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# **TRAINING MATERIAL FOR ASSESSING THE RISK IN THE CONSTRUCTION SECTOR**



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## **M2-EN.1 GENERAL INTRODUCTION TO THE MODULAR COURSE**

This module aims at assessing employee safety and health in a typical workplace in the Construction Sector. The module covers the following topics:

- Detailed analysis of hazards present in the Construction Sector is given with safety measures to prevent the risk where this is possible
- Safety tips, requirements for personal protective equipment and recommended safety and health protection labels and signs are presented
- Risk assessment tool in the Construction Sector with examples of good practice

This module is arranged in such a manner that it might be used by a tutor in class and for self-study by any person interested in Health and Safety in the Construction Sector. The participants during lectures make themselves aware of the types of hazards that an employee may encounter and perform risk assessment in a specific job.

## **M2-EN.2 ORGANISATION OF THE CONSTRUCTION SITE**

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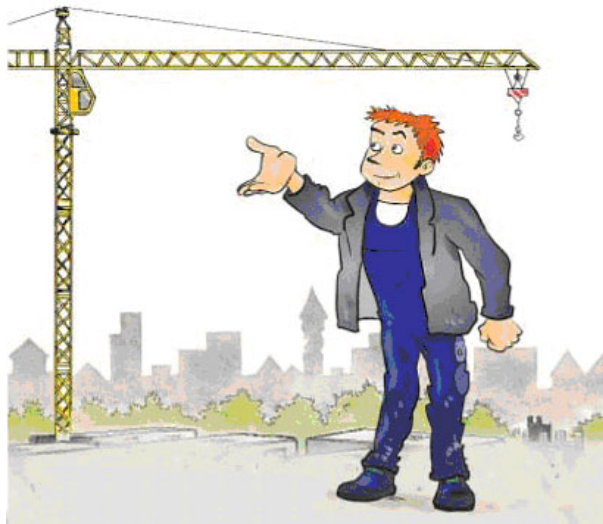
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### **M2-EN.2.1 Introduction**

In this chapter, the general regulations for the organization of construction sites are described. The objective of this chapter is to:

- Identify the most common risk factors
- Describe the constitution of the risk
- Make proposals on how to reduce these risk factors

An essential factor in relation to safety at the construction site is the organization of the site, including the establishment of access roads, escape routes and welfare measures such as toilets, bathrooms and canteens.

A well-organized construction site is fenced in so that unauthorized persons are not exposed to danger from the traffic on the site. The site is organized and kept clear in order to obstruct neither the driving nor the walking traffic. The driving and the walking traffic are if possible kept apart. It must be easy to keep pathways free of water, mud and ice, and they must be organized in a way that makes traffic with e.g. sack trucks possible.

Shacks and welfare measures must be established in conformity with the regulations, and they must be placed practically in relation to the workplace and the access from public roads.

### **M2-EN.2.2 Digging**

Digging must be planned. When planning the character of the ground must be taken in consideration. This includes the nature of the ground, eventual pollution and height of the groundwater, wires, and conduits for electricity, gas and communication, transport conditions and anything else, which might have an impact on safety. (M2.2.1.jpg)

#### **Risk Factors**

- Risk of collapse
- Falling of people into the excavation
- Falling of objects into excavation
- Means of access
- Contact with underground electrical conduits
- The risk of collapse is intensified by rain, snow and frost
- Landslide danger in the excavation
- A steep slope always has a risk of landslip

#### **Safety Measures**

- Make a survey on the nature of the soil before starting
- Provide enough slope if possible
- Proper support of the sides of the excavation
- Fencing (M2.2.2.jpg)
- Disconnect electrical supply-Remove any electrical conduits
- Remove excavation soil or any other material from the boundary of the excavation
- Consider traffic and take measures to avoid vehicles to pass near the excavation
- In an excavation without stiffening, the sides must have a rest in order to avoid landslides
- In case of insufficient rest on a steep slope, stiffening must be made in conformity with the regulations
- Make sure that ladders are at hand in the excavation and that the necessary escape routes are established

### **M2-EN.2.3 Laser**

Direct laser radiation as well as reflected radiation may be dangerous. The extent of the danger depends on intensity, wavelength and exposure time. Lasers are divided into categories in conformity with their dangerousness, and specific precautionary measures match each category. Lasers must always be delivered with satisfactory

instructions, and people who have not had the necessary training must not operate them. Everyone situated in an area where laser is used, must be informed of precautionary measures taken to avoid dangerous radiation.

### **Risk Factors**

- Direct and reflected radiation

### **Impact on Human Health**

- Risk of eye and skin injuries

### **Safety Measures**

- Never use a laser more powerful than necessary
- Never look into laser radiation and do mind reflections from shiny surfaces
- Always use radiation stop
- Turn off the laser when not in use

## **M2-EN.2.4 Demolition**

Demolition of buildings etc. must be planned and organized in order to carry the job securely into effect. Planning includes among other things estimation of the stability of the building during the demolition and inspecting material injurious to health in the building, whether the ground is polluted, and if exceptional environmental and safety precautions are necessary in relation to the surroundings. Experienced workers must always be part of the crew. Workers under the age of 18 are not allowed to participate in a demolition.

### **Risk Factors (M2.2.3.jpg)**

- Wires and conduits for electricity and gas which are not securely disconnected
- Risk of collapse
- Risk of formation of heavy dust clouds, impact from quartz and mineral wool
- Falls from height
- Falling objects
- Presence of asbestos

### **Safety Measures**

- Fencing of the site (M2.2.4.jpg)
- Make an action plan starting demolition from top
- Remove any asbestos products according to the process described by Regulations
- Use Safety Belts when working at Height
- Use safety helmets
- Use respiratory equipment when necessary
- Electricity wires and gas conduits must be dismantled by certified electricians

- Everyone uses the necessary means of personal protection

### **M2-EN.2.5 Gas Conduits**

The employees must be instructed in how to carry the job into effect. They must accurately know the regulations and have access to the written regulations. A person who can hurry to their rescue if necessary must supervise the employees. Everyone must be familiar with first aid at gas related accidents.

All employees must be informed about danger of accidents and illness and be instructed in precautions against fire, explosion, intoxication and suffocation.

#### **Risk Factors**

- Gas might occur in unhealthy concentrations

#### **Safety Measures**

- Always use metering apparatus and gas warning
- Use suitable and efficient breathing mask if necessary

### **M2-EN.2.6 Electricity**

Electrical installations must meet the existing regulations even when the installations are temporary. Panels must be secured in order not to tip over and they must be mounted in a way making them easy to operate. Feed cables for main panels and sub-panels must be suspended or buried. (M2.2.5.jpg)

Heavily dusting work must not take place near these panels.

Temporary cables and wires must be placed where they need to be moved as little as possible. It is an irresponsible act to leave feeding cables lying on the ground. Instead cables and wires must be buried, suspended or placed in specific cable chutes. Also cables must be protected from humidity. The installation must be design and executed by a licensed person. Safety devises must be used i.e. RCD 30mA

#### **Risk Factors**

- Tearing and destruction of cables
- Short circuit or seizure
- Cutting the cables when digging
- Contact with overhead cables
- Contact with damaged cables

#### **Impact on Human Health**

- In worst case electric shock might be lethal

#### **Safety Measures**

- Make sure that articles for everyday use are only connected to that voltage and sort of power which they are designed to

- Plugs, sockets and extension leads must be solid and faultless
- Cables in reel must be completely unreeled in order to reduce the risk of seizure
- Examine the tools if they show signs of defect
- Before digging, gather information on cables and wires within 10 meters from the working area
- Respect all safety rules when digging near high-voltage lines!
- Use sensitive protection devices i.e. RCD 30mA
- Inspect the electrical installation regularly
- When using lifting equipment or erecting scaffolds take into account the overhead cables

If an excavator hits overhead lines or cables, the driver must

- Stay in the excavator until the lines are dead
- Keep everyone else off the excavator
- Make sure that the utility company is informed

### **M2-EN.2.7 Assembling units**

Assembling of pre-cast concrete units and heavy construction units requires exact planning. The units should be delivered in the succession of which to assemble. They should be placed on the truck so that the crane can move them in succession and locate them in the right place in one manoeuvre. Storing units at a construction site must as far as possible be avoided.

Only personnel engaged in assembling units should stay nearby. Crane driver and ground assistant must all the time remain in contact. Swinging units should not pass over shacks or work places where regular assembling is not carried out.

#### **Risk Factors**

- Persons may be hit by hanging or swinging elements
- Faulty elements

#### **Safety Measures**

- Choose the right lifting equipment carefully, use them correctly, and be sure of their regular maintenance
- Before initializing the work, the units must be examined for cracks and faulty bearing surfaces, as well as the lifting equipment.
- Follow the instructions carefully when assembling

### **M2-EN.2.8 Crawlspace, Wells, etc.**

Persons working and staying in narrow rooms are exposed to heavy ergonomic strain on the whole body. Likewise, the risk of industrial accidents is increased and the character of the work may be a mental strain.

It may be necessary to draw up a plan for preparedness, evacuation and drill which contains information on the evacuation of possible injured persons.

Workers under the age of 18 are not allowed to work in closed rooms with danger of explosion or risk of suffocation. Persons working in wells normally have to wear a safety helmet and a lifting belt with lifting wire.

### **Risk Factors**

- Ergonomic strains
- Exposure to dust injurious to health
- Risk of suffocation or intoxication
- Danger of fire and explosions

### **Safety Measures**

- Crawlspace and wells must if necessary be cleaned up before initiating the work
- Check for the presence of toxic fumes
- Use the necessary means of personal protection
- When working in wells one guard must stand above the well and all the time remain in contact with the workers in the well. The guard must be equipped with the necessary rescue equipment and be able to use it correctly

### **M2-EN.2.9 Fire Protection and Open Fire**

Careful planning may prevent fire and explosions. Before initiating a job existing buildings must be examined for inflammables. Do observe:

- Whether inflammable materials, fluids or gasses are stored in the building
- Whether there are hollow spaces, which might contain inflammable materials, hidden cables, etc.
- Whether there are exhaust channels, which may transport inflammable fumes or dust.

When working in heat effective safety routines must be drawn up, and everyone must have received adequate instructions.

### **Safety Measures**

- Waste and used packing must be discarded frequently in suitable containers
- Watch out for creeping fire in small hollow spaces
- Smoking is prohibited where solvents are used and stored
- Always store welding equipment etc. securely
- Make sure to have a quick access to adequate fire fighting equipment
- Make sure that fire fighting equipment always is in proper condition and the workers are trained on how to use it

## **M2-EN.2.10 Welding**

Smoke from cutting and welding contains gasses and several heavy metals, which together may cause chronic injury on the respiratory passages if the pollution is not effectively removed. The skin must be protected against ultra-violet light and sparks. Welding light may cause permanent injuries on the eyes.

Symptoms of eye injuries caused by welding are hypersensitivity to light, watery eyes, swollen eyelids and severe pain in the eyes. Zinc ointment may be used to ease the pain. The ointment must not be used when working or driving due to its doping effect.

### **Risk Factors**

- Impact from gasses and heavy metals causing chronic bronchitis, cancer in the respiratory passages
- Impact from ultra-violet light causing acute and permanent injuries in the eyes
- Sparks and fire risk causing burns
- Risk of electric shock, when welding with electricity under humid conditions

### **Safety Measures**

- Make sure the exhaust is sufficient
- Minimise or eliminate the use of organic solvents for the degreasing process
- During welding, the overalls and gloves that are used, must be kept dry and in good condition
- Always use the necessary means of personal protection
- Do manage the equipment in conformity with the regulations

## M2-EN.3 WORKING ABOVE THE GROUND, SCAFFOLDINGS, LIFTS, LADDERS, ETC

M2-EN.3.1 Introduction

M2-EN.3.2 Roofs

M2-EN.3.3 Front and Mason Scaffoldings

M2-EN.3.4 Ladder Scaffoldings and Trestlework

M2-EN.3.5 Person Lifts

M2-EN.3.6 Front Lifts

M2-EN.3.7 Ladders



### M2-EN.3.1 Introduction

In this chapter, the typical risk factors when working above the ground, are described e.g. on roofs and ladders, lifts, scaffoldings, etc. The objective of this chapter is to:

- Identify the most common risk factors
- Describe the constitution of the risk
- Make proposals on how to reduce these risk factors

The risks, which are specifically connected to work above the ground, may be divided into two main groups:

- People, materials or tools that may fall down
- Material that may break down or tip over because of defects or incorrect use

In both cases, the risk of people being injured is immediate and obvious. There may be all kinds of injuries from blows to permanent injuries and life threatening or lethal injuries. Beyond the physical injuries one must be aware of the mental after effects that people might get as a consequence of an industrial injury, and which in the worst

case may be excessively disabling, and just like the physical injuries result in loss of working capacity for a shorter or a longer period of time, some times even for life.

When assessing the risk at working above the ground, must consider both the people above ground as well as the people on the ground.

Beyond the common risk factors, all kinds of work on roofs or ladders, lifts or scaffoldings have their specific elements of risk. These are described in each of the following chapters together with the safety precautions that are prescribed in connection with the work.

### **M2-EN.3.2 Working on Roofs**

The risk when working on roofs depends – beyond on the height and the inclination of the roof – also on the kind of work, the weather conditions, the type of roof surface and the surface that the worker is to land upon if falling. (M2.3.1.jpg - M2.3.5.jpg)

#### **Risk Factors**

- Falling of Workers
- Falling of objects
- Working on fragile material
- Risk of collapse
- Blowing off materials and tools from the roof due to strong wind

#### **Safety Measures**

- When the height of fall is more than 2 meters, a guardrail which beyond doubt can stop persons about to fall from the roof, must always be set up.
- On roofs with an inclination of more then 15 degrees roof ladders must be used if it is not safe to walk on the laths
- Examine the carrying capacity of the roof and take the necessary precautions
- If there is a risk of collapse, gangways with a secure guard rail combined with a safety net between the gangways should be used
- Make sure that the safety net is suspended and maintained in conformity with the prescriptions
- The workers should be secured against falling materials and tools with guard boards, safety nets or other kind of protection

### **M2-EN.3.3 Front and Mason Scaffoldings**

The highest degree of safety when working in height is achieved when solid fronts or bricklayer's scaffoldings are used. Working on correctly erected scaffoldings is as safe as on the ground. The scaffolding must be adjusted to the jobs which are to be carried out according to its carrying capacity, width, height etc (M2.3.6.jpg, M2.3.7.jpg). The particular circumstances, when working on roofs, must be taken into consideration. Pay special attention when the scaffolding is placed near electric overhead lines. The lines must then be insulated against contact, or the power must be switched off.

### **Risk Factors**

- Scaffolding units are often heavy and unmanageable. Erecting and dismantling the scaffolding imply a considerable risk of overloading of the body.
- The scaffolding may tip over or collapse
- People, material and tools may fall from the scaffolding
- Risk of collision with a car

### **Impact on Human Health**

- Overloading may occur suddenly, if you e.g. lose your balance while carrying heavy burdens. The overloading may also happen in the long run when the body becomes worn out and unfit for work
- According to the circumstances falling may lead to all kinds of injuries from blows to permanent injuries and life threatening or lethal injuries. Workers on the scaffolding as well as near it are at risk

### **Safety Measures**

- Avoid manual handling of the material. Use suitable technical facilities instead
- Make sure that the scaffolding stands on solid foundation and that eventual chocks are stable
- Do examine all parts of the scaffolding and make sure that they are whole, without deformations or corrosion
- Mark out the scaffolding if there is a risk of collision
- Make sure that the floor fills out all of the scaffolding
- Do not use ladders on the scaffolding
- If the working height is more than 2 meters, the scaffolding must be equipped with guard rails, i.e. handrail, knee-high rail and skirting-board
- Access to the scaffolding must be through stairways, ladders or rope ladders. Openings in the scaffolding floor must be closed when working on the scaffolding
- Particular precautions must be taken when working on roofs and near electric overhead lines

### **M2-EN.3.4 Ladder Scaffoldings and Trestlework**

Only persons with the necessary training must erect rolling scaffoldings and trestlework in more than 3 meters high. The rolling scaffoldings must be provided with information on maximum weight on the floor and on points. The use of supporting legs and securing at fixed building units must likewise be stated in the information material, which comes with the rolling scaffolding.

### **Risk Factors**

- Trestlework may roll and be put out of balance

## **Safety Measures**

- Always make sure that the scaffolding is plumb and does not tip
- Make sure that the brakes are put on when in use. The brakes must be easy to handle with no use of tools.
- People are not allowed on the scaffolding when it is moved

## **M2-EN.3.5 Person Lifts**

At long lasting work above the ground person lifts or front lifts may be used instead of scaffoldings. (M2.3.8.jpg) The risk of falling is obvious if the equipment is not used in conformity with the manufacturer's instructions.

## **Risk Factors**

- The lift may tip or something may bump into it
- Hands or other body parts may be crushed between the work stand and walls, ceilings, protruding objects or the lift itself
- Overloading or defects on the material
- Falling of the equipment when dismantling
- Electrical hazards

## **Impact on Human Health**

- As well as falling, crushing may also lead to severe injuries which in worst case may be lethal
- Upper or low limbs injury
- Electrocutation

## **Safety Measures**

- Only workers at the age of 18 or older who are properly instructed may use the lift
- The work stand must at all sides have a 1,1 meter high fence. The gate must be self-closing and open inward.
- Make sure that the foundation is stable and the supporting legs are in use
- Install a handrail in conformity with the manufacturer's instructions
- Control buttons must have a dead-man control and their function must be marked with pictograms easy to understand
- A ground assistant must always be present who in case of emergency can lower the work stand. The ground assistant must be able to operate the lift
- Make sure that the work platform has information on maximum work load, etc. – and do obey the manufacturer's instructions
- Provide fencing on the ground base of the equipment
- Follow the procedure described by the manufacturer when erecting and dismantling the lift

- Provide for maintenance

### **M2-EN.3.6 Front Lifts**

It involves the same risk as person lifts. One must pay special attention to the faultlessness of the capstan and the security system for catching. (M2.3.9.jpg)

#### **Risk Factors**

- Front lifts may be caught by roughness or protruding objects in the wall

#### **Safety Measures**

- The work stand must have a 1,1 meter high fence at all sides
- Make sure that the front lift is supplied with smooth-running spools or the like to avoid catching
- Make sure that the front lift is examined and kept in good order according to the manufacturer's instructions

### **M2-EN.3.7 Ladders**

Ladders are the most simple and maybe the most common used aid for working at a low height. (M2.3.10.jpg) It is though unstable and a physically hard job to work from ladders, therefore, the workers are only allowed to use them for a shorter period of time. Considering this, each working period on the ladder may not exceed 30 minutes. When working alternatively from ladder and from solid ground, working from the ladder may not exceed more than one third of the total daily working time.

#### **Risk Factors**

- Fall of the ladder
- Fall of the worker
- Fall of objects i.e. tools
- Incorrect working postures are hazardous for the body and lead to increased risk of falling or accidents with the tools

#### **Impact on Human Health**

- Injury of the worker or any other person on the ground
- Injury from falling objects i.e. tools
- Working on ladders is hard specially for the feet, the knees and the back and may impede the circulation

#### **Safety Measures**

- Do not use a ladder to perform a job at a height more than 5m from the ground
- Secure the ladder on the top and the bottom or use another person to secure it when working
- Keep tools in special pockets on the workers clothes

- Use appropriate footwear
- Only one person on the ladder is allowed
- Carry only light and handy burdens on the ladder
- Use only tools which can be handled with one hand
- Always follow the specifications of the ladder with respect to maximum length, weight, inclination, etc.
- Do examine the ladder on a regular basis for looseness, corrosion, cracks and tears. Repair or discard the ladder if necessary

## **M2-EN.4 MACHINES**

M2-EN.4.1 Introduction

M2-EN.4.2 Common Machine Safety

M2-EN.4.3 Concrete Work

M2-EN.4.4 Machines for Wood Processing

M2-EN.4.5 Power-driven Hand Tools

M2-EN.4.6 Bolt and Nail Guns

M2-EN.4.7 Compressed-air Plants



### **M2-EN.4.1 Introduction**

In this chapter, the typical risk factors when working with machines on a construction site are described. The aim of this chapter is to:

- Identify the most common risk factors
- Describe the constitution of the risk
- Make proposals on how to reduce these risk factors

The structure of the chapter is as follows: First, a section on the general risks when working with machines and the general requirements for buying, maintaining and using the machines is presented, being followed by a section with a more detailed interpretation of risks when working with specific types of machines and the necessary precautions.

General hazards when working with machines:

- Dangerous parts of the machinery
- Flying fragments
- Wrong illumination
- Defects on the machine
- Instability of the machine
- Surfaces, edges and corners
- Electricity

- Static electricity
- Danger of fire and explosion
- Din and vibrations
- Troublesome smoke, dust, gasses, etc.
- Awkward working postures
- Inconvenient working methods

### **M2-EN.4.2 Common Machine Safety**

Machines must always be organized in a way so that they may be used in conformity with their purpose without imposing danger on safety and health. When delivered they must be equipped with the necessary protection equipment and must be as easy to operate and comparatively noiseless as possible. Instructions and information on the demands for training, use of means of personal protection etc. must come with the purchase of the machine. Information on din and vibrations from the machine must likewise appear in the instructions. Users of the machine, including employers, foremen, service mechanics etc. are obliged to ensure that the machine is in order and that the necessary protective measures are available and function according to their design. (M2.4.1.jpg, M2.4.2.jpg)

Furthermore, do observe the specific rules for workers under the age of 18 and the possibility of specific rules at specific types of machines.

#### **Risk Factors**

- Dangerous machine parts might be touched or grasp people nearby
- Flying fragments
- Noise
- The operator may lose the control of the machine
- Risk of radiation from draught, cold, heat, light, radioactivity or laser

#### **Impact on Human Health**

- Injury or amputation of body parts
- Muscular rheumatism, injury to the eyes or skin
- Hearing problems
- General malaise

#### **Safety Measures**

- Make sure that dangerous machine parts are securely screened. When the screen is off, the machine must be unable to function.
- Do observe that starter buttons and pedals are secured in a way that makes it impossible to start the machine unintentionally. Also observe that emergency shutdown buttons are visible, accessible and organized in conformity with the specifications

- Make sure that the machine is correctly equipped with dead-man control, panic switch or two-hand control device where required
- Make sure that the safety of the machine is controlled in conformity with the specifications

### **M2-EN.4.3 Machines for concrete Work**

When using machines in connection with concrete work the general rules for working with machines are valid (**M2.4.3.jpg**). One must pay special attention to mobile machines, e.g. an archer with rotary discs or airscrews that might be dangerous for the feet if the operator loses control of the machine. The screen and the dead-man control must function correctly.

#### **Risk Factors**

- Heavy work at e.g. mixing machines
- Emission of carbon monoxide from the engine's exhaust
- Vibrations
- Skin contact with concrete

#### **Impact on Human Health**

- Back, arms and legs are worn out
- Carbon monoxide is deadly toxic
- Vibrations may damage the circulation and cause white fingers
- Skin irritation

#### **Safety Measures**

- Use the necessary aid at heavy work
- Only out-door use of machines with petrol engines or in well ventilated rooms
- Minimize the working time with vibrating machines. The vibration damper must be maintained
- Use PPE i.e. gloves and eye protection

### **M2-EN.4.4 Machines for Wood Processing**

These are stationary machines, circular saws, band saws and smoothing-planes. Normally, workers under the age of 18 may not operate these machines. The instructions of the machine must contain information on the safety regulations. (**M2.4.4.jpg – M2.4.6.jpg**)

#### **Risk Factors**

- Rotary and fast-moving cutting tools
- Ejection of material or broken blades
- Heavy or unmanageable materials

- Dust or steam
- Electricity

### **Impact on Human Health**

- Cutting off finger or hands
- Injury from flying fragments
- Loading and wearing out of the body
- Impact on the eyes, mucous membranes or lungs
- Electric shock

### **Safety Measures**

- Make sure that the machine and the safety screen work correctly and that they are organized in conformity with the specifications
- Do not wear gloves, jewellery or loose clothes when working
- Do examine that the blade is sharp, flat, without wavering and without blue spots or cracks
- Make sure you have a good working height and a good support for the units
- The exhaust system must be able to pick up dust and shavings at the cutting edge. The air from the exhaust must not be re-circulated in the working area
- Maintain the machine properly

### **M2-EN.4.5 Power-driven Hand Tools**

Power-driven hand tools include among other things circular saws, chain saws, smoothing planers, drilling machines, groove milling machines and different types of grinding machines. If the vibrations are strong, there may be restraints on the daily use of the machine. (M2.4.7.jpg – M2.4.9.jpg)

### **Risk Factors**

- The machines vibrate, produce dust and are noisy
- There is a risk of the unit getting stuck in the machine
- In grinding machines the disc may burst
- Working with heavy tools is hard and there is a risk of loosing control over them
- Flying fragments
- Damaged cables

### **Impact on Human Health**

- There are the same risks when working with hand tools as when working with other types of machines, including to a considerable degree the risk of injuring parts of the body, hands or feet

- When working with granite, concrete, tile etc. the dust may cause silicosis or asbestosis
- When the disc bursts, fragments are ejected with a power strong enough to penetrate the body of a human being
- Electric shock

### **Safety Measures**

- Always make sure that the tool is in order and well maintained
- If possible choose tools with vibration damper
- Use hearing protector for noisy work, and breathing masks when dust is produced if there is no mechanical exhaust system
- Do not use engine chain saws on a ladder or above shoulder level. Always wear a helmet, safety spectacles, hearing protector, leg protector and foot protector when working with an engine chain saw
- When working with grinding machines, always be meticulous concerning the correct fixing of the disc. Never drive faster than the limits of the disc. Do always observe the specifications. Always use exhaust, safety spectacles and hearing protector.
- Do not wear loose-fitting clothes e.g. scarves which may be caught by the machine

### **M2-EN.4.6 Bolt and Nail Guns**

Bolt guns are shooting tools where the muzzle velocity of the bolt for some types may exceed 100 m/s. Nail guns shoot with a lesser power, but are as dangerous as bolt guns. Both types of tools must have at least two independent safety catches, which prevent unintended start. (M2.4.10.jpg) The tools must only be used by workers over the age of 18, who must be thoroughly instructed and trained in operating the tools.

### **Risk Factors**

- Risk of shooting through the material
- Risk of smashing of the material or throwing back the bolt

### **Impact on Human Health**

- Bolt as well as nail guns shoot with great power, therefore, injection of bolts and nails from these tools may cause injuries on human beings which in worst case may cause disabilities or death

### **Safety Measures**

- Make sure that shooting through the material cannot happen – or that nobody stands in the shooting direction
- Always use the gun in conformity with the specifications
- Wear a helmet, closely fitting safety spectacles and hearing protector

- Put up warning signs

### **M2-EN.4.7 Compressed-air devices**

Compressed-air devices must be set up so that they are not exposed to collision or bumps and strokes. Containers must be equipped with pressure gauge, safety valves and drain cocks for condensation (**M2.4.11.jpg**). Containers with a high pressure must be examined in conformity with the current specifications at least every four years. Besides, the common regulations also include pneumatic machines and tools. There are specific rules for storing, protecting from fire and using pressure bottles.

#### **Risk Factors**

- Production of noise and dust from pneumatic tools
- Working with concrete and brickwork may generate quartz dust
- Vibrations may cause damage on buildings
- Risk of falling of broken bricks
- High pressure cleaners and cutters act as cutting tools. Jets may be thrown back from hollow spaces and curved surfaces. The jet has a powerful backlash

#### **Impact on Human Health**

- Dust may be injuring to the eyes, mucous membranes and lungs
- Quartz dust is specially dangerous, since it may cause silicosis and cancer
- Din may damage the hearing
- Vibrations may damage the circulation, muscles and joints
- Jets from high pressure cleaners and cutters may cause deep and severe injuries

#### **Safety Measures**

- Vacuum cleaning in connection with the work may reduce the inconvenience. Always wear safety spectacles, breathing masks and hearing protector when working with pneumatic hammers
- If possible avoid hand used tools or use mechanical support
- At sand blasting, do wear air supplied breathing masks and dust repellent clothes. Moisten the used sand before it is swept off. Do not wear the working clothes in the canteen
- Do not use hand held high-pressure cleaners and cutters if the pressure is more than 800 bar. Make sure that no one else is in the working area. Make sure you have a non-skid foothold and never stand on ladders. Use the necessary means of personal protection

## M2-EN.5 MEANS OF TRANSPORT

M2-EN.5.1 Introduction

M2-EN.5.2 Means of Transport in General

M2-EN.5.3 Cranes

M2-EN.5.4 Lifts

M2-EN.5.5 Machines used in Construction



### M2-EN.5.1 Introduction

In this chapter, the typical risk factors when working with means of transport on a construction site are described. The aim of this chapter is to:

- Identify the most common risk factors
- Describe the constitution of the risk
- Provide suggestions on how to reduce these risk factors

The driver or the user of the mean of transport is in charge of the daily inspection and the necessary tightening-up in conformity with the instructions. The driver or the user must pay attention to any kind of irregularities in the operation of the means and immediately notify his supervisor. The supervisor carries the responsibility of repairing the means immediately before the work is resumed. Specially trained personnel must carry out all repairs, including the annual inspection.

Inspection and maintenance of the means are supposed to secure that the means are kept in order. The annual inspection must among other things include all mechanical parts, hydraulic components, pneumatics, electrical equipment and safety equipment. When examining the load-bearing parts one must observe signs of cracks,

deformations and loose or damaged construction joints. If the paint peels off it might be a sign of damage or overload of the means.

All means of transport must be equipped with a logbook documenting authorisations, continuous inspection and repairs if any. Furthermore, operator's manual and repair instructions must be kept in or near the means.

### **M2-EN.5.2 Means of Transport in General (M2.5.1.jpg, M2.5.2.jpg)**

The driver's cabin in trucks, cranes etc. must be organized in a way that gives the driver a good view on the street and the working area. It must be possible to heat and ventilate the cabin and it must be isolated from noise and vibrations. Driver's seat and control lever must be ergonomic, and there must be enough room for the legs. (M2.5.3.jpg) The access to the cab or seat must be unhindered and safe.

#### **Risk Factors**

- Collision
- Faulty operation
- Cold, din and vibrations
- Heavy work

#### **Impact on Human Health**

- Collision or faulty operation of the means may lead to severe injuries of persons or damages of property. Crashing burdens or construction units may furthermore cause injuries which in the worst case may lead to disablement or death
- Cold, din and vibrations are tiring and cause stress which increases the risk of faulty operation or inadvertence. Impact during a long period of time may lead to muscular rheumatism, illness and injuries on body and hearing
- Inconveniently designed handles and buttons increase the risk of faulty operation and are hard for the back and the limbs of the driver

#### **Safety Measures**

- Make sure that the cabin is clean and tidy so that the wheel, handles and buttons are easy to operate. Clean windows increases the vision considerably
- Use a signalman if the view on the road and the cargo is obstructed
- Make sure that buttons and handles are easy to identify and operate
- Use large operation handles for work that requires a lot of power and smaller handles or buttons for precision work. Buttons and handles must not require power and precision simultaneously
- Buttons and handles on cranes must fall into neutral position when not in operation

### **M2-EN.5.3 Cranes**

There are particular requirements concerning the safety of cranes. When rising new cranes or cranes after rebuilding, repair or re-arrangement, load tests must be carried

out in conformity with the current rules. The purpose of the load test is to examine the strength and the security of the load-bearing parts, including means of bearing, crane girder, spinnaker boom, driving track or rail and the security of cantilevers, rotary rims etc. Since certain safety devices have to be switched off while testing, only particular experts are allowed to do the tests. The driver should if possible be present when testing. (M2.5.4.jpg - M2.5.6.jpg)

For most types of cranes there are several requirements concerning the training and certification of the driver to use and operate the crane. Crane driver certificates cannot be issued to workers under the age of 18.

Everyone who attaches or releases cargo from a crane hook is called ground assistant. The ground assistant must be accordingly trained and has to be of at least 18 years old.

The ground assistant and the crane driver have the right and an obligation to refuse to carry out a job that they feel that does not comply with the necessary safety requirements.

The ground assistant must:

- Keep in touch with the driver during the work
- Stop the work if there is any doubt concerning safety matters
- No one is allowed to stand upon cargo which is attached and lifted from the ground
- Always wear a helmet, feet protection and suitable protective gloves
- Always use the right ground tools and discard defected or imperfect tools
- Check before every lifting that the hook is vertical to the centre of gravity of the cargo, that the burden is in balance, that all slings are correctly attached and that the cargo is not stuck to the ground

### **Risk Factors**

- Cranes might sink into the ground or skid and tip over
- The wind might tip the crane or make its cargo swing
- Cranes might break down because of faulty erection or operation
- Crane might collide with people, buildings, goods or construction units

### **Impact on Human Health**

- Falling or swinging cargo may cause injuries
- The burden might tip when put down
- Fault at the ground material – or overload
- Worn out or faulty ground tools

### **Safety Measures**

- Tower cranes must always be erected by specially trained personnel
- Make sure that the foundation is appropriate

- Keep a safety distance – at least half a metre – from buildings, goods or construction units
- Keep the slewing area and if necessary the driving area securely barred
- Always make sure that safety appliances are correctly adjusted in conformity with the specifications
- When erecting the crane it is important to check that high-level stop, stop at traffic end and the signal instruments etc. are functioning correctly
- If more than one crane is erected at site, make sure that cranes cannot collide with each other
- Always leave tower cranes with a loose slewing brake so that the crane may turn with the wind
- Do observe the wind when working with both heavy and light cargo. No matter the strength and stability of the crane, it might be necessary to postpone the work even at light wind
- At mobile cranes always use supporting legs in conformity with the specifications

#### **M2-EN.5.4 Lifts**

When designing the construction site it must be assessed whether to choose a lift for persons or a front lift only for material. Erecting, dismantling and changing the lifts whether they are for persons or material only, must only be carried out by specially trained personnel. (M2.5.7.jpg – M2.5.9.jpg)

#### **Risk Factors**

- Overloading of the lift
- Unintended start of the lift
- An inclining lift may slip or tip over
- The wind

#### **Impact on Human Health**

- Injuries caused by fall or crushing

#### **Safety Measures**

- Make sure that the loading dock is effectively barred
- Establish an emergency brake on each storey
- Avoid covering the lift car with a wind-tight material
- Never exceed the maximum load
- Make sure that the load cannot fall off
- At the end of the day the lift car must be driven into the lowest position and the power supply must be switched off with a lockable main switch

- An inclining lift must be erected on solid ground and attached to fixed construction units

### **M2-EN.5.5 Machines used in constructions**

Machines in constructions must only be used for transportation of persons if they are built to do so. Machines driving on public roads must be adjusted according to the Road Traffic Act. Machines driving on the site should meet the same demands.

Several types of machines in the construction sector must have a driver protection against overturning and/or falling objects. The driver must at least have a licence for a tractor.

#### **Risk Factors**

- Risk of bumping into people – for certain types of machines there is also a risk that the driver himself may get hit
- Risk of cutting gas conduits and electricity cables when digging
- Risk of skidding and overturning
- Frost burst of the caterpillar treads

#### **Impact on Human Health**

- Bumping into people may cause severe injuries
- Cutting gas conduits and electricity cables when digging may result in poisoning or severe electric shock
- Frost burst of the caterpillar treads may cause severe injuries

#### **Safety Measures**

- Keep a safe distance to people and avoid swinging above people
- Machines with a walking driver must be equipped with operating equipment which makes it impossible for the driver to be crushed between the machine and fixed units. The machine must stop when the driver leaves the operating equipment
- Keep a safe distance to electricity cables and gas conduits, fixed units and steep slopes
- Avoid overloading
- The bucket or other parts to lift must be held low when driving and dropped before the machine is left
- The machine must be cleaned on a daily basis. In periods of frost the caterpillar treads must be cleaned very carefully

## M2-EN.6 MATTER AND MATERIAL

M2-EN.6.1 Introduction

M2-EN.6.2 Common Regulations

M2-EN.6.3 Paint

M2-EN.6.4 Organic Solvents

M2-EN.6.5 Epoxy and Isocyanate

M2-EN.6.7 Asphalt

M2-EN.6.7 Mineral Wool

M2-EN.6.8 Quartz Dust

M2-EN.6.9 Impregnated Wood

M2-EN.6.10 Wood Dust, Fly Ash, Cement

M2-EN.6.11 Asbestos

M2-EN.6.12 Lead

M2-EN.6.13 Silica

M2-EN.6.14 Earth Polluted with Oil and Chemicals



### M2-EN.6.1 Introduction

In this chapter, the typical risk factors when working with different types of hazardous matters and materials are described. The aim of this chapter is to:

- Identify the most common risk factors
- Describe the constitution of the risk
- Make proposals on how to reduce these risk factors

The employer has to make sure that hazardous matters and materials are removed, substituted or reduced to a minimum. Technical and economic consequences of a substitution must be counterbalanced with safety and health interests.

## **M2-EN.6.2 Common Regulations**

Hazardous matters mean matter and material, which are hazardous to breathe in, swallow, contact with the skin and eyes, or are flammable or explosive. The supplier of hazardous matters and materials must provide easily understood safety instructions, which describe:

- The composition of the matter, its physical and chemical characteristics and the type of hazard
- Means of personal protection, first aid and fire-fighting
- Transportation, handling, storing and removal of the matter

The employer carries the responsibility that work place instructions are drawn up where people work with hazardous matters and materials. The instructions must be based on the information from the supplier and adjusted according to the local conditions at the enterprise. The employees must receive the latest drawn up instructions.

### **Risk Factors**

- Synergy effects of different hazardous materials being used on site
- Air pollution is worse when it is combined with hard physical work
- Din may exacerbate the injurious impact from certain solvents

### **Impact on Human Health**

- Pulmonary diseases like asthma, bronchitis, silicosis and asbestosis. It often takes years from the impact to the break-out of the disease, and these diseases are often chronic
- Organic solvents are absorbed through skin and lungs and may lead to injuries of the internal organs, including brain damage
- Certain matters may cause allergy and eczema
- Several matters are carcinogenic even in very small doses
- Risk of congenital malformation

### **Safety Measures**

- Follow carefully the handling instructions for hazardous materials
- Dust may often be seen in the air or on shelves and landings. One can often see, smell or taste steam and gas. However, be aware of the fact that not all matters send out warnings like smell etc.
- Isolate the dangerous matter by e.g. encapsulating the working process
- Make sure the ventilation is effective
- Use the relevant means of personal protection

### **M2-EN.6.3 Paint**

Paint may contain unhealthy metalliferous pigments e.g. compounds of lead, chromium or nickel. Paint may contain irritating or allergenic matters. (M2.6.1.jpg)

#### **Risk Factors**

- Risk of breathing in aerosol and solvents
- Risk of fire and explosion

#### **Impact on Human Health**

- The same as for organic solvents

#### **Safety Measures**

- Avoid skin contact-Use gloves and glasses
- Personal hygiene is very important. Always wash the hands carefully before eating
- Make sure that water, soap and clean and dry towels are available at the work place
- Use water diluted paints where possible

### **M2-EN.6.4 Organic Solvents**

Organic solvents dissolve oil, grease, paint, plastic etc. They are used as means of degreasing and detergents and are components of paint, glue etc. White spirit is the mostly used organic solvent.

#### **Risk Factors**

- Risk of absorption through skin or lungs
- Risk of fire or explosion

#### **Impact on Human Health**

- Organic solvents may cause acute or chronic injuries on several organs
- Irritation of the mucous membranes of the eyes, the nose and the throat
- Nervous system and brain injuries. Lapse of memory, frayed temper and depression are typical symptoms

#### **Safety Measures**

- Reduce the use of organic solvents and follow the instructions on how to handle the solvents carefully
- Smoking and open fire are forbidden
- Make sure the ventilation is effective and use breathing masks
- Protect the skin with gloves or other suitable means of protection
- Do not leave cloths with solvents in the open, in open containers

### **M2-EN.6.5 Epoxy and Isocyanate**

Epoxy is a highly allergenic matter. Allergy may occur even after a short time impact.

#### **Risk Factors**

- Risk when breathing it in or when in contact with the skin

#### **Impact on Human Health**

- Contact with or breathing in epoxy and isocyanates may cause allergy, eczema or allergic asthma

#### **Safety Measures**

- Persons who suffer from heavy perspiration from the hands, eczema, allergy or pulmonary diseases may not work with these matters
- It is normally prohibited to spray with these matters outside special spray sheds
- Special training is demanded for personnel working with epoxy or isocyanates
- Follow the handling instructions carefully – also according to removal of waste
- In the work place there must be access to wash-hand basins with running hot water. The taps must not be hand-operated
- There must be access to showers with hot and cold water, means of cleaning, soap, towels and suitable skin cream
- Be very careful with the personal hygiene
- Necessary first aid kit must be available on the work place

### **M2-EN.6.6 Asphalt**

Work with asphalt includes laying out different types of road asphalt and asphalt mastic, roofing with bitumen products, insulation of bridges and damp proofing with bitumen products. (M2.6.2.jpg, M2.6.3.jpg) If the contents of the asphalt material cause safety or health problems, the material must be replaced with less dangerous one. Work place instructions must be drawn up for work with asphalt and bitumen materials.

#### **Risk Factors**

- Risk of air pollution injurious to health
- Risk when in contact with the skin
- Risk of burning

#### **Impact on Human Health**

- Contact with the skin may cause eczema and burns

#### **Safety Measures**

- Work with asphalt may only be carried out by persons who have gone through special training, or have been instructed accordingly

- Always work at the lowest temperature possible. Do observe the maximum work temperatures
- Use breathing masks, high boots , proper gloves and other means of personal protection
- Have always be access to water and cleaning articles

### **M2-EN.6.7 Mineral Wool**

Mineral wool consists of synthetic mineral fibres which are bound with plastic resin. Mineral wool is extensively used for insulation. (M2.6.4.jpg)

#### **Risk Factors**

- When managing mineral wool products, mineral fibres of different sizes are liberated creating little scratches in the skin and in the mucous membranes of the eyes

#### **Impact on human Health**

- Mineral fibres may cause watery eyes, itch and skin eruption
- There is an increased risk of bronchitis and pneumoconiosis

#### **Safety Measures**

- Organize the work so that least possible part of it is carried out above the head and most of it is done before rooms and constructions are closed and completed
- Avoid dust
- Use dust repellent clothes without pockets and turn-ups. Wear headgear with a peak
- Gloves, safety spectacles and breathing masks must be available at the work place
- When cleaning: vacuum-clean and wash. No sweeping with a dry broom

### **M2-EN.6.8 Quartz Dust**

Several construction materials produced of sand, clay, granite, flint, arenaceous quartz etc. contain crystalline silicon dioxide (quartz). So do certain types of paint, hard stopping, glue etc.

#### **Risk Factors**

- Quartz dust may reach deep down in the lungs or the alveolus during inhalation

#### **Impact on Human Health**

- Quartz dust may be accumulated in the lungs and cause silicosis (grinder's disease)
- Quartz dust is carcinogenic

### **Safety Measures**

- Use the least dusting working methods possible
- Use exhaust, and if the dust cannot be removed that way use water
- Cleaning: vacuum-clean and sweep with water, no use of a dry broom only
- Use means of personal protection when necessary

### **M2-EN.6.9 Impregnated Wood**

Pressure treating of wood is done with means containing copper and boron combinations. Combinations with chrome and phosphorus are also found. Vacuum treating of wood is done with means containing organic solvents and e.g. tributyltin combinations. (M2.6.5.jpg)

### **Risk Factors**

- If you get it on your skin or breathe it in

### **Impact on Human Health**

- Boron combinations may have an impact on men's reproductive organs and cause congenital malformation
- Chrome is allergenic and carcinogenic
- Tributyltin combinations are highly exasperating when it gets on your skin or in your eyes

### **Safety Measures**

- Only use pressure-treated wood when it its necessary to prevent attack from fungus and insects
- Avoid contact with the skin. Use if possible gloves and apron e.g. if the wood gets wet in the rain
- Use breathing masks if the wood generates dust during the work

### **M2-EN.6.10 Wood Dust, Fly Ash, Cement**

Wood dust is produced when processing the wood. (M2.6.6.jpg)

Fly ash is used as rubble in connection with road construction and in cement, concrete and gas concrete. Fly ash consists of fine particles which are liberated from the waste gas from coal-fired power stations.

It is prohibited to use cement and non-hardened cement-containing products if it contains water-soluble chromate of more than 2 mg per kilo dry cement, or if the content is not stated on the packaging. (M2.6.7.jpg)

### **Risk Factors**

- Wood dust may dry the skin and the mucous membranes and irritate the respiratory passages
- Fly ash may irritate the skin and the mucous membranes

- Cement may irritate the skin

### **Impact on Human Health**

- Wood dust may cause nasal cancer and allergies
- Fly ash may cause allergy during a long period of time
- Chromate may cause eczema when in contact with the skin

### **Safety Measures**

- Use an exhaust system when the process may cause wood dust
- Use means of personal protection
- Do follow the instructions carefully
- Apply particle filters at the air supply system in the cab of the contractor is machine

### **M2-EN.6.11 Asbestos (M2.6.8.jpg)**

It is prohibited to use asbestos or asbestos-containing material. High-pressure flushing of asbestos-containing material including eternit roofs is prohibited. Asbestos-containing material which is temporary taken down, dismantled or in any other way removed from its original position, may not be re-erected or reused – also when the material is still intact.

Working with demolition and repair of asbestos-containing material is permitted.

Workers under the age of 18 should not work with asbestos-containing material or be exposed to asbestos dust.

### **Risk Factors**

- Danger of breathing in asbestos dust

### **Impact on Human Health**

- Asbestos dust may cause asbestosis which is a chronic pulmonary disease
- Asbestos dust may furthermore cause lung cancer and pleural cancer

### **Safety Measures**

- Prepare a plan of work
- Notify the works to the Inspector
- Use tools and work methods which cause the least possible dust formation. If necessary, moisten the material about to be demolished
- Bar the working area so that unauthorized persons are kept away
- Use effective breathing masks and dust repellent clothes without pockets preferably of single use (M2.6.9.jpg - M2.6.11.jpg)
- Make sure the cleaning is done properly after work. Vacuum-clean and wash. Sweeping with a dry broom is not allowed

- Work clothes and daily clothes must be kept separately
- Eating on the working place is not allowed
- Act in conformity with the regulations when the waste must be disposed
- Provide suitable cleaning and washing facilities
- Wash the working clothes separately or dispose them
- Do not drill asbestos products
- Only trained personnel must be working with asbestos

### **M2-EN.6.12 Lead**

Lead combinations have earlier been used e.g. in paint. There may be a risk of impact from lead and lead combinations e.g. at demolition, especially scraping off, burning and cutting up of materials which are covered with lead-containing paint. (M2.6.12.jpg - M2.6.13.jpg)

Workers under the age of 18 are not allowed to work where they may be exposed to impact from lead.

#### **Risk Factors**

- Lead dust and lead steam may be breathed in or absorbed through the skin

#### **Impact on Human Health**

- Lead is carcinogenic
- When the exposed over a long period of time lead may cause injuries in the brain, the nervous system, the kidneys, the stomach and the intestinal canals. Lead may cause anaemia and affect the reproduction ability of both men and women. There is also a risk of congenital malformation

#### **Safety Measures**

- Development of lead dust and lead steam must be prevented effectively
- Use a breathing mask and means of personal protection if there is a risk of lead impact
- Wash the work clothes separately

### **M2-EN.6.13 Silica**

Silica is a natural component of a variety of materials used or encountered in construction activities. Crystalline silica can be found in substantial quantities in sand, sandstone and granite, and often forms a significant proportion of clay, shale and slate. Concrete and mortar also contain crystalline silica.

#### **Risk Factors**

The health hazards of silica occur from breathing in the dust. Exposure of workers or the public can occur from the following activities:

- demolition processes

- concrete scabbling, cutting or drilling
- stone masonry
- facade renovation
- tunnelling through dry, silica-bearing rock
- blast cleaning of buildings, especially using sand

Power tools for cutting or dressing stone lead to high exposures throughout the work. Exposure often depends on the size of working space is, the existence of ventilation and the proximity of worker's breathing zone to the source of the dust.

### **Impact on health**

- Inhalation of the very fine dust of crystalline silica can lead to the development of silicosis (resulting to breathing disorders)
- Exposure to very high concentrations over a short period can cause acute silicosis, resulting in rapidly progressive breathlessness and death within a few months of onset.
- Exposure over a longer period leads to progressive silicosis, causes fibrosis of the lung tissue, subsequently resulting in loss of lung function and finally death.

### **Safety measures**

- Eliminate and substitute silica by using other materials (i.e. non-silica grids)
- Control dust by using dust suppression techniques (water supply) or local exhaust ventilation (exhaust ventilated tools)
- Use positive pressure or airline breathing apparatus
- Use appropriate personal protective equipment (PPE) (respirators, clothing) and have specific training on its proper use
- The protective equipment must be stored in clean, dry conditions away from chemicals
- Employers must have available facilities for washing and changing where workers wash their hands before eating, drinking, smoking and going to the toilet.
- Appoint a separate place away from the work site for eating, drinking and smoking
- Have regular health surveillance (medical examination, chest X-rays, etc)

### **M2-EN.6.14 Earth Polluted with Oil and Chemicals**

Working with chemically polluted earth may be a health risk. If the type and extent of the pollution are not known, the kind of health risk the work implies cannot be determined.

### **Risk Factors**

- Risk of breathing in dangerous matters and getting it on the skin

### **Impact on Human Health**

- The impact depends on the type of pollution

### **Safety Measures**

- The work must - if possible - take place above the excavation.
- Cabs, tents etc. must be ventilated with overpressure
- Work that produces dust must be sprinkled
- Diaphragms and pumps may prevent steam, fluids etc. from penetrating into the excavation
- Do restrict the access to the polluted area
- Use the relevant means of personal protection
- Be exceptionally careful with the personal hygiene. Wash the face, the hands and the forearms – also before going to the lavatory

## **M2-EN.7 IMPACT OF THE WORK**

M2-EN.7.1 Introduction – Ergonomics

M2-EN.7.2 Manual Operation

M2-EN.7.3 Physically Hard Working Postures and Movements

M2-EN.7.4 Mental Impact

M2-EN.7.5 Noise

M2-EN.7.6 Vibration

M2-EN.7.6.1 Hand and Arm Vibration

M2-EN.7.6.2 Whole-body Vibration

M2-EN.7.8 Weather Conditions

M2-EN.7.8.1 Cold

M2-EN.7.8.2 Heat

M2-EN.7.9 Illumination



### **M2-EN.7.1 Introduction – Ergonomics**

Ergonomics mean adjustment of the working conditions and working tools to worker's conditions and needs. Muscleskeleton injuries may be prevented to a great extent if the work is carefully planned and organized. The place of work must be organized; machines and working tools must be chosen so that they fit the work to be carried out and the person who does it. Today it is possible to get ergonomic elaborated tools, hand tools and other good technical facilities which increase safety, reduce the harmful impact and not least increase the quality and the efficiency.

In the construction sector, heavy lifts, inconvenient working postures and one-sided repeated work are the impacts, which are most frequently stated as the reason for the musculoskeletal diseases and injuries.

In this chapter, several working conditions are described, which are typical for the construction sector. The impact of these conditions on the health and safety of the worker is described and safety measures are suggested.

### **Risk Factors**

- Inconvenient and heavy lifting, pulling and pushing: If the load is sudden and heavy the work implies a particular risk.
- Inconvenient working postures
- Cold, draught, vibrations etc. may intensify the impact

### **Impact on Human Health**

- Diseases in the muscles, tendons and joints – the back is particularly exposed
- Infiltration and myositis of neck and shoulders
- Osteoarthritis, circulatory diseases, tenosynovitis

### **M2-EN7.2 Manual Operations**

Manual operation means lifting, carrying, tipping, pushing and pulling which are carried out using muscular strength. Tasks which include manual operation must always be taken into serious consideration. Manual operation which includes a risk must always be avoided by organizing the work or using technical facilities. If this is not possible other effective preparations must be made.

### **Risk Factors**

- Even light burdens may include a risk if the lift is one-sided, with one hand, in cramped places, on an uneven or smooth foundation or on ladders or stairways
- Worsening factors may e.g. be unhandy burdens, distorted working postures and sudden unexpected loads

### **Impact on Human Health**

- Back injuries from heavy or incorrect lifting
- Fall or lack of balance may cause acute injuries
- Repeated minor damages may lead to a risk of attrition over a longer period

### **Safety Measures**

- Make sure that the working area is tidy and that the foundation is cleared and safe to stand/walk upon
- Use the correct lifting technique
- Avoid carrying heavy burdens on ladders and stairways. Use technical facilities instead

### **M2-EN.7.3 Physically Hard Working Postures and Movements**

Physically hard working postures are often due to badly organized work places or a working area placed too high or too low. Physically hard working postures may also be due to the use of incorrect elaborated tools or faulty working equipment according to the task and the person.

#### **Risk Factors**

- Inflexible work, lying, kneeling or other awkward working postures
- Heavy work
- There are particular risks from physically hard monotonous work

#### **Impact on Human Health**

- Muscles and joints are exposed to grind
- There is a strain on the circulation
- Oedema in the legs
- One-sided and repeated physically hard work is very tiring. Monotonous work may affect the muscles and the circulation system and may cause mental distress
- The risk is increased when several kinds of impact are combined, e.g. digging with a shovel

#### **Safety Measures**

- Organize the work and the work place in a way so that physically hard working postures as far as possible are avoided
- Organize the work so that one-sided repeated work, as far as possible, is avoided, and make sure that there is an opportunity for changing between the work tasks
- Use knee protection, pillows and stools to support the body. Make sure that the circulation is not hampered during the work
- Do change the working posture frequently
- If the worker must walk and work at the same time, the tools and means of transportation must be of adequate size in order to carry out the work in an upright position

### **M2-EN.7.4 Mental Stress**

In the construction sector mental stress is often experienced in connection with pressure of time, working at a high rate, noise, weather conditions (very high or very low temperatures), contradictory demands, no influence in the organization of one's own work, solitary work, and bullying or harassment. Mental stress leads to a generally depreciated working climate.

#### **Risk Factors**

- Piecework may lead to an elevated working rate and cause stress, tiredness and inattention. Risk of accidents

- The demands for quality are not adjusted to the demands for use of time

### **Impact on Human Health**

- Mental tiredness, lack of energy, headache, insomnia, anxiety, low self-confidence
- A long term impact may lead to stress, depression, gastric ulcer or cardiovascular diseases
- A person suffering from stress will have a higher risk of making an error that may cause an accident

### **Safety Measures**

- Avoid jobs based upon time performance
- Make sure that the work is organized in a way that prevents frustrations and negative mental experiences
- Use special questionnaires to define the problems
- Take organisation measures
- Use special qualifications of each worker
- Motivate workers

For further information of mental stress, refer to section M0-EN.8.

### **M2-EN.7.5 Noise**

Exposure to continuous din above 75-80 PNdB implies a risk of permanent hearing disability. Impulsive noise with a peak value above 130-140 PNdB may injure the hearing even at very few incidents of impact.

Hearing protectors to be used when there is not any possibility for further reduction by technical measures as a single measure only under exceptional circumstances.

### **Risk Factors**

- The risk of permanent hearing disability depends on the power and duration of the din
- Brief but powerful din may also cause permanent injuries
- Increase of accident rate due to poor communication
- Din may also cause stress

### **Impact on Human Health**

- Tinnitus and abnormal hypersensitivity to sound
- Permanent hearing disability caused by din is a chronic injury in the internal ear
- Din may lead to elevated pulse and blood pressure which over a longer period of time is harmful for the organism

### **Safety Measures**

- Avoid unnecessary din – also when the limit values are not exceeded

- Turn off equipment that is not in use
- Select low noise machines-tools
- Apply shock absorbers to noisy machines etc.
- Use hearing protector if the noise cannot be avoided. Remember that even the best protector almost does not protect at all if it is removed from time to time – even shortly

For further information of mental stress, refer to section M0-EN.5.

## **M2-EN.7.6 Vibration**

### **M2-EN.7.6.1 Hand and Arm Vibration**

The impact from vibrations should be reduced to below 130 PNdB. Even this should be reduced which can be done by simple measures. It is the employer's responsibility to lower the vibration.

#### **Risk Factors**

- The risk of injuries caused by vibrations depends on the power and duration of the impact
- Risk of accidents due to attack of numbness or white fingers

#### **Impact on Human Health**

- Buzzing or numb fingers
- Impact during a long period of time may lead to white fingers
- Permanent reduced tactile sense and ability to grasp. A permanent buzzing in the fingers, ache in the shoulders and joints and increased risk of osteoarthritis

#### **Safety Measures**

- Select proper machines-tools
- Stop working if the fingers start to buzz or become numb
- Find other working methods
- Be aware of the fact that gloves only lower high-frequency vibrations. The risk of white fingers is not reduced by using gloves

### **M2-EN.7.6.2 Whole-body Vibrations**

Whole-body vibrations are the term for the impact which all of the body is exposed to when a person stands, sits or lies on a vibrating foundation. High vibration power and a long-term duration of the impact increase the risk of injuries while periods of rest reduce the risk.

Fixed working postures and frequent twists in the back, increase the risk of injuries. So do tired muscles or when the back is pushed together after hard physical work. Jolts and unexpected movements which are caused by e.g. an uneven foundation or smaller collisions also increase the risk.

Unnecessary vibrations must be avoided.

### **Risk Factors**

- The driver of cranes and contractor machines are particular at risk

### **Impact on Human Health**

- Risk of problems with the back, pains across the loins, ruptured disc and early degeneration of the vertebral column

### **Safety Measures**

- Level the road, avoid solid wheels and vehicles without suspension
- Choose seats with possibility for adjusting the seat according to the weight of the driver

## **M2-EN.7.8 Weather conditions**

### **M2-EN.7.8.1 Cold**

When cooling down the tactile sense is diminished and so is the ability to do a precisely done job. This increases the risk of accidents.

### **Risk Factors**

- Lying, kneeling or sitting work with direct contact with cold or moist surfaces increase the risk of cooling down

### **Impact on Human Health**

- Cooling down has a negative impact on the circulation and the metabolism
- Cooling down leads to increased risk of local overloading of the muscular structure

### **Safety Measures**

- Use adequate work clothes and reduce the time for working
- Use a suitable mat if the work is carried out lying, sitting or kneeling

### **M2-EN.7.8.2 Heat**

Powerful heat radiation from the sun combined with a high atmospheric humidity may be hard, especially for elderly people.

### **Risk Factors**

- There is a particular risk at heavy work at warm machines under the sun, e.g. asphaltting, for people working on scaffolds
- Protective clothes keeps in the heat

### **Impact on Human Health**

- Fluid loss, high temperatures,

### **Safety Measures**

- Avoid exposure to direct sun shine when temperature and humidity is high
- Provide workers with cool water
- Wear suitable light working clothes
- Do interrupt the work with frequent breaks in surroundings not that warm

### **M2-EN.7.10 Illumination**

- Insufficient illumination - i.e. not enough, too much or incorrectly placed – may lead to bad working conditions concerning the sight.

### **Risk Factors**

- Increased risk of falling and other accidents
- It may be the occasion of fixed and awkward working postures

### **Impact on Human Health**

- Exertion of the eyes, pain in the eyes, headache, muscular tension in the neck and the shoulders

### **Safety Measures**

- Make sure that the access roads, transportation roads and areas with traffic at any time are illuminated with at least 25 lux at ground level, floor level or scaffolding level
- Make sure the work place have adequate illumination
- Bar unlighted areas where there might be a risk of falling etc.

## **M2-EN.8 MEANS OF PERSONAL PROTECTION**

M2-EN.8.1 Introduction - means of Personal Protection

M2-EN.8.2 Helmets, Hearing Protectors and Safety Spectacles

M2-EN.8.3 Breathing Masks

M2-EN.8.4 Rappelling and Protection against Falling

M2-EN.8.5 Protection of Skin

M2-EN.8.6 Protective Clothes



### **M2-EN.8.1 Introduction - Means of Personal Protection**

If the job cannot be planned, organized or carried out ensuring safety and health, it must be done only if the worker uses means of personal protection. Using personal protective equipment must be the last possible solution.

Personal Protective Equipment must:

- always protect as they were meant to do
- not cause inconvenience
- be carefully selected
- be properly maintained and cleaned
- be fitted to use under the conditions at the place of work

Personal Protective Equipment must have manufacturer's instructions, which contain information on their use, cleaning, maintenance and storing. It must furthermore state the limitations of the means.

The employer is responsible to:

- provide and pay for workers' personal protective equipment
- ensure that the personal protective equipment is used during the whole working period and that it is used in conformity with its design and purpose

The employees are obligated to use the means of personal protection that are given to them with the instructions on how to use them. They must notify their supervisor if their means of personal protection are defective.

### **M2-EN.8.2 Helmets, Hearing Protectors and Safety Spectacles**

Workers must always wear protective helmets when working or staying in places where the head is at risk, and where mandatory signs exist. The choice of helmet must be based on the working situations where the helmet must be worn. There might be reasons to choose a helmet in specific colours or shapes, so that e.g. a ground assistant is particularly visible to the crane driver.

Hearing protection must be used from the beginning if the noise assessment indicated damage to hearing because of work. Hearing protection is only effective if used correctly and consistently. Even when removed briefly in surroundings with noise, the protection is considerably reduced.

Safety spectacles must always be used when working or staying in places where there is a risk of being hit by flying particles, sprays from corroding gasses or steam, or harmful radiation.

If you use glasses the safety spectacles must be large enough to embrace the glasses – otherwise you must use safety spectacles with corrective lenses.

Workers must always use the personal protective equipment according to instructions and discard worn out or defect means. Helmets must be discarded if they have been subject to blows or crushing.

### **M2-EN.8.3 Breathing Masks**

Breathing masks provide protection against polluted air or lack of oxygen. There is a distinction between filtering breathing masks and air supplying breathing masks. Filtering breathing masks may be chosen when air-supplying masks are not necessary. Employers must be careful to choose a breathing mask with the right type of filter.

Characteristics of filtering breathing masks:

- they are easy to use and with only relatively little inconvenience
- the protection can be limited
- they should be used the most for three hours a day

Air supplying breathing masks must be used when the filtering mask does not protect effectively. Air supplying breathing masks must always be chosen when:

- there is a risk of lack of oxygen

- there is high concentration of air pollution
- the type of air pollution is not known
- no suitable filters are available
- filtering masks do not fit tightly enough
- when the use of breathing masks is needed for more than three hours

Breathing masks must be used in conformity with the manufacturer's instructions and their filters must be changed regularly. The areas where breathing masks must be used should be clearly marked.

### **M2-EN.8.4 Rappelling and Protection against Falling**

If the work involves a risk of falling, then equipment for protection against falls must be used. The use of such equipment is therefore an emergency solution. If there is a danger of falling, the work place will normally be secured by hand rails, scaffoldings, lifts, etc.

Workers must ensure that:

- prior every use the equipment is undamaged and without defects on the wires, cracks, attrition or other kind of damage. In case of defected equipment, the damage must be repaired or discard the equipment if the repair does not make it completely functional. A regular examination must be done according to manufacturer's instructions
- The equipment is chosen to fit the task and be used in accordance with manufacturer's instructions
- the anchorage is able to stand the weight of a falling person and is of the required height. The anchorage must lie above the secured person and not too far out in order to reduce the length of the fall to a minimum
- the areas where equipment for protection against fall must be used are clearly marked

There are specific rules concerning rappelling. Employees doing rappelling must have a special adequate training in carrying out the task, especially in the relevant rescue procedures.

### **M2-EN.8.5 Protection of Skin**

The skin protects the human being against physical, chemical and biological impacts. Tears on the skin or direct contact with hazardous materials may cause irritated or allergic contact dermatitis.

#### **Risk Factors**

- acid, bases, solvents, cleaning articles or cutting oil can cause contact dermatitis
- perfume, chromate, epoxy, preservatives or nickel can cause skin allergies
- cold, heat or contact with solvents can cause drying, decomposition or degreasing of the skin

- when latex gloves are used, sweat is generated
- risk of penetration of hazardous materials exist

### **Safety Measures**

- Avoid using irritating and allergenic matters or possible contact with hazardous materials
- Use suitable safety gloves when necessary. Cotton gloves may absorb humidity from the skin and protect against decomposition
- Workers should not clean their hands with stronger means than necessary

### **M2-EN.8.6 Protective Clothes**

Protective clothes imply suit, apron, arm protector, waistcoat, shoes etc. that are suitable to protect against different kinds of impact. They may protect the whole body or just part of it. The type of protective clothing depends on the working process or the dangerous impacts.

Reinforced shoes with a steel cap must be used where there is a risk of crushing or injuries because of falling objects. Reinforced shoes with a protective sole must be used where there is a risk of stepping on sharp objects like nails or broken glass. A reinforced shoe with both the steel cap and the protective sole must normally be used in the construction sector.

#### **Special attention:**

- Chemicals will eventually penetrate the protective clothing. The clothing must be discarded when it does not provide the necessary protection anymore
- When using a power chain saw, workers must wear trousers with cut obstructing insets
- When working in cold or heat thermal clothes may be practical, but suits made of metallised woven textiles provide good protection against heat radiation
- When choosing the type of reinforced shoes, the characteristics of the floor must be taken into consideration, as well and the fact that the work will be carried out while walking or standing. The shoe must fit tightly and in a proper way

#### **Workers must remember that:**

- there might be several types of impact at the same time
- the protective clothes actually do afford the necessary protection
- the clothes must be checked if they are intact

**M2-EN.9 RISK ASSESSMENT TOOL**

<b>Hazard</b>		<b>Who (Employees that might be harmed)</b>	<b>Harm</b>	<b>Safety Precautions</b>
<b>Source</b>	<b>Hazard description</b>			
Digging	<ul style="list-style-type: none"> <li>- Risk of collapse</li> <li>- Falling of people into the excavation</li> <li>- Falling of objects into excavation</li> <li>- Means of access</li> <li>- Contact with underground electrical conduits</li> <li>- The risk of collapse is intensified by rain, snow and frost</li> <li>- Landslide danger in the excavation</li> <li>- A steep slope always has a risk of landslip</li> </ul>	Worker	All types of injuries	<ul style="list-style-type: none"> <li>- Make a survey on the nature of the soil before starting</li> <li>- Provide enough slope if possible</li> <li>- Proper support of the sides of the excavation</li> <li>- Fencing</li> <li>- Disconnect electrical supply-Remove any electrical conduits</li> <li>- Remove excavation soil or any other material from the boundary of the excavation</li> <li>- Consider traffic and take measures to avoid vehicles to pass near the excavation</li> <li>- In an excavation without stiffening, the sides must have a rest in order to avoid landslides</li> <li>- In case of insufficient rest on a steep slope, stiffening must be made in conformity with the regulations</li> <li>- Make sure that ladders are at hand in the excavation and that the necessary escape routes are established</li> </ul>

Roof-top working	<ul style="list-style-type: none"> <li>- Falling of Workers</li> <li>- Falling of objects</li> <li>- Working on fragile material</li> <li>- Risk of collapse</li> <li>- The wind may blow off materials and tools from the roof</li> </ul>	Worker	All types of injuries	<ul style="list-style-type: none"> <li>- When the height of fall is more than 2 meters, a guard rail which beyond doubt can stop persons about to fall from the roof, must always be set up.</li> <li>- On roofs with an inclination of more than 15 degrees roof ladders must be used if it is not safe to walk on the laths</li> <li>- Examine the carrying capacity of the roof and take the necessary precautions</li> <li>- If there is a risk of collapse, gangways with a secure guard rail combined with a safety net between the gangways should be used</li> <li>- Make sure that the safety net is suspended and maintained in conformity with the prescriptions</li> <li>- The workers should be secured against falling materials and tools with guard boards, safety nets or other kind of protection</li> </ul>
Construction equipment	<ul style="list-style-type: none"> <li>- Collisions</li> <li>- Faulty operation</li> <li>- Noise and vibrations</li> </ul>	Workers	<ul style="list-style-type: none"> <li>- All types of injuries</li> <li>- Stress</li> <li>- Myalgia</li> <li>- Hearing impairments</li> </ul>	<ul style="list-style-type: none"> <li>- Use machines according to instructions</li> <li>- Use signalman where necessary</li> <li>- Maintain machines carefully</li> <li>- Use personal means of protection for safety reasons</li> </ul>
Cranes	<ul style="list-style-type: none"> <li>- Turning over or breakdown</li> </ul>	Crane driver and Builders	<ul style="list-style-type: none"> <li>- All types of injuries</li> </ul>	<ul style="list-style-type: none"> <li>- Use cranes according to instructions</li> <li>- Use personal means of protection</li> </ul>
Excavations	<ul style="list-style-type: none"> <li>- Falling in</li> </ul>	workers	<ul style="list-style-type: none"> <li>- All types of injuries</li> </ul>	<ul style="list-style-type: none"> <li>- Prop up the excavation according to instructions</li> <li>- Establish escape routes according to instructions</li> </ul>

Scaffolding	<ul style="list-style-type: none"> <li>- Scaffolding units are often heavy and unmanageable. Erecting and dismantling the scaffolding imply a considerable risk of overloading of the body.</li> <li>- The scaffolding may tip over or collapse</li> <li>- People, material and tools may fall from the scaffolding</li> <li>- Risk of collision with a car</li> </ul>	Builders and workers	<ul style="list-style-type: none"> <li>- All types of injuries</li> </ul>	<ul style="list-style-type: none"> <li>- Avoid manual handling of the material. Use suitable technical facilities instead</li> <li>- Make sure that the scaffolding stands on solid foundation and that eventual chocks are stable</li> <li>- Do examine all parts of the scaffolding and make sure that they are whole, without deformations or corrosion</li> <li>- Mark out the scaffolding if there is a risk of collision</li> <li>- Make sure that the floor fills out all of the scaffolding</li> <li>- Do not use ladders on the scaffolding</li> <li>- If the working height is more than 2 meters, the scaffolding must be equipped with guard rails, i.e. handrail, knee-high rail and skirting-board</li> <li>- Access to the scaffolding must be through stairways, ladders or rope ladders. Openings in the scaffolding floor must be closed when working on the scaffolding</li> <li>- Particular precautions must be taken when working on roofs and near electric overhead lines</li> </ul>
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Physical impacts	<ul style="list-style-type: none"> <li>- Heavy lifting, pulling and pushing</li> <li>- Bad working positions</li> <li>- Cold, heat, vibrations</li> </ul>	All workers	<ul style="list-style-type: none"> <li>- Pains in muscles, tendons and joints               <ul style="list-style-type: none"> <li>- especially the back is vulnerable</li> </ul> </li> <li>- Myalgia and straining of neck and shoulders</li> <li>- Osteoarthritis, circulatory disorders, inflammation of the sinovial sheath</li> </ul>	<ul style="list-style-type: none"> <li>- Plan the work so unnecessary strain and loads are avoided</li> <li>- Observe the safety precautions indicated</li> <li>- Always use the necessary means of personal protection</li> </ul>
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## M2-EN.10 EVALUATION TEST

For the situations described in the following photos please perform a risk assessment.



M2.10.1.jpg



M2.10.2.jpg



M2.10.3.jpg



M2.10.4.jpg



M2.10.5.jpg



M2.10.6.jpg



M2.10.7.jpg

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M2.10.5.jpg <http://www.taproot.com/blog/houseconst.jpg>

M2.10.6.jpg <http://www.salemconference.com/constructiontour/index.html>

M2.10.7.jpg [http://members.cox.net/benito.loyola/house/Loyola\\_Lot\\_95\\_notes.htm](http://members.cox.net/benito.loyola/house/Loyola_Lot_95_notes.htm)

M2.5.8.jpg, M2.5.9.jpg <http://www.liftking.com/>