



Safety Protocols and Procedures

Introduction

Lifting operations are inherent to many occupations in the construction industry. They can be performed manually or using lifting equipment. Both manual lifting and mechanical lifting operations can put construction workers at great risk of injury or health symptoms causing sick leave or disability. The costs of accidents and ill health related to lifting operations are immense. This article describes the risks associated with lifting operations in the construction industry and measures to reduce these risks.

Definitions

Lifting operations

A lifting operation is an operation concerned with the lifting and lowering of a load. A load is the item or items being lifted which could include a person or people. A lifting operation may be performed manually or using lifting equipment. Manual lifting, holding, putting down, carrying or moving is often referred to as 'manual handling of loads' ^[1].

Lifting operations in construction occur during transportation of material from the storage place to the place where it is being processed, and during the processing of materials. A load includes any material or people that are lifted or lowered by lifting equipment.

Lifting equipment in construction

Lifting equipment includes any equipment or machinery used at work for lifting or lowering loads or people, including accessories and attachments used for anchoring, fixing or supporting the equipment ^[2]. There is a wide range of lifting equipment in the construction industry. Typical examples are:

- A hoist: is a device used for lifting or lowering a load by means of a drum or lift-wheel around which rope or chain wraps. It may be manually operated, electrically or pneumatically driven and may use chain, fiber or wire rope as its lifting medium.
- A crane: is a type of machine, generally equipped with a hoist, wire ropes or chains, and sheaves, that can be used to lift and lower heavy materials and to move them horizontally. Different types that can be found in construction are:
 - A tower crane: is a balance crane that consists of the same basic parts. Fixed to the ground on a concrete slab, tower cranes offer height and high lifting capacity. The base is then attached to the mast which gives the crane its height. The mast is attached to the slewing unit (gear and motor) that allows the crane to rotate.
 - Telescopic crane: has a boom that consists of several tubes fitted one inside the other. A powered mechanism extends or retracts the tubes to increase or decrease the total length of the boom. These types of booms are highly adaptable, are often truck mounted and used for short term construction projects.
 - A mobile crane: is a cable-controlled crane mounted on crawlers or rubber-tired carriers or a hydraulic-powered crane with a telescoping boom mounted on truck-type carriers or as self-propelled models. They are designed to easily transport to a site and use with different types of load and cargo with little or no setup or assembly.
 - All terrain crane: is a mobile, truck mounted crane with the necessary equipment to travel at speed on public roads, and on rough terrain at the job site using all-wheel and crab steering.
 - A crawler crane: is a crane mounted on an undercarriage with a set of tracks (also called crawlers) that provide stability and mobility. They need little set-up and can travel with a load but are very heavy and cannot easily be moved from one job site to another.
- A power shovel (also stripping shovel or front shovel or electric mining shovel) is a bucket-equipped machine, usually electrically powered, used for digging and loading earth or fragmented rock and for mineral extraction conveyor systems.
- A telescopic handler, or telehandler, is a type of crane, with the versatility of a single telescopic boom that can extend forwards and upwards from the vehicle. On the end of the boom several attachments can be fit, such as a bucket, pallet forks, muck grab, or winch.

- A forklift truck is a powered industrial truck with hydraulic lift system and forks to pick up and transport materials.
- Lifting equipment for lifting people:
 - An aerial work platform, elevating work platform, or mobile elevating work platform (MEWP) is a mechanical device used to provide temporary access for people or equipment to inaccessible areas, usually at height. There are distinct types of mechanized access platforms and the individual types may also be known as a "cherry picker" or a "scissor lift". They can be vehicle-mounted, self-propelled or trailer-mounted.
 - A passenger lift or passenger hoist or construction elevator is commonly used on large scale construction projects, such as high-rise buildings to transport persons.

Lifting accessories

Lifting accessories means a component or equipment not attached to the lifting machinery, allowing the load to be held, which is placed between the machinery and the load or on the load itself, or which is intended to constitute an integral part of the load and which is independently placed on the market; slings and their components are also regarded as lifting accessories^[3]. These accessories include amongst others chains, ropes, slings, shackles, eyebolts, lifting/runway beams, lifting frames and vacuum lifting devices.

The load

The load includes any material and people (or any combination of these) that is lifted by the lifting equipment. Loads are often provided with permanent or semi-permanent fixed or attached points for lifting. In most cases, these are considered to be part of the load. Examples of loads include:

- loose bulk materials
- sacks, bags, pallets and stillage's
- discrete items (such as a large concrete block)
- machinery and any permanently attached lifting eyes
- a skip and the lugs fixed to its side.

Risks associated with lifting operations.

Risks of manual lifting

Although the number of workers in the EU-28 who report carrying or moving heavy loads has decreased slightly in recent decades, it is still high at around 32%^[4]. The physical load from manual lifting in the construction industry has been reported extensively ^{[5][6]}. Examples of jobs in the construction industry with manual lifting tasks are: scaffolding, bricklaying and processing plasterboard.

Manual lifting tasks with high loads or frequencies may induce musculoskeletal disorders (MSDs), e.g. low back pain. According to the European Working Conditions Survey (EWCS 2015) 52% of the construction workers reported backache in the past 12 months^[4]. It should be noted that the EWCS does not make a distinction between work-related or other causes of backache. In addition of MSDs, manual lifting tasks can also lead to accidents causing acute trauma such as cuts or fractures.

What makes manual lifting hazardous?

There are several risk factors that may increase the occurrence of injury from manual lifting. These factors are related to the different characteristics of the load, the task and organization of the work, the work environment and the worker ^[7]:

The load, which may be:

- too heavy - There is no exact weight limit that is safe. ISO-standard 11228-1 Ergonomics - Manual handling - Part 1: Lifting and carrying proposes a limit of 25 kg for men and 15kg for women under ideal conditions.
- too large - if the load is large, it is not possible to follow the basic rules for lifting and carrying — to keep the load as close to the body as possible; thus, the muscles will get tired more rapidly; moreover, the shape or size may obscure the worker's view, thus increasing the risk of slipping, tripping or falling.
- unbalanced or unstable objects or if the contents can move make it difficult to hold the center of gravity of the load close to the middle of body; this leads to uneven loading of

muscles and fatigue; moreover, loads containing liquid can lead to an uneven distribution and sudden movements of the load can make the worker lose their balance and fall

- difficult to grasp: this can result in the object slipping and causing an accident; loads with sharp edges or with dangerous materials can injure workers. Gloves usually make the grasping more difficult than with bare hands. Providing the objects with handles or using aids for gripping (e.g. when carrying plate material) reduces the load on the worker.

The task and organization of the work if it requires:

- awkward postures or movements, e.g. a bent and/or twisted trunk, raised arms, bent wrists, over-reaching
- a high frequency or repetition with insufficient recovery periods;
- a high rate of work, which cannot be influenced by the worker
- unstable loads or loads handled with the body in an unstable posture.

The work environment if it has:

- insufficient room, in particular vertically, to carry out the activity; this may lead to awkward postures
- uneven floors, thus presenting tripping hazards, is unstable or is slippery in relation to the worker's footwear
- bad position of the load or work place design, causing reaching with the arms, bending or twisting the trunk and elevated arms yield high muscular force
- variations floor levels or in working surface, requiring the load to be manipulated on different levels
- unsuitable temperature, humidity or ventilation, making workers feel tired; sweat makes it hard to hold tools, meaning that more force must be used; cold can make hands numb, making it hard to grip
- insufficient lighting, increasing the risk of accidents, or force workers into awkward positions to see clearly what they are doing.

Individual characteristics, such as:

- lack of experience, training and familiarity with the job
- age: the risk of low back disorders increases with age and with the number of years at work
- physical dimensions and capacity such as height, weight and strength
- prior history of musculoskeletal disorders, in particular back disorders.

Moreover, manual handling of heavy loads can cause injuries if the load suddenly hits the worker or causes slipping or falling. Handling of smaller loads for a long time without rest can result in fatigue. For a tired person loads can become too heavy after hours of handling, resulting in faulty movements, and the risk of injuries and disorders will increase.

Hazards of using lifting equipment

The hazards: associated with the use of lifting equipment in construction are:

- Hazards related to the loads, e.g. crushing due to impact of moving objects or loads falling from vehicles because they are not slinged properly or the wrong type of slings were used
- Hazards from moving vehicles or collapsing structures, i.e. cranes falling over because of improper fixation or strong wind, unsafe loads, loads exceeding the safe weight limits, trapping/crushing risk in the use of MEWPs while working at height, falling from height , limbs or bodies caught in machinery
- falling from lifting platforms or being crushed when the platform moves
- musculoskeletal hazards related to force exertions, poor working postures and/or repetitive work
- hazards related to poor environment that may interfere with communication between workers or concentration needed for the task (noise) or cause sweaty, slippery objects (heat, poor ventilation)
- Contact with overhead electrical cables.

Possible causes of these hazards may be: poor mechanical design (breaks in use, not powerful enough, components fracture or malfunction), poor workplace design, malfunction of the (manual, mechanical, electronic) signalling system, not using the proper equipment for the purpose or misuse (not using as designed, e.g. the load was too heavy),

loads insecurely attached, poor maintenance (breaks or emits noxious gases) or untidy workplace, human error when operating machines or erecting scaffolding.

Ensuring safe and healthy lifting operations

General requirements

All employers have legal duties to fulfil to prevent harm to workers. The legislation is based on EU directive transposed into national legislation. The most important directives regarding lifting operations and lifting equipment in construction are:

- 89/391/EEC - the "OSH framework" directive, defines the measures to encourage improvements in the safety and health of workers at work^[8]
- 89/654/EEC – sets out the basic requirements for workplaces^[9]
- 2009/104/EC - on the use of work equipment, including provisions concerning the use of work equipment for lifting loads (annex II)^[10]
- 90/269/EEC – the manual handling directive, on the minimum health and safety requirements for the manual handling of loads^[11]
- 92/57/EEC - on the minimum health and safety requirements for temporary and mobile construction sites^[12]
- 2006/42/EC – the machinery directive, requirements for placing machinery on the market. Machinery includes also interchangeable equipment, safety components, lifting accessories, chains, ropes and webbing, removable mechanical transmission devices and partly completed machinery.^[3] Directive 2006/42/EC of 17 May 2006 on machinery. Available at: <https://osha.europa.eu/en/legislation/directives/directive-2006-42-ec-of-the-european-parliament-and-of-the-council>

Preventive measures follow the general principles of prevention in the Council Directive 89/391/EEC concerning health and safety at work. Employers, with project supervisors, must cooperate and protect workers' health and safety. At temporary and mobile construction sites the project supervisor nominates a site coordinator who is responsible for (the coordination of) health and safety.

Risk assessment of lifting operations

Employers are required to assess the health and safety risks that their employees face and to reduce these risks to an acceptable level. In short, an effective risk assessment should comprise the following steps:

- Identify hazards and those at risk

Think about the work that is done and identify what may cause or increase the risk of work related musculoskeletal disorders. Involve the employees in this process. With respect to lifting operations and lifting equipment the risk assessment should focus on the risk factors that have been described before. Think about everyone who may be hurt by each hazard. This means not just employees, but also contractors, self-employed persons, and members of the public. Specific attention should be paid to young and older workers. Consider the causes of the identified hazards.

- Evaluate and prioritize the risks

Evaluate the risk for each hazard, which means calculating the probability of harm to occur and how severe the health effect may be. Prioritize the risks based on the exposure, the probability and the severity of the effect.

- Decide on preventive action

If health risks do exist develop a plan of action for risk reduction. Check whether the hazard can be removed completely, whether the risk can be controlled, if protective measures can be taken to protect the whole workforce or if personal protective equipment is needed to protect workers if a risk that cannot be adequately controlled by collective preventive measures.

- Take action

Prioritize preventive and protective measures and specify short and long term actions. Specifying who does what and when, when a task is to be completed and the means allocated to implement the measures.

- Monitor the risks, and review preventive measures.

Evaluate, on a regular basis, to see if the risk has been reduced to an acceptable level and if new risks have emerged. Decide if further action should be taken.

Specific tools are available for risk assessment at construction sites, of manual handling ^{[13][14]}.

Preventing OSH hazards at the pre-build phase

Health and safety should be designed into constructions, before, during and after the building phase ^{[15][16]}. Architects should be made aware of the potential hazards of their design and improvements that can be made by avoiding the need for manual handling. Contractors, clients, and suppliers can encourage good practice standards to be fully implemented. The risks to construction workers can be avoided before work starts on site by:

- putting in place a purchasing policy for machinery and work equipment, for example, buying equipment that meets the essential health and safety requirements (CE-mark)
- setting health and safety requirements in tender specifications (meeting national legislation as a minimum)
- planning the work process to minimize the number of workers who could be harmed
- starting control activities before getting to site, e.g. by planning, training, site induction and maintenance activities
- ensuring all persons, including managers, are trained and able to carry out their work without risk to the safety or health of themselves or other workers. The drivers and operators of vehicles and earth-moving or materials-handling equipment should be trained and physically fit.

Risk reduction of manual lifting

The minimum health and safety requirements for the manual handling of loads are given by the European Union Directive 90/269/EEC^[11], which is transposed into law in all EU Member States. The directive requires employers to use the appropriate means to:

- Avoid the need for manual handling of loads by workers;
- Take the appropriate organizational measures to reduce the risk if manual handling cannot be avoided;
- Ensure that workers receive adequate information on the weight of a load, the center of gravity or the heaviest side when a package is unevenly loaded; and
- Ensure proper training and precise information on how to handle loads correctly.

In practice, the following prevention measures can be taken ^[7]:

- Risk elimination — consider whether manual lifting operations can be avoided, for example by using powered or mechanical handling equipment. The use of a crane on site enables it to be always available for use, such as taking delivery of materials.
- Risk reduction by technical measures: if manual lifting cannot be avoided, consider if lifting loads can be reduced, e.g. by using light materials or supplying materials in smaller bags? If that is not the case consider if lifting equipment can be used and which device would be preferable with respect to safety and health aspects and costs. Ensure that the lifting equipment is ergonomically well designed and well maintained.
- Risk reduction by workplace measures: improve workplace conditions to reduce the risk, e.g. by planning the storage of building material close to the place where it is being processed and by keeping the work site clean and without obstacles to reduce the risk of slip injuries during manual handling. Ensure that materials that need to be lifted manually are positioned in a way that limited bending or reaching is needed.
- Risk reduction by organisational measures such as reducing the physical task demands such as frequency and duration of manual lifting operations, e.g. by introducing job rotation and the introduction of breaks.
- Inform the workers to increase their awareness of risk factors present, how to recognize and avoid unsafe working conditions and the consequences of not avoiding them. Furthermore, workers must be trained in using the safe and healthy working methods.

Requirements when using lifting equipment.

The employer is responsible for ensuring that lifting operations within his scope of work are carried out safely and must identify one person to be in control of the lifting operation. The employer shall ensure that every lifting operation involving lifting equipment/accessories is properly planned by a competent person, appropriately supervised and carried out in a safe manner. To ensure this, he should:

- nominate a competent person who is suitably trained and experienced to ensure safe lifting operations
- provide adequate resources to enable lifting operations to be carried out safely
- ensure that all appointees i.e. supervisors, crane operators and operatives with duties under this procedure are properly trained, licensed, competent and aware of those duties
- confirm by regular monitoring that lifting procedures are being properly implemented.

At the corporate level, a safety culture should be promoted which involves a high stakeholder commitment to identify and control occupational risk factors and improve safety and surveillance measures. Hours of work must be controlled. Using lifting equipment safely requires concentration and long hours make this difficult.

Planning the lifting task

Before performing a lifting operation, the workers should plan and prepare for the task. They should make sure that they know where they are going, that the area is clear of obstacles and they have a good grip on the load. This includes training of the workers on how to handle loads correctly: their hands, the load and any handles should not be slippery. If they are lifting with someone else, they should both know what they are doing before they start. For a safe performance of a manual handling task they should put their feet around the load, with the body over it, i.e. as close as possible to the load. The lift should be performed using the leg muscles and with straight back. The load should be as close as possible to your body. Lift and carry the load is done with straight downward turned arms.

Requirements for lifting equipment

The employer shall ensure that lifting equipment provided for use at work is safe, i.e. that it is:

- sufficiently strong, stable and suitable for the proposed use. Similarly, the load and anything attached (e.g. timber pallets, lifting points) must be suitable
- positioned or installed to prevent the risk of injury, e.g. from the equipment or the load falling or striking people
- visibly marked with any appropriate information to be taken into account for its safe use, e.g. safe working loads. Accessories, e.g. slings, clamps etc., should be similarly marked
- where equipment is used for lifting people it is marked accordingly, and it should be safe for such a purpose, e.g. all necessary precautions have been taken to eliminate or reduce any risk.

Before using mobile lifting equipment the following safety precautions should be taken:

- The working environment: Routes should be leveled, marked and planned in such a way as to avoid potential hazards such as overhead power lines and steeply sloping ground. Where possible a one-way system should be used. Speed limits should be required and clearly displayed, they should be reduced for adverse site conditions and for areas near work in progress. The working environment should be kept clean and tidy, with floors and access routes clear of obstacles. Good lighting levels are needed to ensure that all potential hazards, e.g. obstructions and spills can be clearly seen. All stairs, ramps and other level changes should be clearly visible and slip resistant; safety signs should be used where appropriate.
- Check machines on fuel, oil, and water levels, water, fuel, and hydraulic lines for leaks, the condition of the tracks or tires, the condition of attachment cutting edges and teeth, visibility from the cab, windows, mirrors and lights, worn or slippery surfaces, etc.
- If vehicles drive backwards when the driver's rear view is obscured, the help of another worker is required. If no one is available, the driver must walk round to the rear of the vehicle themselves to see that all is clear and give a sound signal before starting to reverse.

Additionally, these vehicles should use an audible warning device such as a horn when driving in reverse.

- A crane operator should always move loads according to the established code of signals, and use a signaller. Hand signals are preferred and commonly used. A signaller may be required by law if the operator's view of the intended path of travel is obstructed. The assistance of a trained and authorised signaller should be available when the view of the driver or operator is restricted. The signaller must be in clear view of the operator, have a clear view of the load and equipment and keep other persons out of the machine's operating area.
- An unattended vehicle should have the engine switched off, and unless the vehicle is on a marked incline the gear should be left in neutral and the handbrake on; on sloping ground the wheels should also be chocked. Tipping bodies should be lowered when the machine is unattended, but if it is occasionally necessary to leave them in the raised position they should be blocked to prevent their fall.
- Drivers and their assistants should wear safety shoes during loading and unloading.

Requirements for lifting of personnel.

Lifting of construction personnel shall be avoided unless it is the least risk option ^[17]. Personnel transfer by lifting is not permitted in hours of darkness unless specifically approved by the site manager and supported by thorough risk assessment and assessment of alternatives.

The equipment used for lifting personnel for work and for personnel transfer shall be specifically designed, certified and clearly marked as suitable for personnel lifting and should not be used for any other purposes. Using lifting equipment which has not been specifically designed for lifting people should only occur in exceptional circumstances, e.g. for rescue purposes.

All personnel lifts shall be classed as non-routine lifts and be subject to stringent planning and controls, risk assessment and written authorization by the site manager. Before the lift, the person in charge of the lift shall sign to confirm all involved personnel have been trained and understand the lift plan and the risks involved. Pick up/set down areas shall be of an adequate size and free from hazards affecting access and egress from the carrier.

Environmental and other limits for personnel lifts shall be set out in the lift plan with clarity on where they differ from limits for other lifting. In case of any changes in job scope or conditions, the job shall be made safe and stopped, risks re-assessed and a pre-job meeting executed before the job is restarted. Examples of such changes include weather conditions, day or night operations or changes in personnel or equipment involved.

Equipment for lifting people shall be fitted with two distinct mechanisms for preventing the load from falling, one of which shall be self-acting/fail safe. Any free-fall possibility should be locked out.

Personnel lifts shall only be conducted where there is line of sight (full visibility) between the equipment operator and signaller, and between the signaller and the person being lifted.

A rescue plan shall be prepared for all personnel lifts as part of the lift plan. All equipment required to implement the rescue plan shall be readily available prior to and during the lift. Rescue plans shall be practiced at regular intervals. Note that rescue operations can introduce their own hazards; therefore the planning and execution of rescue exercises requires particular care and attention including additional risk assessments. A test lift without personnel shall be carried out where there is confined access, potential for snagging or other hazard.

Maintenance and inspection

Accidents may happen because lifting equipment is not inspected and maintained regularly. All equipment should be thoroughly examined prior to it being put into service and after there has been any major alteration that could affect its operation. Lifting equipment may need to be thoroughly examined at intervals laid down in an examination scheme drawn up by a competent person, taking into account the manufacturer's recommendations and national regulations. All examinations must be undertaken by a competent person who is sufficiently independent and impartial in order that an objective decision can be made.

What needs to be examined depends on the professional judgment of the competent person undertaking the examination. For most common lifting equipment and accessories, there are standard procedures and criteria. Methods include a visual examination and functional checks, measurements of wear, traditional non-destructive testing and load testing.

Where an examination scheme has been drawn up, this should identify and specify the parts to be thoroughly examined, the methods of examination and testing and the intervals for examination (and testing of the different parts, where appropriate).

Reports and defects

Records should be kept of all thorough examinations and inspections for all lifting equipment and lifting accessories. Any defects noticed should be immediately reported to the supervisor for correction. If any defect affects the safe operation of the machine, it should be rectified before the machine is used.

Effective action should be taken to manage risks by ensuring the lifting equipment is not used until the defect is remedied. Such defects must be confirmed in writing in the report, even if it is remedied immediately (e.g. by destruction of a sling). The person making the report must also notify the relevant enforcing authority with a copy of the report. Enforcing authorities may follow up such reports to check that risks are being adequately managed.

