aid and provide advance first aid response - provides additional competencies required to apply advanced first aid procedures. This type of training is suitable for some high-risk construction sites.

Manage first aid services and resources - provides competencies required to apply advanced first aid procedures and to manage a first aid room.

Provide first aid in remote situations - provides the competencies required to administer first aid in a remote and/or isolated situation, including preparing for aero-medical evacuation. This type of training is suitable for high-risk construction sites that are likely to have a major delay in accessing emergency services.

Additional training for first aiders

First aiders should attend training on a regular basis to refresh their first aid knowledge and skills and to confirm their competence to provide first aid. Refresher training in CPR should be undertaken annually and first aid qualifications should be renewed every three years.

First aiders may also need to undertake additional first aid training to respond to specific situations at their construction site. For example, where Workers have severe allergies, first aiders should be trained to respond to anaphylaxis if this topic has not been covered in previous first aid training.

Number of trained first aiders

The following ratios are recommended:

- Low risk construction sites – one first aider for every 50 Workers.
- High risk construction sites – one first aider for every 25 Workers.

The number and type of trained first aiders can be further refined by following the five-step guide below:

STEP 1:

Identify the maximum number of Workers at the construction site at any one time.

STEP 2:

Consider the nature of the work being carried out at the construction site and determine if your Workers are at a high risk of being exposed to hazards that could require immediate first aid treatment.

STEP 3:

Determine if the construction site is remote or if access to emergency services is difficult. High risk construction sites that do not have timely access to medical and ambulance services should have at least one first aider for every 10 Workers.

STEP 4:

Consider the variety of ways that your Workers carry out work, for example:

- if a Worker spends most, if not all, of their time working alone and in transit i.e., their construction site is their vehicle and the places they visit in the course of their work (for example, couriers, taxi drivers, sales representatives, door-to-door charity collectors and inspectors).
- if a Worker's location varies on a regular basis and they often work without supervision (for example, tradespeople, construction Workers in the housing industry, farm hands and cleaners).
- if a Worker sometimes works alone for relatively short periods of time (for example, when opening or closing a business for trade or working back late to meet a deadline).

In these situations, it may not be practicable to have a first aider available at all times at the construction site. However, these Workers must be able to access first aid assistance, for example by ensuring they are provided with:

- an effective means of contacting emergency services or first aiders.
- information, instruction and training on how to respond if a serious injury or illness occurs.

STEP 5:

Before finalising the number of first aiders your workers require access to, consider if there are any other factors that indicate that your construction site needs additional first aiders, for example:

- the arrangement of work (multiple shifts or overtime).
- seasonal work, where there may be a sudden and significant increase or decrease in the number of workers.
- where there are large numbers of other persons present on a regular basis (e.g., schools, shopping centres, hotels and function centres).
- construction sites that have unique hazards such as fitness centres, amusement rides and dive schools.
- access during times when a first aider is absent (e.g., annual leave).

First aid procedures

You should develop and implement first aid procedures to ensure that Workers have a clear understanding of first aid in their construction site. The procedure should cover:

- the type of first aid kits and where they are located.
- the location of first aid facilities such as first aid rooms.
- who is responsible for the first aid kits and facilities and how frequently they should be checked and maintained.
- how to establish and maintain appropriate communication systems (including equipment and procedures) to ensure rapid emergency communication with first aiders.
- the communication equipment and systems to be used when first aid is required (especially for remote and isolated workers). These procedures should contain information about how to locate the communication equipment, who is responsible for the equipment and how it should be maintained.
- the work areas and shifts that have been allocated to each first aider. These procedures should contain the names and contact details of each first aider.
- arrangements to ensure first aiders receive appropriate training.
- arrangements for ensuring that workers receive appropriate information, instruction and training in relation to first aid.
- seeking information when a worker commences work about any first aid needs that may require specific treatment in a medical emergency, such as severe allergies. Information about a worker's health must be kept confidential and only provided to first aiders with the worker's consent.
- how to report injuries and illnesses that may occur in the construction site.
- practices to avoid exposure to blood and body substances.
- what to do when a Worker or other person is too injured or ill to stay at work, for example if they require assistance with transport to a medical service, home or somewhere else where they can rest and recover.

- access to debriefing or counselling services to support first aiders and Workers after a serious construction site incident.

Record-keeping

A record of any first aid treatment given should be kept by the first aider and reported to managers on a regular basis to assist reviewing first aid arrangements.

Procedures and plans for managing an emergency

Workers must ensure that an emergency plan is prepared for the construction site that provides procedures to respond effectively in an emergency.

The emergency procedures must include:

- an effective response to an emergency situation.
- procedures for evacuating the construction site.
- notification of emergency services at the earliest opportunity „ medical treatment and assistance, and
- effective communication between the person authorised by the person conducting the business or undertaking to co-ordinate the emergency response and all persons at the construction site.

You may incorporate your first aid procedures into your emergency planning procedures.

Emergency procedures should specify the role of first aiders according to their level of qualification and competence. In particular, first aiders should be instructed not to exceed their training and expertise in first aid. Other staff, including supervisors, should be instructed not to direct first aiders to exceed their first aid training and expertise.

Involving your workers in decisions about first aid

Construction Site Owners and Principal Contractors, so far as is reasonably practicable, must engage with Workers on health and safety matters that will directly affect them. This includes first aid. Involve your Workers - get their ideas, ask them what they think the risks are at work and what first aid equipment and facilities they think is needed.

Providing first aid information to workers

All Workers must be given clear information about the first aid available at their construction site, including the:

- location of first aid kits.
- names and locations of first aiders.
- location of a first aid room (if there is one), and
- procedures to follow when they need first aid.

This information should be given:

- when a Worker is first employed (for example, at induction).
- when there is a change in the nature or location of their work.
- when there is a change in first aiders (for example, if a first aider leaves or a new one is added).
- at regular intervals as a reminder (for example, annually).

FIRST AID AND THE RISK MANAGEMENT PROCESS

Step 1 – Identify potential causes of construction site injury or illness

- Does the nature of the work being carried out pose a hazard to people's health and safety?
- Have these hazards been identified in work that is being carried out?
- Has incident and injury data been reviewed?
- Has consultation with workers and their Health and Safety Representatives occurred?
- Is specialist or external assistance required?

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Step 2- Assess the risk of construction site injury and illness

- How often does a hazard have the potential to cause harm?
- What type of injuries would the hazard cause?
- How serious are the injuries?
- Does the number and composition of workers and other people affect how first aid should be provided?
- Could the size and location of the site affect how first aid is provided?

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Step 3 – What first aid is required?

First aiders	First aid kits and procedures	First aid facilities
• How many First Aiders are needed? • What competencies do they require? • What training do they need?	• What kits/modules are needed and where should they be located? • Is other first aid equipment needed? • Who else is responsible for maintaining the kits? • What procedures are needed for my construction site?	• Is a first aid room or infirmary required?

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Step 4

Review first aid to ensure effectiveness

Use the above steps to manage first aid and associated risks

CHAPTER 26

PROTECTION OF CHILDREN AND YOUNG WORKERS

Construction sites are deemed high risk work areas and even for the most qualified and experienced Worker, a construction site can present many risks that can cause injury and even death if the Worker isn't safety focused. It's because of this reason that Construction Site Owners, and Principal Contractors must ensure that they implement safe systems to protect the health and safety of young Workers and ensure that children are not permitted on a construction site either as Workers, visiting a construction site or living on a construction site with working parents.

Children on construction sites

Cambodian Law

Cambodian Law states that the minimum age of a person who is permitted to conduct hazardous work is 18 years of age.

Hazardous work includes working underground, lifting, carrying or moving heavy loads, working near furnaces or kilns used to manufacture glass, ceramics or bricks, firefighting, construction and demolition work, work involving exposure to harmful chemical agents, work done in high temperatures, handling and spraying chemicals.

The act of placing a minor into working conditions which are detrimental to his/her health or his/her physical development are punishable by an imprisonment from 2 (two) years to 5 (five) years and a fine from 4,000,000 (four million) Riels to 10,000,000 (ten million) Riels.

Cambodian Law also enforces the prohibition of Workers, their families and children from living in any building under construction, even temporarily.

Construction site owners, site managers and Principal Contractors have a responsibility to ensure that children under the age of 18 years of age are not permitted on a construction site.

Why are construction sites dangerous for children?

- Children do not possess experience, knowledge or judgement about construction site hazards and safe work practices.
- Children are unlikely to know if they are being exposed to health and safety risks and may find it hard to speak up even if they do.
- Children may be energetic and enthusiastic, but shy about asking questions or making demands of adults.
- Children may do work they are not prepared for nor capable of doing safely because they are used to being told what to do by parents.
- Children may skylark near machinery, dangerous substances or chemicals without realising the risks involved.
- Children can be inquisitive and adventurous, and their natural curiosity may lead them into dangerous situations in construction sites.
- Children do not have the experience and maturity to respond appropriately in unexpected, dangerous or stressful situations.
- Children may be vulnerable to pranks and teasing by adult Workers taking advantage of their inexperience and innocence.

- Children may be vulnerable to bullying and harassment.
- Children are still growing and will be comparatively weaker and have less stamina than adults.

Children under 18 years of age are not permitted on constructions sites in Cambodia

Protection of young workers

Industry Standards regard a young worker as being aged between 18 and 24 years of age. Young Workers bring new skills, energy and innovation into a workforce, and protecting and promoting the health and safety of young Workers is an investment for businesses now and into the future.

Hazards for young workers

The following hazards are likely to represent a particular risk to young Workers compared with older, more experienced Workers. Construction Site Owners and Principal Contractors should pay attention to these hazards and make sure associated risks are managed using the risk management process.

Physical work activity

<u>Hazardous manual tasks</u>

Young Workers may be at greater risk of manual tasks injuries because of their smaller size and the fact that their muscle strength is still developing. They may misjudge the degree of difficulty when handling items that are heavy, bulky or out of reach and may persist when a more experienced Worker would ask for assistance.

Repetitive work

Injuries to the muscles and joints may occur in jobs where repetitive or forceful movements are required, especially with awkward postures or insufficient recovery time. Young Workers may not be able to recognise the early symptoms of work-related overuse injuries or know what to do to avoid more serious injuries.

Vibration

Young Workers may face a greater risk of injury to the arm and shoulder following long periods using tools and equipment that vibrates. They may become tired more easily in situations where they have to maintain a tight grip on a piece of equipment to control it.

Regular exposure to whole-body vibration, such as when riding in off-road vehicles on uneven surfaces, may be associated with back pain and other spinal disorders. Young Workers may be at greater risk of damage to the spine because their muscle strength is still developing, and their bones do not fully mature until around 25 years of age.

Noise

Young Workers may face a greater risk of damaged hearing because of their poor understanding of the effects of excessive noise and failure to follow safety instructions. Research suggests that hearing impairment at a young age is likely to affect education and employment opportunities later in life.

Extreme cold or heat

Young Workers may not be able to recognise the early body reactions to extreme heat or cold or know what to do to avoid more serious symptoms. They may also be unwilling to draw attention to the fact that they feel unwell in situations where they are trying to keep up with other Workers.

Sunburn

The risk of sunburn may be increased in young Workers who may be less likely to follow instructions to limit sun exposure or to use protective clothing and sunscreen lotions. As the effects of skin damage due to sun exposure are long term, the effects often do not become evident until later in life.

Hazardous chemicals and other substances

There may be greater risk of exposure to hazardous chemicals and accidents with explosive and flammable liquids and gases when young Workers are involved, because of their inexperience and poor ability to understand the consequences of failing to follow safety instructions.

Young Workers may be unsure of how to access safety information in Safety Data Sheets (SDSs) for hazardous chemicals and they may not understand them if they do have access to them. Exposure to certain chemicals may have more serious consequences for young Workers than adults (e.g., the effects of lead).

Safe work procedures and the proper use, wear, storage and maintenance of personal protective clothing and equipment may need to be closely supervised to avoid serious injury or disease

Operating machinery

Industrial equipment and machinery

Inexperience may result in poor ability to identify hazards associated with the operation of industrial equipment and machinery or to understand the consequences of failing to follow safe operating instructions.

Vehicles

Young Workers, with no experience driving vehicles on roads, may be required to drive vehicles and ride motorbikes in unsafe situations. They may also be required to move vehicles in other construction sites, such as within construction sites, depots, maintenance workshops and rail yards. Young Workers, without the necessary skill or training, should not be operating vehicles on any work site.

Young Workers may be less likely to be able to control a vehicle and more likely to take risks resulting in breakdowns and accidents. They may not have the experience to cope with off-road situations, such as driving in sand or mud.

Other work situations

Construction site bullying and work-related stress and violence

Young Workers may find it difficult to cope with stressful work situations, such as dealing with violent and aggressive behaviour. They may fear for their physical safety, especially if they work alone without family or friend support. They may also worry about losing their jobs if they complain.

New work may be stressful for young Workers who are subjected to practical jokes, teasing and unpleasant initiation ceremonies. Workers should not be subjected to this type of behaviour.

Unpopular work

Young Workers who are keen to do well in their first jobs may be given work that is unpopular with other Workers. Inexperienced new Workers may not know how to deal with hazards associated with unpopular work, such as cleaning up spills, cleaning toilets and working in spaces that are hot, noisy, cramped or dirty.

Paced work

Young Workers may be less skilled in pacing the work according to their capabilities. They may be more subject to peer pressure to take on tasks that are too much for them, or to work too quickly.

Training and induction for young workers

Industry Standards require persons who supervise young Workers to provide young Workers with information, training, instruction or supervision that is necessary to protect them from risks to their health and safety whilst they are working on a construction site. It also requires that the information, training and instruction be provided in a way that is readily understandable by any person to whom it is provided

Young Workers cannot be put into a new job and automatically be expected to work safely. Nor is it enough to simply provide young Workers with a workplace health and safety booklet, as they may not read or understand it. Language and literacy levels also need to be taken into account when providing young Workers with information and instruction.

Knowledge and experience

People often make judgements based on some knowledge or experience of hazards and the safest way to deal with them. Over time, what they know about safety grows because of the variety of experiences they have, at home, at school, at play and at work. These things are not always learned in formal training courses.

Young Workers usually have limited knowledge and a limited range of experiences. Before a young person begins work, Principal Contractors should identify the gaps in their knowledge and assess their ability to work safely. Competency should be tested. It is not sufficient to accept a young Worker's assurance that he or she is experienced and competent. Driving vehicles and riding motorbikes is one example where competency testing is needed before a young person begins these work activities.

Due to the high levels of risk involved with some activities on a construction site, information, training, instruction, or supervision are of utmost importance in preventing injury and illness for young Workers. Inexperienced Workers require increased levels of information, training, instruction or supervision than experienced Workers.

Safety Induction for young workers

Persons conducting a business or undertaking should ensure that young Workers understand what they are being told and shown during construction site inductions. They should encourage young Workers to ask questions. The following steps will assist in this regard:

- Give young Workers clear instructions and ask them to repeat the instructions. Encourage young Workers, particularly those Workers with language or literacy needs, to ask questions.
- Show the new Worker how to do the task, emphasising the main points.
- Supervise the new Worker while they perform the task and correct any mistakes.
- Ask questions as you go and give the young Worker an opportunity to ask questions and raise issues.
- Follow up the Worker with frequent visits; and
- Remember training is an ongoing process.

Duties of young workers

Induction programs should also inform young Workers about their duties as a Worker under the Work, Health & Safety legislation. It is important for young Workers to understand when they start work that, as Workers, they have certain legal duties under the WHS Act. It is important to inform young Workers that:

- they must take reasonable care for his or her own health and safety.

- they must take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons.
- they must comply, so far as the Worker is reasonably able, with any reasonable instruction that is given by the Principal Contractors to allow compliance with laws & regulations.
- they must cooperate with any reasonable policy or procedure of the construction site relating to health and safety at the construction site which has been notified to Workers.

The right to refuse work

Induction programs should inform young Workers that under the law, Workers have a duty not to expose themselves to risk. Workers should also be informed that they have a corresponding right under the law to cease work that is unsafe. Specifically, any Worker who believes that carrying out a certain task would expose him or her to a serious risk to health or safety emanating from an immediate or imminent exposure to a hazard, has a right under the law to refuse to perform that task until exposure to the risk has been managed.

Young Workers should know what to do and who to contact if they believe there is a serious safety problem (i.e., report it to their Health and Safety Representative or supervisor). Workers should also be made aware of procedures for reporting hazards and resolving safety issues in their construction site.

As a young worker, if you feel unsafe you must stop work and report it

Ongoing information, training, instruction and supervision

The workplace health and safety induction given to Workers will provide most of the initial information, training and instruction for young Workers to commence work safely. Principal Contractors continue to provide ongoing safety information, training, instruction or supervision. It is not a “once only” process for young Workers who are new to the job. If the work is changed in any way, additional information, training, instruction or supervision should be provided to make sure young Workers' safety knowledge and skills are up to date. Principal Contractors should adequately supervise young Workers to ensure they are carrying out the tasks in accordance with the training that has been provided.

High-risk tasks will require more in-depth information, training, instruction or supervision. Young Workers should not perform high-risk tasks until they can demonstrate relevant knowledge, skills and experience. Principal Contractors should ensure that young Workers are adequately trained to undertake the tasks they are required to perform.

Principal Contractors should assess or have someone on their behalf assess the young Worker's competency to ensure they are satisfied that the young Worker can safely perform the task. When performing high-risk tasks, young Workers should always be accompanied by another competent person.

Young Workers may be required to receive training in relation to specific tasks, especially where these tasks have not been performed for a prolonged period.

Principal Contractors should ensure a record of all training provided to young Workers is kept at the construction site. Records should include:

- names of persons who received training.
- dates of the training sessions.
- skills taught.
- outline of the course content.
- names of the persons who provided the training and their qualifications.
- tasks to be performed once training has been delivered.

If training occurs away from the usual place of work, supervisors should know about the content of the training programs, so they are able to check on whether the young worker is putting classroom safety lessons into practice.

It is up to all Principal Contractors to decide on what training is appropriate for the construction site, depending on the type of work performed at the construction site. There should be prior consultation with all relevant parties.

Training should focus on the end result, which is to have a young Worker who has the skills and knowledge to work safely. The training should be evaluated to ensure that it achieves this result.

Due to their lack of experience in construction sites, young Workers may have difficulty raising problems with their supervisors. Principal Contractors should take steps to reassure young workers and encourage open discussion about situations where they feel they are at risk of injury or harm.

Training, and the attitude to safety, has to be consistent across the workforce. Principal Contractors need to engender a culture of health and safety across their construction sites. If older workers don't use safety gear, then why should young workers? Everyone needs to reinforce this culture of safety in the construction site.

Young workers lack experience and will follow an older worker's example

Tell me, show me, watch me method

Use the 'Tell me, show me, watch me' approach when doing task-specific instruction and training with young Workers. This approach has three steps:

- **Tell me** - provide a clear and detailed explanation of the task to the young Worker, highlight key elements and outline the documented procedure.
- **Show me** - demonstrate the task while the young Worker observes you, explain key elements and ask the young Worker questions to check their understanding.
- **Watch me** - observe the young Worker performing the task and provide clear and constructive feedback to support them to perform the task safely.

Provide personal protective equipment (PPE)

Provide young Workers with the necessary equipment and show them how to wear/use any protective gear. Ensure that young Workers understand why PPE is important and how it can prevent work-related injuries and illnesses. Most importantly, ensure that young Workers are given PPE that fits them correctly and is designed for young Workers.

Supervise young workers

Research shows that quality relationships between supervisors and their young Workers reduce the risk of injury in the construction site. Often young Workers are worried about losing shifts or their job if they raise health and safety issues. Modelling positive working relationships, providing constructive feedback and encouraging them to keep asking questions can empower young Workers to speak up.

Consult young workers

As a Principal Contractor, you are responsible for sharing health and safety information with all Workers. Include young Workers in consultation about health and safety matters, such as construction site hazards and control measures, and encourage them to actively participate in the consultation process. Ensure that health and safety representatives (HSRs) are included as part of the health and safety culture in the construction site.

Unsafe is unacceptable

Many young Workers find themselves working in unsafe conditions which can put them in danger, both mentally and physically. Young Workers have the right to feel safe at work, and Principal Contractors have a responsibility to create a safe working environment.

Young workers – how to identify unsafe work conditions

Unsafe conditions are practices or hazards that can put you in danger both mentally and physically.

These may include:

- not getting a job induction when you start work.
- not being shown how to do a task, or not being properly supervised.
- not being given suitable personal protective equipment (PPE) for the job.
- not having the right falls protection systems when you're working at height.
- physical hazards such as slippery floors, falling objects, unguarded machinery, heavy lifting or work with repetitive actions.
- exposure to bullying, sexual harassment, customer or colleague violence and aggression.

If you find yourself working in unsafe conditions, it's important that you speak up and report it to your Principal Contractor. If your Principal Contractor does not listen to you, you must report it to local authorities.

Gender based violence and harassment (GBVH)

Violence and harassment refer to a range of unacceptable behaviours and practices, or threats thereof, whether a single occurrence or repeated, that aim at, result in, or are likely to result in physical, psychological, sexual or economic harm.

Gender-based violence and harassment (GBVH) means violence and harassment directed at persons because of their sex or gender or affecting persons of a particular sex or gender disproportionately and includes sexual harassment.

No worker on a construction site should experience GBVH. Construction site owners and Principal Contractors are responsible for preventing gender-based violence and harassment (GBVH) on the construction site. Accordingly, management of GBVH risks is to be included in the Safety Management System and feature in regular site safety inspections.

Construction site owners and Principal Contractors will establish a confidential and accessible grievance mechanism for reporting GBVH by workers and by the surrounding community. The grievance mechanism should include the option of reporting anonymously. Examples of reporting channels include direct reports to supervisors and team leaders, independent helplines (NGOs), email address or whistleblowing lines, trade union representatives, health and safety committees and complaint/feedback boxes.

Construction site owners and Principal Contractors shall acknowledgement complaints and advise the complainant of next steps and what support is available.

CHAPTER 27

MANAGING COVID-19 RISK

This section provides information about managing the risk of exposure to COVID-19 at construction sites in Cambodia. This information is a guide only and all persons operating or visiting a construction site should refer to the latest Cambodian Government Directions for applicability.

Restrictions can apply across Cambodia

Depending on your industry your construction site may:

- be required to close temporarily for on-site work.
- remain open for on-site work with a completed COVID Safe Plan in place.
- be subject to restricted operations or industry specific obligations.

All Construction Sites in Cambodia should have a COVID Safe Plan.

COVID-19 and the construction industry

A COVID-19 infection can cause mild to severe respiratory illness.

Researchers are still learning about COVID-19 and its long-term effects. Current research suggests that COVID-19 spreads through:

- droplets when an infected person coughs, sneezes, talks or sings - these can enter your eyes, nose or mouth when you are in close contact.
- touching objects or surfaces (such as door handles) contaminated with droplets.
- airborne aerosols generated by actions like coughing, sneezing, talking or singing - these can stay in the air for some time, especially in indoor spaces with poor ventilation.

Take reasonable measures by following the site Covid-19 policies and procedures

Due to working in proximity to other people and the potential to come into contact with potentially contaminated surfaces, steps must be taken to reduce the risks of exposure for workers in the construction industry.

Principal Contractors have a duty to provide and maintain, so far as is reasonably practicable, a working environment that is safe and without risks to the health of workers. This includes preventing, and where prevention is not possible, reducing, risks to health and safety associated with potential exposure to COVID-19.

Workers have a duty to take reasonable care of their own and others' health and safety in the construction site and cooperate with their Principal Contractors about any action they take to comply with the Cambodia Government Covid-19 rules and regulations.

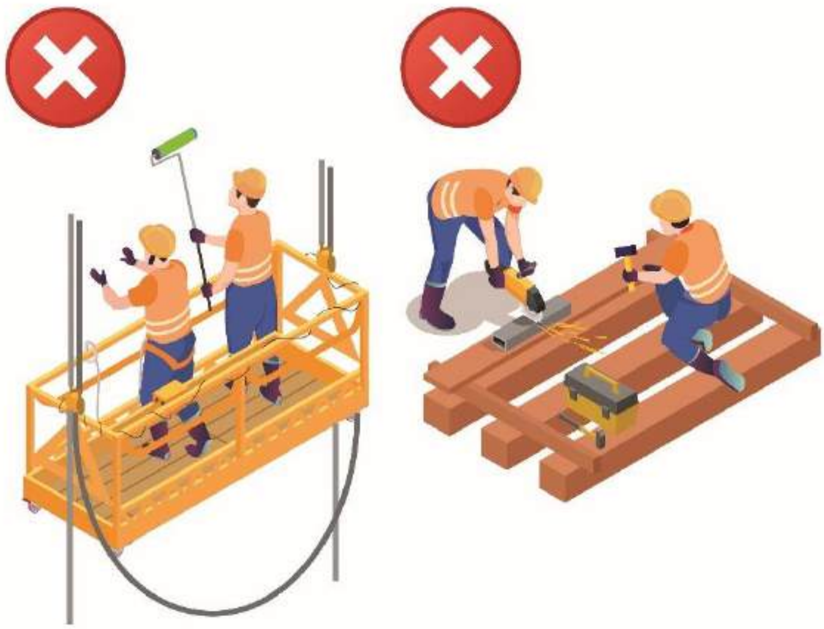
Identifying risks at construction sites

Principal Contractors must identify the level of risk to the health of workers from exposure to COVID-19 at their construction site.

This must be done in consultation with health and safety representatives (HSRs), if any, and workers, so far as is reasonably practicable.

Some activities that may pose a risk of exposure to COVID-19 can include:

- travelling in personnel hoists and lifts.
- work that requires workers to be in close contact with others.
- using shared tools or equipment.
- sharing facilities such as bathrooms, kitchens and communal break areas.



An example of workers not social distancing

Controlling risks

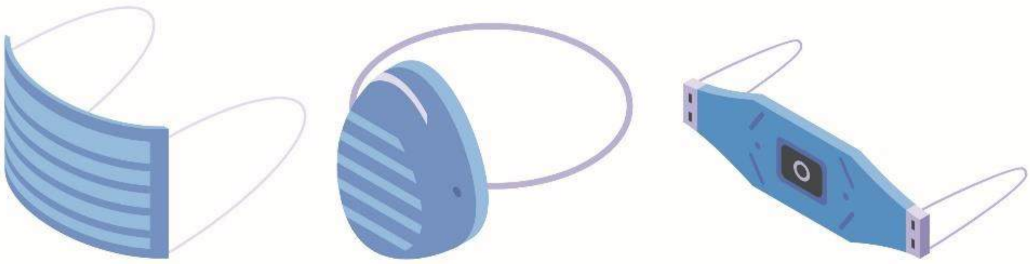
Face masks in construction sites

Face masks are an important measure to help slow the spread of COVID-19 in the community. The risk of transmission is highest where people are close to each other, and in enclosed spaces. If Cambodia Government rules stipulate that face masks must be worn in public areas, all people working on or visiting a construction site must wear a face mask at all times, unless they have a lawful reason not to.

Types of face masks

When a face mask is required to be worn on a construction site, you must wear a fitted face mask that covers the nose and mouth. A face mask is always recommended, however a fitted snood or fitted gaiter is acceptable. Fitted means the snood or gaiter can extend in a fitted form to snugly fit over and cover your nose and mouth.

Loose fitting face coverings such as bandanas or scarves, or face shields worn without a face mask, are not acceptable.



Standard N95 or P2 Mask

Snoods or Gaiters must be closely fitted around the mouth and nose

Using face masks in construction sites

Where the work or task requires the use of specific types of face masks in the construction site, these must be provided by the Principal Contractor. Where a worker seeks to provide and use their own face mask at work, an Principal Contractor must ensure that the face mask is safe and suitable for the construction site and work activities being performed.

Workers may already wear respiratory protective equipment (RPE) to control risks associated with their work. Where RPE is worn at the construction site, the Principal Contractor must conduct a risk assessment to ensure the level of RPE provided controls the risks associated with their work, including the risk of exposure to COVID-19.

Where workers have a lawful reason not to wear a mask, Principal Contractors must implement other risk control measures, so far as is reasonably practicable, to control the risk of exposure to COVID-19 in the construction site. Such arrangements may include for workers who are not wearing a mask to work in areas where there are less people and physical distancing of 1.5 metres can be maintained.

Correct use of face masks

Face masks are only effective when they are worn and maintained correctly. Principal Contractors must provide information, instruction, training and supervision to workers and contractors on:

- when face masks are to be worn.
- how to put on and wear face masks correctly to ensure they are effective.
- how long face masks can be worn.
- how to remove face masks safely, including changing them during shifts.
- how to safely store and wash reusable face masks or dispose of single use masks.

Principal Contractors need to provide appropriate hygiene amenities for workers to safely put on, remove and dispose of face masks, such as hand washing facilities or alcohol-based hand sanitiser and rubbish bins.

Where Principal Contractors provide reusable face masks, they should also provide facilities to clean them. Alternatively, Principal Contractors may provide an adequate supply of reusable masks that will allow workers to rotate them and clean them at home. Masks should be provided with instructions on cleaning (for example, washing daily after use in hot soapy water) and appropriate secure storage to transport used masks safely (such as plastic zip-lock bags).

Workers have a duty to take reasonable care for their own health and safety, which includes following the information, instruction and training provided on how to correctly wear their face mask.

3 easy steps to don a face mask

Controlling the risk of heat-related illness

The risk of heat-related illness may be increased while workers wear face masks in hot weather. Principal Contractors should conduct a risk assessment when temperatures are expected to increase, and face masks are required to be worn. Any risk assessment must be undertaken in consultation with workers and HSRs, and take into account:

- where the work is conducted (for example indoor or outdoor).
- temperature, humidity and air movement in the work environment.
- nature and type of work tasks (for example physical workload).
- clothing and personal protective equipment (PPE).

Heat-related illness can be a risk in indoor and outdoor working environments. Principal Contractors need to implement control measures to reduce the risk, including those listed below.

For both indoor and outdoor work environments:

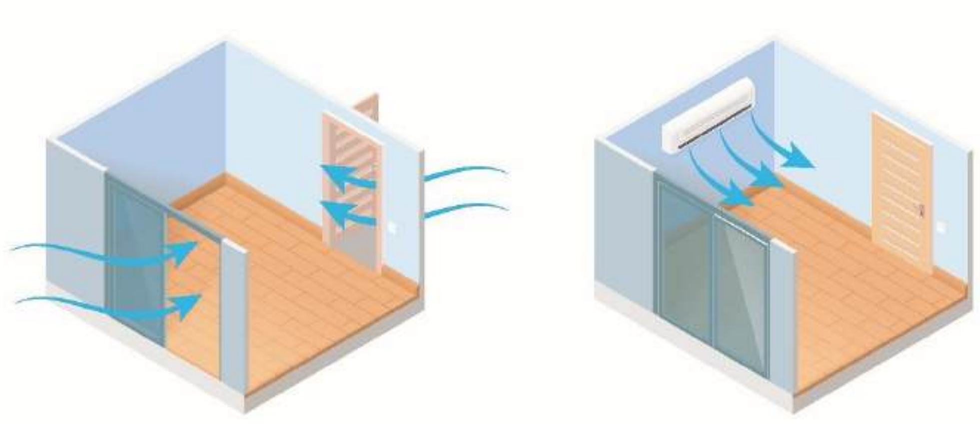
- consider whether the work can be conducted in a way that allows physical distancing of 1.5 metres to be maintained.
- ensure drinking water is readily accessible.

- revise work and rest schedules to allow workers sufficient time to rehydrate,
    - where possible, this should include regular short breaks for workers to remove their masks to drink water.
    - physical distancing measures must be maintained during breaks.

- provide workers with information, instruction and training to recognise early signs and symptoms of heat-related illness.
- where possible have a buddy system in place so that any signs of heat stress can be quickly identified and addressed.
- where possible ensure workers do not work alone.
- consider rotating duties to reduce each worker's exposure to heat, including rotation between outdoor and indoor work (where relevant).
- reduce physical demands by using mechanical aids or additional resourcing.
- when face masks are likely to become damp or dirty, consider providing an additional supply of face masks to allow for regular replacement.
- use less restrictive face masks (for example surgical masks) where P2 masks are not required for the work that is being carried out.

For indoor work:

- ensure the work area is ventilated as much as possible, for example by keeping doors and windows open.
- where outside air is too hot for natural ventilation or there is no breeze, use air conditioning, ensuring the air conditioning system is using as much fresh air as possible, rather than recirculated air.
- use blinds to block direct sunlight from windows.



Any of the above methods work to allow fresh air inside

For outdoor work:

- consider whether any workers are at higher risk of heat-related illnesses when working outdoors.

- provide a shaded area where workers can maintain physical distancing and remove their masks.
- where possible, consider providing workers with face masks that are lightweight and a light colour.
- if protective clothing is worn, such as coveralls, ensure it is lightweight, loose fitting and light in colour where possible.
- re-evaluate the workload, taking into account the weather conditions and time of day when the work will be done.
- consider whether the work can be rescheduled to another time or day when the temperature will be cooler.

Screening

Principal Contractors should implement a screening process to minimise the introduction of COVID-19 to a construction site by asking workers entering the site at the start of their shift if they have travelled, been in contact with any confirmed cases of COVID-19 or if they have flu-like symptoms, Principal Contractors will ensure person-to-person contact is minimised.

Construction site mapping

In the event of a worker being confirmed as having COVID-19, those who are potentially affected need to be quickly identified. Principal Contractors should implement processes to record the schedule and work locations for workers (including contractors), that enables tracing of those who have come into contact with the confirmed case.

The record should include:

- day and time where work was undertaken.
- members of teams that worked together.
- specific work area on the construction site.
- any breaks taken, including time and location.

Movement between sites, or areas within large sites, should be minimised as much as possible. Where attending multiple sites is necessary (e.g., for HSRs, first aiders, emergency wardens) movement between sites should be recorded in the construction site mapping.

Safe physical distancing

Safe physical distancing of at least 1.5 metres should be implemented wherever possible. Principal Contractors should consider each work task and whether there is a safe alternative way to undertake the work with an increased distance between workers.

Other control measures may include:

- marking safe distances in work, transit and break areas (e.g., on floors and walls).
- considering different shift patterns to minimise the number of workers onsite (e.g., AM/PM shifts).

- staggering start times breaks and finish times to avoid congestion in high traffic areas and minimise workers coming into contact with each other as they move around the site.
- planning for how physical distancing will be maintained during inclement weather (e.g., use of lunch or crib rooms and amenities).
- installing temporary physical barriers (e.g., fences, screens) between work areas, where appropriate.

Where it is not possible to undertake work tasks and maintain physical distancing, other control measures need to be implemented. For example:

- minimise the number of person-to-person interactions that need to be completed within 1.5 metres.
- minimise the number of individuals involved in activities that need to occur within 1.5 metres of each other.
- provide personal protective equipment (PPE) (e.g., gloves, masks, glasses).

Where essential work activities need to be undertaken in restricted spaces (e.g., lift shafts, personnel hoists, lifts), the number of workers working in the space should be minimised.

Hygiene

Principal Contractors should:

- ensure all workers follow good hygiene practices, including washing hands frequently with soap and water for at least 20 seconds, covering coughs and sneezes, or coughing into their elbow or shoulder and avoiding touching eyes, nose or mouth.
- display hygiene information in prominent locations on the construction site such as tea rooms, site offices, toilets, foyers, lifts and site entrances.
- provide hand sanitiser at site entrances and exits, in all hoists, amenities and other high traffic areas of the site. Communicate with staff about hand sanitiser locations and encourage regular use.

Wash palm to palm, backs of your hands, backs of your fingers, base of your thumbs, wash with fingers interlaced, wash your fingernails

Principal Contractors must ensure that workers have access to appropriate amenities. Principal Contractors should review and revise the number and locations of amenities, to reduce movement around the site.

Amenities need to include:

- hand washing facilities (whether permanent or temporary), such as a wash basin, clean running water, soap and paper towels, placed in strategic locations to ensure workers can access them in a timely manner.
- access to hand sanitiser.
- rubbish bins with touch-free lids (e.g., foot pedal bins).
- thorough and regular sanitation.
- appropriate waste management systems.

Shared tools, plant and equipment

Avoid the shared use of shared tools, plant and equipment wherever possible. For example, drop saws, drills, grinders, ladders or elevating work platforms should not be used by more than one person.

Where it is not possible to eliminate shared use:

- provide cleaning products (e.g., alcohol spray or solution) where communal tools, plant and equipment are located.
- keep cleaning products with tools, plant and equipment as they move around the site.
- ensure all operators thoroughly wash or sanitise their hands before and after every use.
- ensure all parts of tools, plant and equipment (e.g., including handles, handrails) are wiped down before and after use.

The shared use of phones, desks, offices, computers and other devices should also be avoided. Where this is not possible, these items should be regularly disinfected.

Cleaning

Thorough and regular cleaning needs to be undertaken of all:

- work areas.
- transit areas (including personnel hoists and lifts).
- communal and meal break areas.
- shared facilities (e.g., bathrooms and kitchens).
- shared equipment.

Ensure all communal equipment is sterilized using alcohol or appropriate cleaning agents

Personnel hoists

Workers using hoists and lifts may be at greater risk of exposure to COVID-19, because they are required to be in close contact with others and potentially contaminated surfaces.

Control measures to reduce the risk in personnel hoists should include systems of work, physical distancing, personal hygiene, PPE and cleaning.

It is acknowledged that not all hoists and lifts are identical in size or dimension and have varying weight limits. Where it is not possible to implement physical distancing measures in a personnel hoist, all other available control measures need to be used.

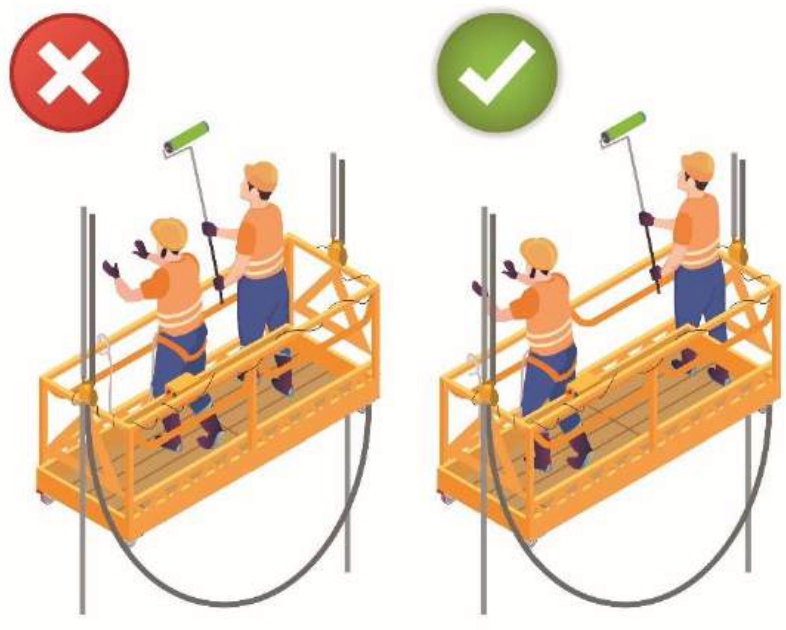
Control measures may include:

- limiting worker movement between levels and floors on site, where it is possible and safe to do so.
- reviewing which hoists are available for use on site and identifying if additional hoists can be used (for example where a partially occupied building is under construction, consider whether a residential lift can be used solely for construction persons).
- physical distancing of 1.5 metres and hygiene systems to be followed when waiting for a hoist, particularly on floors where worker volumes may increase during peak times (start, break, finish times). For example, the ground floor, floors with meal or break out spaces and floors with bathroom amenities.
- determining how many persons can use a hoist at any time (including hoist operator) taking into consideration the size of the hoist, limited duration and additional control measures in this guide.
- marking out hoist floors, identifying:
    - where workers stand.
    - what direction they are to face when in the hoist to avoid face to face contact.
    - sequencing of entering and exiting.
- marking the hoist waiting area at each floor to ensure physical distancing is maintained.

- regularly communicate and remind workers (e.g., through posters, digital displays):
  - appropriate positioning of persons and sequence of people entering.
  - not to touch the walls or doors of the hoist.
  - the cleaning regime in place.
- during peak periods have systems in place to limit crowding of persons entering and exiting the work area. For example:
  - developing a schedule for use of the hoist.
  - staggering which floors persons are able to use the hoists for.

Hoist operators may be exposed to additional risk. They should:

- be provided with PPE that protects them from person-to-person transmission and from touching contaminated surfaces (e.g., surgical mask/P2 respirator and glasses).
- perform frequent hand washing with soap and water or the application of hand sanitiser positioned within the hoist.
- where possible, change the hoist operator every two hours into a different role.



Workers must maintain a safe distance when using personnel hoists

Personal protective equipment

Principal Contractors must provide information, instruction and training on the safe use, decontamination, maintenance and disposal of any PPE provided.

Any PPE provided needs to be practical for the work environment (e.g., allowing the necessary visibility and mobility) and properly decontaminated or disposed of at the end of every shift.

Principal Contractors should monitor and encourage correct use of PPE, for example by providing information on posters and digital screens about:

- washing or sanitising hands before putting PPE on, and putting face protection on before gloves.
- removing gloves before face protection, washing or sanitising hands after removing PPE and decontaminating or disposing of used PPE safely.

What to do if a worker has COVID-19

In the event of a suspected or confirmed COVID-19 on a construction site, Principal Contractors and self-employed persons, with management or control of a construction site must notify the Cambodia Ministry of Health immediately after becoming aware that:

- a worker, independent contractor, worker of the independent contractor or self-employed person has received a confirmed diagnosis of COVID-19, and
- the worker, independent contractor, worker of the independent contractor or self-employed person has attended the construction site within the relevant infection period.

Ensure workers know what to do

The symptoms of COVID-19 to watch out for are fever, chills or sweats, cough, sore throat, shortness of breath, runny nose and loss or change in sense of smell or taste.

Some people may also experience headache, muscle soreness, stuffy nose, nausea, vomiting and diarrhoea.

If a worker develops symptoms of COVID-19 they should isolate immediately, seek advice from their doctor or call the Cambodia Ministry of Health and get tested.

A Principal Contractor's duty to eliminate or reduce risks associated with exposure to COVID-19 so far as is reasonably practicable includes ensuring that:

- workers know what to do or who to notify if they feel unwell or suspect they've been infected.
- any unwell worker does not attend the construction site, including workers who have been tested for COVID-19 or who are confirmed cases.

Cleaning onsite accommodation

Coronaviruses can survive on surfaces for a long time, but cleaning and disinfecting will kill them. The length of time the virus survives on surfaces varies. The amount of contaminated body fluid (for example respiratory droplets), the type of surface, the temperature, and the humidity all have an impact on how long the virus survives.

Onsite accommodation used by workers must be regularly cleaned to prevent the spread of viruses. It is important to clean the accommodation facility, including floors, doors, walls, tables and chairs before disinfection, as dirt and grime can affect how well a disinfectant works. Clean the surface with detergent and warm water using a clean cloth, then follow with a disinfectant. You can also use combined detergent/disinfectant products.

Frequently touched surfaces have a higher risk of spreading viruses. Clean and disinfect these often. Some disinfectants will claim they keep killing viruses for long periods (e.g., up to 28 days). The maker usually bases this type of claim on laboratory tests and may not take into account any build-up of dirt and grime that can occur. This advice also doesn't reflect the effect of frequent cleaning, which can reduce the coating of disinfectant. Clean and disinfect frequently touched surfaces several times a day, despite any claims about how long it is effective.

Clean **minimally touched surfaces**, such as floors, at least once a day. Spot clean ceilings, blinds and walls as required. They do not usually need to be disinfected as well.

It is good to routinely clean surfaces as follows:

- Clean and disinfect frequently touched surfaces with detergent and a disinfectant.
- Clean minimally touched surfaces and fittings when visibly dirty and immediately after a spill.

In areas with high community spread, clean and disinfect frequently touched surfaces several times a day.

If a person with suspected or confirmed COVID-19 has been in the room, clean and disinfect all surfaces they may have touched, coughed or sneezed on.

The risk of spreading COVID-19 in onsite accommodation can be minimised through good general hygiene. This includes:

- promoting cough etiquette and respiratory hygiene.
- regular cleaning and disinfecting of frequently touched surfaces.
- providing enough alcohol-based hand sanitiser for workers to use. Alcohol-based hand sanitiser stations should be available, especially in areas where food is eaten and often touched.
- training workers on how to use alcohol-based hand sanitiser effectively.
- opening accommodation windows where possible and setting air-conditioning to fresh air. This increases the rate of air flow and the use of outdoor air.

GLOSSARY

Abrade - to scrape or wear away by friction or erosion

Administrative control - controls that alter the way the work is done, including timing of work, policies and other rules, and work practices such as standards and operating procedures (including training, housekeeping, and equipment maintenance, and personal hygiene practices).

Alcohol - is a colourless volatile flammable liquid which is produced by the natural fermentation of sugars and is the intoxicating constituent of wine, beer, spirits, and other drinks, and is also used as an industrial solvent and as fuel.

Arc Eye or **welders flash** - is a painful eye condition caused by damage to the cornea from ultraviolet radiation during arc welding.

Atmosphere - is the air in a particular place or area.

Auxiliary Hoist - is a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

Boom-type elevating work platform - refers to a telescoping device, hinged device, articulated device or any combination of these, used to support a platform on which personnel, equipment and materials may be elevated.

Breathalysers - are devices used to measure the amount of alcohol in a person's breath.

Building work - refers to land work, building work of a new construction, repair work, modification work, and installation**.**

Cable Locator - is an instrument used for detecting the presence and approximate location of buried services in advance of undertaking excavation works. It aims to avoid accidents while excavating.

Cantilevered suspension rig - is a rigid structural element that extends horizontally and is supported at only one end. Typically, it extends from a flat vertical surface.

Carcinogen - is a substance capable of causing cancer in living tissue.

Certification work - refers to examination, analysis and certification of a design document, calculation, technical instructions for building or demolition work and operation of building or demolition work, compliance with building technical regulations and other existing regulations to ensure safety, well-being in building or demolition work and in the use of the construction.

Commission - refers to bringing (usually something newly produced) into working condition.

Competent authority - refers to Government Ministries, departments and its officers who have been given responsibility to monitor and enforce regulations and laws relating to the construction industry.

Competent Person - refers to a person who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to workers, and who has authorization to take prompt corrective measures to eliminate them.

Control Strategies - refers to the way to manage the execution of your strategic plan.

Control measure - a thing, work process or system of work that controls the WHS hazard or risk.

Construction - refers to the process of construction work or to a building, a structure or permanent or temporary architecture constructed with construction materials, equipment or products.

Construction contract - refers to a contract between a construction owner and a builder and a contract between a builder and a sub-contractor to carry out building or demolition work.

Construction controller - refers to a technical official who is appointed by the competent authority in order to check building or demolition works and controls construction quality and safety.

Construction equipment - refers to equipment that is assembled, made, or produced to be used in or fixed to a construction in order to increase quality, comfort and ease of construction use, namely lamp, electric wire, optic wire, sink, faucet, bathtub, air- conditioner, elevator, pipe.

Construction material - refers to a raw material to be mixed, combined, assembled, or used as a construction structure, equipment or products, such as sand, crushed stone (aggregate), gravel, cement, steel, glass, clay, ceramic, wood.

Construction owner - refers to an owner or a real estate developer of a construction that is built on his/her own land or on someone else's land with the landowner's permission or a perpetual lessee who builds a construction on the lessor's land.

Construction product - refers to finished or semi-finished product that is made or produced with construction materials and used to build a construction structure, such as roof tile, brick, mortar, concrete, pillar, wall, decorated ridge-piece on rooftop, concrete floor, concrete pipe, ceiling plaster, corrugated iron/steel, fibreboard, wallpaper, paint, or tile adhesive.

Construction project management - refers to the work that a construction project manager carries out on behalf of a construction site owner in order to ensure that a building or demolition project operates efficiently in terms of time, cost, quality and safety.

Construction work - refers to design work, surveying work, building work, demolition work, site management work, certification work, testing work, construction project management or construction safety and quality control.

Contaminant - is a polluting or poisonous substance that makes something impure.

COVID Safe Plan - refers to an implemented Covid-19 plan consisting of construction site and Cambodian laws and regulations, procedures and policies to prevent and combat Covid-19 on the worksite.

Dangerous building - refers to a construction or any part of a construction or construction materials, equipment attached to the construction which may cause danger to a neighbouring construction(s), lives, bodies, and health of construction users, neighbours and the public.

Dead load (scaffolding) - refers to the weight of the scaffold itself

Decommissioning - is when equipment or machinery is removed a/or taken out of working service

Demolition work r- efers to the work of dismantling or removing any part of a construction, or removing a whole construction, or the work of destroying the construction.

Design document - refers to a technical document for the purpose of construction works such as architectural design, structural design, mechanical system plan, electrical system design, wastewater-clean water system design, fire safety system design, or other technical designs/plans, documents, and instructions for building or demolishing and using a construction.

Design work - refers to plan/design drawing work, research work and data analysis for architectural and engineering work, planning work, preparation of lists of estimated costs, preparation of technical instructions, and detailed plan/design drawing work.

Dismantling - means to take a machine apart or to come apart into separate pieces.

Drugs - are a medicine or other substance which has a physiological effect when ingested or otherwise introduced into the body.

Electricity Supply Authority - refers to a person or body engaged in the distribution of electricity to the public or the transmission or supply, directly or indirectly, to the public. An electricity supply authority may also be known as a network operator, a network service provider or an electricity entity.

Worker - a person employed under a contract of employment or contract of training.

Fire Warden - a person(s) designated by the person with responsibility for workplace activities, or workplace manager, to assist them in implementing the necessary fire safety arrangements as identified by the manager to prevent a fire from endangering the health and safety of occupants and other relevant person for whom a duty of care is held.

Flammable Waste Materials - refers to waste that will create fires under certain conditions, perhaps spontaneously combust, and have a flash point less than 60 °C (140 °F). Examples include waste ethanol, methanol, hexane, acetic acid and acetone.

Fatigue - is extreme tiredness resulting from mental or physical exertion or illness.

Formwork - is the term used for the process of creating a temporary mould into which concrete is poured and formed. Traditional formwork is fabricated using timber, but it can also be constructed from steel, glass fibre reinforced plastics and other materials.

Hazard - refers to a potential source of harm, illness, injury, disease or death, including the potential to cause illness, injury, disease or death.

Hazard and operability analysis (HAZOP) - is a structured and systematic technique for system examination and risk management

Health and safety officer (HSO) - refers to a person at a worksite given the responsibility to monitor and identify health and safety issues at the worksite.

Hierarchy of control - is a system for controlling risks in the workplace. The hierarchy of control is a step-by-step approach to eliminating or reducing risks and it ranks risk controls from the highest level of protection and reliability through to the lowest and least reliable protection.

High-risk work licence - is a photographic licence, issued to persons who have been trained and assessed as competent to work in a class of work defined as high-risk work.

Hot Work - refers to work involving electric or gas welding, cutting, brazing, or similar flame or spark-producing operations.

Housekeeping Program - refers to the routine cleaning and organizing of the workplace. As housekeeping is an ongoing safety practice, orderly conditions in the workplace should be maintained on a consistent basis, not restored after orderliness has been allowed to slip.

HSR - refers to Health and Safety Representative.

Hungover - refers to someone who is unwell because they drank too much alcohol on the previous day.

Ignition Source - is a flame, spark or hot surface capable of igniting flammable vapours or fumes, or any substance capable of burning.

Independent contractor - is a self-employed person or entity contracted to perform work for or provide services to another entity as a nonworker.

Interlocking Door - is an interlocking system that is composed of two doors electronically connected so one cannot open until the other has closed.

Live load (scaffolding) - is the weight of the workers, equipment and materials which will be used on at any one time on the scaffold.

Load - refers to weight, pressure, or any force that presses or has impact on a construction structure.

Local authorities - refers to any authority that needs to be contacted prior, during, and post construction, e.g., law enforcement, emergency services, and government departments.

Material Safety Data Sheet - is a technical document which provides detailed and. comprehensive information on a controlled product related to health effects of exposure to the product, hazard evaluation related to the product's handling storage or use and measure to protect workers at risk of exposure.

Metabolic Heat Load - is the term used to measure how hard muscles are working during physical activity.

Modification work - refers to alteration of the function of the whole or a part of a construction.

Musculoskeletal injury or disorder - refers to an injury relating to the muscles and skeleton, including bones, joints, tendons, and muscles.

Nip-point or **pinch point** - is a point of convergence between two rolling parts, or a rolling part and a stationary part, where all or part of the human body could become trapped and injured.

Other persons - refers to site inspectors, government officials, and persons who do not fall into the categories of contractor, worker, or visitor.

Passive Fall Prevention Device - material or equipment, or a combination of material and equipment, that is designed for the purpose of preventing a fall and that, after initial installation, does not require any ongoing adjustment, alteration or operation by any person to ensure the integrity of the device to perform its function.

pH neutral - refers to a chemical that is neither acidic nor alkaline.

Power Take Off (PTO) - refers to any of several methods for taking power from a power source, such as a running engine, and transmitting it to an application such as an attached implement or separate machine.

Principal contractor - refers to a person who employs one or more people to work on a construction site.

Registered Training Organisation - is an organisation providing Vocational Education and Training courses to students, resulting in qualifications or statements of attainment that are recognised and accepted by industry and other educational institutions.

Reinforced Concrete - is concrete in which metal bars or wire is embedded to increase its tensile strength.

Residual Current Device (RCD) - is a safety device that quickly breaks an electrical circuit to protect equipment and to reduce the risk of serious harm from an ongoing electric shock.

Risk - refers to the chance or likelihood that a hazard will cause harm to a person.

Safe system of Work - is a formal procedure based on a systematic examination of work in order to identify the hazards.

Safe working load (SWL) - sometimes stated as the Normal Working Load is the maximum safe force that a piece of lifting equipment, lifting device or accessory can exert to lift, suspend, or lower, a given mass without fear of breaking.

Safe Work Method Statement (SWMS) - is a document that sets out the high-risk construction work activities to be carried out at a workplace, the hazards arising from these activities and the measures to be put in place to control the risks.

Scaffolding - is a temporary structure on the outside of a building, made of wooden planks and metal poles, used by workmen while building, repairing, or cleaning the building.

Scaffold designer - is usually a civil engineer who designs scaffolding structures to support construction work.

Shear - refers to when something, especially something made of metal, shears, it breaks into two pieces, usually because of a sideways force.

Shoring Up - is the process of temporarily supporting a building, vessel, structure, or trench with shores (props) when in danger of collapse or during repairs or alterations.

Task Analysis - is the analysis of how a task is accomplished, including a detailed description of both manual and mental activities, task and element durations, task frequency, task allocation, task complexity, environmental conditions, necessary clothing and equipment, and any other unique factors involved in or required for one or more people to perform a given task.

Testing work - refers to study, analysis, geological calculation of construction structures, construction tools and machinery, and construction materials, equipment and products.

Trades person - refers to a construction technician (skilled worker/workman) who has received a training at a related specialized technical school or who is skilled and experienced in carrying out building works, or a tradesperson whose professional board has not been created.

Under the influence - refers to someone affected by alcoholic drink or drugs.

Utility Owner - means the owner or operator of any Utility (including both privately held and publicly held entities, cooperative Utilities, and municipalities and other governmental agencies.

Young Worker - refers to an inexperienced worker between the ages of 18 and 24 years old.

Contact Details

Ministry of Land Management, Urban Planning & Construction	
Contact Ph:	+855 (0) 23 215 279
Address:	771-773, Preah Monivong Blvd., Sangkat Boeung Trabek, Khan Chamkarmon Phnom Penh
Email:	mlmupc.cabinet@gmail.com
Website:	www.mlmupc.gov.kh
Ministry of Public Works and Transport	
Contact Ph:	1275 (free call)
Address:	St 598 (Street HE Chea Sophara) Sangkat Chrang Chamres 2, Khan Russey Keo, Phnom Penh
Email:	info@mpwt.gov.kh
Website:	www.mpwt.gov.kh
Police Department	
Contact Ph:	117
Fire Department	
Contact Ph:	118
Ambulance (Calmette Hospital)	
Contact Ph:	119
Electricity of Cambodia	
Contact Ph:	023 723 871
Address:	Ang Yukanthor (St. 19), Wat Phnom, 12202, Phnom Penh
Phnom Penh Water Supply	
Contact Ph:	023 724 046
Address:	No. 45, Preah Moha Ksat Triani Kossomak (Ave. 106), north of the Railway Station, 12201, Phnom Penh