MANUAL PREVENTION OF OCCUPATIONAL RISKS OF OVERHEAD BRIDGE AND GANTRY CRANE

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MODULE I
PREVENTION AND LEGISLATIVE FRAMEWORK BASIC RIGHTS AND DUTIES

UNIT
1.1.- LAW ON PREVENTION OF OCCUPATIONAL RISKS

The legislation in force on the prevention of occupational risks is numerous and extensive due to the powers of the different administrations in this area, which has meant an important change in society's mentality since it no longer seeks only to reduce the number of occupational accidents, but the great objective of companies and workers is to promote a culture of prevention of occupational risks in order to improve the quality and productivity of companies while improving the health and safety of workers and, ultimately, their well-being.

Starting from the fact that current legislation obliges public authorities to ensure health and safety in the workplace, the development of policies to protect both the health and safety of workers by preventing risks arising from their jobs is the main need in this respect. To this end, Law 31/1995 of 8 November on the Prevention of Occupational Risks provides the general framework for the development of the various preventive actions to be carried out, always in harmony with European Union regulations.

The Occupational Risk Prevention Law establishes the necessary guarantees and responsibilities to ensure that the level of protection of the safety and health of workers is adequate and sets the legal framework from which the regulatory standards will specify the more technical aspects.

The following is a literal list of the articles of the Occupational Risk Prevention Law related to the rights and duties of workers as well as the obligations of employers.

UNIT
1.2.- BASIC WORKERS' RIGHTS

Article 14.1

"Workers have the right to effective protection in the field of occupational safety and health, from which derives a corresponding duty on the part of the employer to protect workers against occupational hazards".

Article 17

"To have at their disposal the work equipment and personal protection means appropriate to the performance of their duties"

Article 18

"To be informed of the risks to safety and health at work, of the protection and prevention measures applicable to such risks, and of the measures taken in the event of an emergency".

Article 18

"To be consulted and involved in all matters affecting occupational safety and health"

Article 19

"To have sufficient and appropriate theoretical and practical training in preventive matters, focused on the workplace"

Article 20

"To have the emergency measures in accordance with the size and activity of the company"

Article 21

"In case of serious and imminent risk, the activity shall be stopped and, if necessary, the workplace shall be immediately abandoned"

Article 22

"To have the measures of surveillance and control of health according to the risks"

Article 25

"To ensure the protection of workers who, because of their own personal characteristics or known biological condition, including those who are recognised as having a physical, mental or sensory disability, are particularly sensitive to the risks arising from their work".

UNIT

1.3.- DUTIES OF THE WORKERS

Article 29

This article deals with the duties of workers with regard to risk prevention.

Article 29.1

"It is the responsibility of each worker to ensure, in accordance with his possibilities and by complying with the preventive measures adopted in each case, his own safety and health at work and that of other persons who may be affected by his professional activity, because of their acts and omissions at work, in accordance with their training and the instructions of the employer.

In particular, workers shall, in accordance with their training and the employer's instructions:

1. Make appropriate use, in accordance with their nature and the foreseeable risks, of the machinery, apparatus, tools, dangerous substances, transport equipment and, in general, any other means by which they carry out their activity.

2. Use correctly the protective means and equipment provided by the employer, in accordance with the instructions received from the employer.

3. Not to put out of operation and to use correctly the existing safety devices or those that are installed in the means related to their activity or in the workplaces where it takes place.

4. Immediately inform their direct superior and the workers designated to carry out protection and prevention activities or, where appropriate, the prevention service, of any situation which, in their opinion, involves a risk to the safety and health of workers on reasonable grounds.

5. Contribute to the fulfilment of the obligations laid down by the competent authority in order to protect the safety and health of workers at work.

6. Cooperate with the employer so that the employer can ensure that working conditions are safe and do not pose a risk to the safety and health of workers".

UNIT

1.4.- EMPLOYER'S OBLIGATIONS

This implies a business commitment to safeguard the health and safety of the workers at its service. The Law establishes specific **obligations** for all employers, which can be of **two kinds**:

- **Organisational:** the obligations that refer to how the employer must organise preventive activities.

- **Operativas:** the concrete actions of a technical nature: risk assessment, training and informing workers, etc.

The main **preventive activities** to be developed in the companies are the following:

➢ To draw up the Prevention Plan.
➢ Organization and establishment of the preventive structure.
➢ Ensure the consultation and participation of workers.
➢ To carry out the evaluation of risk factors and the planning of preventive activity.
➢ To design, apply and coordinate the plans and programmes of preventive action.
➢ Train and inform workers.
➢ Investigate and analyse accidents at work.
➢ Provide first aid, assistance and support in the preparation of emergency measures.
➢ To carry out health surveillance of workers in relation to risks arising from work.
➢To apply specific regulations, in addition, to carry out the coordination of business activities, the control of work equipment and personal protection equipment, etc.

Prepare and keep at the disposal of the labour authority the following documentation:

- ✤ Risk assessment.
- ✤ Prevention Plan.
- ✤ Protection and prevention measures and protection materials.
- ✤ Results of the periodic controls.
- ✤ Controls of the state of health of the workers and conclusions obtained from them.
- ✤ List of occupational accidents and professional illnesses that have caused incapacity for work of more than one day.

Article 15

"The employer shall implement the measures which constitute the general duty of prevention, in accordance with the following general principles:

- ➢ Avoiding risks.
- ➢ Assess the risks that cannot be avoided.
- ➢ Combat risks at source.
- ➢ Adapt the work to the person.
- ➢ Take account of technical developments.
- ➢ Replace the dangerous with the less dangerous or no risk.
- ➢ Plan prevention.
- ➢ Adopt measures that put collective protection before individual protection.
- ➢ Give appropriate instructions to workers.

UNIT
1.5.- OTHER PROVISIONS

Finally, we will also cite literally, texts of Royal Decree 1215/1997 of 18 July 1997 directly related to work equipment for lifting loads, since they contain the minimum health and safety provisions for the use of this work equipment used by workers (overhead cranes, handling equipment, etc.).

ANNEX I

2. Minimum requirements for work equipment for lifting loads:

(**a**) Work equipment for lifting loads must be firmly installed in the case of fixed equipment, or have the necessary components or conditions in other cases, to ensure its strength and stability during use, taking account in particular of the loads to be lifted and the stresses induced at the points of suspension or attachment to structures.

(**b**) Machinery for lifting loads must have a clearly visible indication of its nominal load and, where appropriate, a load plate indicating the nominal load for each configuration of the machinery.
Lifting accessories must be marked in such a way that the essential characteristics for safe use can be identified.
If work equipment is not intended for lifting workers and there is a possibility of confusion, appropriate signs must be visibly affixed.

(**c**) Permanently installed work equipment must be installed in such a way as to reduce the risk of the load falling, being released or being unintentionally diverted in a dangerous manner or otherwise striking workers.

(**d**) Machinery for the lifting or moving of workers must have the appropriate characteristics

1° prevent, by means of appropriate devices, the risk of falling from the carrier, where such risks exist

2° avoid the risk of the user falling from the carrier, where such risks exist

3° Avoid the risks of crushing, entrapment or impact of the user, in particular those due to incidental contact with objects.

4° Guarantee the safety of workers who, in the event of an accident, are blocked in the cabin and allow their release.

If for reasons inherent to the place and the unevenness, the risks foreseen in the previous paragraph 1° cannot be avoided by means of any safety device, a cable with a reinforced safety coefficient must be installed, the good condition of which will be checked every day of work.

ANNEX II

3. Conditions of use of work equipment for lifting loads.

1. General:

(**a**) Demountable or mobile work equipment used for lifting loads must be used in such a way as to ensure the stability of the equipment during use under foreseeable conditions, taking account of the nature of the ground.

(**b**) The lifting of workers is permitted only by means of work equipment and accessories provided for the purpose.

However, where, exceptionally, work equipment not intended for that purpose is to be used, appropriate measures must be taken to ensure the safety of workers and to provide adequate supervision.

While workers are on work equipment designed for lifting loads, the control position must be occupied at all times. Workers being lifted must have a safe means of communication and provision must be made for their evacuation in the event of danger.

(**c**) Unless necessary for the proper execution of the work, measures must be taken to avoid the presence of workers under suspended loads.

The passage of loads over unprotected workplaces normally occupied by workers shall not be permitted. If this is not possible, because it cannot be guaranteed that the work will be carried out correctly in any other way, appropriate procedures must be defined and implemented.

(**d**) Lifting accessories must be selected on the basis of the loads to be handled, the pressure points, the coupling device and the atmospheric conditions, and taking account of the method and configuration of the lashing. Lifting accessory assemblies must be clearly marked so that the user is aware of their characteristics if they are not removed after use.

(**e**) Lifting accessories must be stored in such a way as to prevent damage or deterioration.

2. Work equipment for lifting non-guided loads.

(**a**) If two or more items of work equipment for lifting non-guided loads are installed or assembled on a site in such a way that their fields of action overlap, appropriate measures must be taken to prevent collisions between the loads or the items of equipment themselves.

(**b**) When using mobile work equipment for lifting non-guided loads, measures must be taken to prevent the equipment from rolling, tipping and, where appropriate, moving or slipping. Checks must be made to ensure that these measures are carried out correctly.

(**c**) If the operator of work equipment for lifting non-guided loads cannot observe the full path of the load either directly or by means of auxiliary devices providing useful information, a signalman must be designated in communication with the operator to guide him and organisational measures must be taken to prevent collisions of the load which could endanger workers.

(**d**) Work must be organised in such a way that, while a worker is hanging or unhanging a load by hand, he can carry out these operations safely, in particular by ensuring that he retains direct or indirect control of them.

(**e**) All lifting operations must be properly planned, properly monitored and carried out with a view to protecting the safety of workers.

In particular, when two or more pieces of work equipment for lifting non-guided loads have to be lifted simultaneously, a procedure must be drawn up and implemented to ensure that operators are properly coordinated.

(**f**) If work equipment for lifting non-guided loads cannot maintain the loads in the event of a partial or total failure of the energy supply, appropriate measures must be taken to avoid exposing workers to the corresponding risks.

Suspended loads must not be left unattended unless access to the danger zone is impossible and the load has been safely suspended and is maintained in complete safety.

(**g**) The use of work equipment for lifting non-guided loads in the open must be stopped when the weather conditions deteriorate to the point of jeopardising operational safety and thus putting workers at risk. Adequate protection measures, in particular to prevent work equipment from tipping over, must be taken to avoid risks to workers.

UNIT
1.6.- REFERENCE STANDARDS

➢Texto Refundido de la Ley del Estatuto de los Trabajadores, aprobado por Real Decreto legislativo1/1995 de 24 de marzo.

➢Law on the Prevention of Occupational Risks (Law 31/1995 of 8 November 1995, approving the Law on the Prevention of Occupational Risks.

➢Royal Decree 39/1997 of 17 January 1997, approving the Regulations on Prevention Services.

➢Community Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work.

➢Royal Decree 485/1997 of 14 April 1997 on minimum provisions for health and safety signs in the workplace.

➢Royal Decree 486/1997, of April 14, establishing minimum health and safety provisions in the workplace.

➢Royal Decree 487/1997, of 14 April, on minimum health and safety requirements for the manual handling of loads that pose risks, particularly to workers' backs.

➢Real Decreto 488/1997, de 14 de Abril, (B.O.E. 23/IV/97) sobre disposiciones mínimas de Seguridad y Salud relativas al trabajo con Equipos que incluyen Pantallas de Visualización.

➢Royal Decree 664/1997, of 12 May, (B.O.E. 24/V/97) on the protection of workers against risks related to exposure to biological agents at work.

➢Royal Decree 665/1997, of 12 May, (B.O.E. 24/V/97) on the protection of workers against risks related to exposure to carcinogens at work.

➢Royal Decree 1215/1997 of 18 July 1997, establishing the minimum health and safety requirements for the use of work equipment by workers.

➢ Royal Decree 773/1997 of May 30, 1997 on minimum health and safety provisions for the use by workers of personal protection equipment.

MODULE II

THE CRANE BRIDGE

To understand what bridge cranes are, how they work, etc., we must ask ourselves:

What is meant by load?
Load is any material object that can be lifted by lifting equipment.


What is meant by work equipment or machinery for lifting and transporting loads?

We must understand that they are work equipment with sufficient capacity to carry out lifting, transport and storage operations of loads including the necessary elements for:

➢ Anchoring
➢ Fixing
➢ Work Team Support


What do we mean by lifting accessories?

They are components, without being integral parts of the work equipment or lifting machine, that make it possible to grip or tie up the load for handling.

UNIT
2.1.- GENERAL DEFINITION OF A BRIDGE CRANE

The bridge cranes, they're machines.

Due to the different types of movements that the work team has, they are used to lift, transport and deposit loads (materials, parts, metal coils, ...) both for indoor work (industrial warehouses, production halls, workshops, etc.) and outdoor work (naval ports, outdoor storage, …).

In both cases, the lifting, transport and storage of loads can take place during the production or storage process.

UNIT
2.2.- MAIN COMPONENTS

➢ Structure or chassis

➢ Track and caster wheels.

➢ Bridge longitudinal travel gear.

➢ Transverse movement of the carriage.

➢ Hook lift.

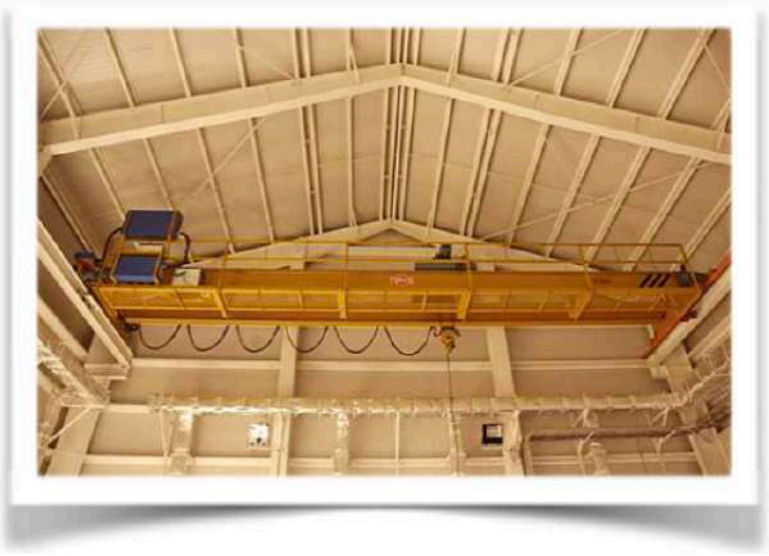
➢ Control devices.

Mainly, it is a **metallic structure formed by a raised beam or by several metallic beams forming a "U"** being this **structure** necessarily **rigid and non-deformable.**

This metal structure is **moved** by a system of **wheels mounted on side rails**, which can be **moved by one or more electric motors.**

Supported by the metal structure and with the capacity to move along it, **there is a self-propelled trolley with a hoist to lift the loads.**

The rails used for the movement (translation movement) of the bridge along the roadway are approximately at the same height as the self-propelled trolley, this being the maximum working height of the machine.



UNIT
2.3.- HANDLING OF THE BRIDGE CRANE

The crane **can be operated either from the cabin or from the ground**. In this case, **the bridge crane can be controlled with a pendant or a remote control pendant.**

If the crane is controlled from the cabin, this cabin will be added to the metal structure (bridge), although it is becoming increasingly common in this type of machine for it to be controlled by means of a wired or wireless remote control.

The operator's cabin on the bridge crane itself offers a better view of the loads to be handled and is mainly suitable for handling bulky loads.

Cable or wireless remote controls are generally used to work with less bulky loads. Working with this type of device requires the operator to accompany the load at all times.

UNIT
2.4.- CONTROL VERIFICATION WITH BUTTON PANEL

Before starting the machine it will be necessary to check:

➢ that there are no obstacles in the running area

➢ That the team responds to the controls

➢ Test all movements without load and at low speed

➢ Brake operation

➢ Lifting Limiter (Limit Switch)

At the end of the day it will be necessary to check:

➢ that the buttonhole is located in the place provided

➢ That no suspended loads are abandoned

➢ That the hook is in the upper third of his career.

UNIT
2.5.- SAFETY ELEMENTS IN WORKS WITH BRIDGE CRANE

Control pendant with emergency stop device. The emergency stop is clearly identified and cannot be unintentionally reset.

Limit switches for both lifting movements (upper and lower), t**rolley travel movements** (maximum and minimum) and **bridge travel movements** (start and end of travel rails) Its purpose is to slow down or suppress a certain movement when there may be a collision between two parts of the crane, or between the crane and the load.

Shock absorbers, prevent the derailment of the bridge crane.

Overload limiters acting on the lifting mechanism. They can be **manual** (tensiometric) or **electronic**, the latter offering high precision and safety. Their purpose is to prevent any movement when there is an overload on the load to be transported.

Brakes. They will act on mechanized surfaces being able to dissipate the heat produced during their operation. We identify brakes for the different mechanisms of movement of the bridge crane being these:

➢**Lifting mechanisms:** Each mechanism must be equipped with two brakes capable of holding, each one of them, one and a half times the admissible load.

➢**Mecanismo travel mechanisms:** Each mechanism must be equipped with an electro-hydraulic brake to reduce speed and movement.

➢**Mecanismo steering:** Each trolley must be equipped with means to slow down, stop and hold in the position required by the maneuver.

Safety latches on load lifting hooks

Main switch, cuts off the power supply. Only to be used in case of severe anomalies and/or emergencies.

Grounding. All the electrical elements of the work equipment must have an efficient earthing system.

Collective protections in overhead passages such as guardrails.

Individual protections, safety harness, safety helmet, protective gloves, etc.

Nominal lifting load visible on the bridge crane itself.

UNIT
2.6.- LIFTING ACCESSORIES, SLINGS, RIGGING AND SEESAWS

Lifting accessories, slings, can be made up mainly of ropes, cables or chains, but can also be flat slings made of synthetic fibre fabric.

THE ROPES

These are **textile elements whose diameter must not be less than 8 mm**. For lifting loads, they must be made of natural textile fibres such as hemp, sisal, etc. or synthetic fibres such as polyamide, polyester, polypropylene or polyethylene.

The breaking load of a rope depends on its diameter, on the quality and nature of the fibres used for its manufacture, and on the state of conservation (or deterioration) in which it is found. A rope deteriorates faster the smaller its diameter.

THE CABLES

They are metallic elements formed by several cords arranged helically in one or several superimposed layers, around a core that can be textile, metallic or mixed.

The strands are made up of one or more steel wires also arranged helically in one or more layers.

The breaking load of a rope depends on the number of wires in it, the cross-section of the wires and the quality of the steel.

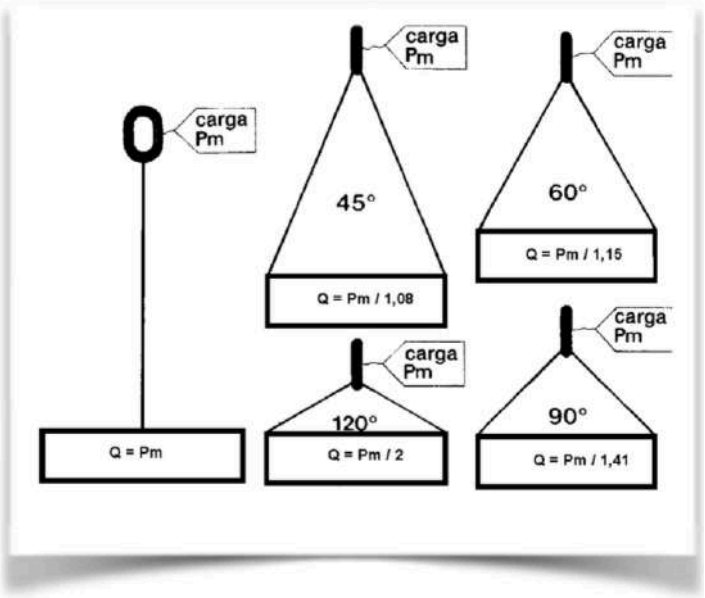
Normally the cables are supplied lubricated, and to guarantee their maintenance it is sufficient to use the type of grease recommended by the manufacturer.

In the case of a broken cord, abnormal and localised reduction in the diameter of the cable, the existence of knots, etc, the cable will be rejected.

THE CHAINS

They are **metal elements** that are characterized by the ability to form very small angles between the links, although unlike the two previous lifting accessories, the chains are heavier and less resistant to cold.

The working load capacity of a sling, of whatever type, will depend on the angle formed by the branches supporting the load. Thus, for a two-branch sling, the load capacity decreases as the angle formed by its branches increases.



When using slings, the following aspects must be taken into account:

➢ Knots decrease the strength of the sling by 30-50%.

➢ Welding of terminals, rings or eyelets reduces the resistance by 15 - 20 %.

➢ Joints using cable ties reduce the strength by 20 %.

➢ Avoid, if possible, an angle between sling strands of more than 90°.

➢ Strings of different slings must not be mounted on top of each other on the hook and must never be supported on sharp edges.

➢ Before lifting the load, it should be raised slightly above ground level (to a height of less than 10 cm), and the slings should be tensioned manually to check that the load is properly secured and balanced.

➢During the lifting operation, the slings must not be touched and workers must be kept away from the load.

THE BALANCES

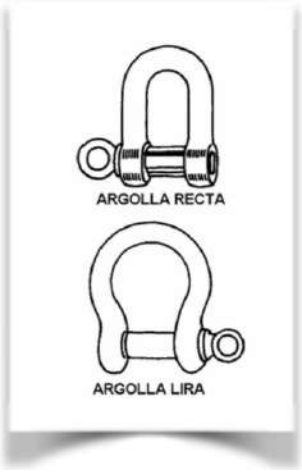
They are **steel profiles with eyelets or hooks** on which several slings are placed.

Their use reduces the length of the slings and thus the need for height of the lifting equipment.

UNIT
2.7.- CONNECTING ELEMENTS

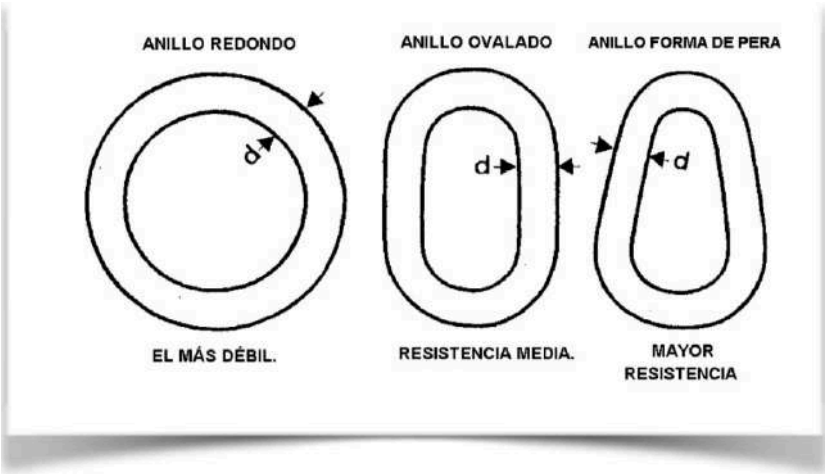
THE ARGULLS

They are made of forged steel and have a bracket and a tight shaft, which is normally threaded at one end of the bracket, preventing it from being opened.



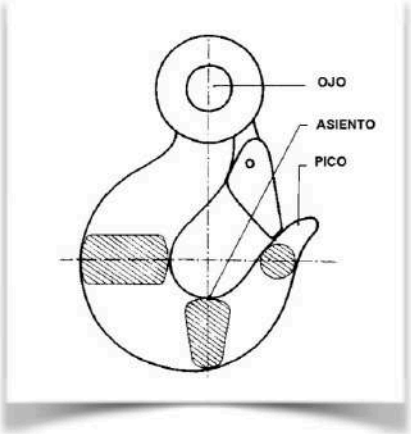
THE RINGS

They have various shapes, although their straight section is usually circular.



UNIT
2.8.- THE HOOKS

These are metal elements, normally made of steel or cast iron, **which facilitate the rapid hooking of loads**, but are exposed to the risk of unhooking. For this reason, only hooks equipped with a safety device against accidental unhooking should be used.



REMEMBER, **a hook should not be deformed in an attempt to increase its load capacity. A bent hook must be destroyed.**

During the hooking of the load:

➢ Stresses should be supported by the hook seat and not by the peak.

➢ The safety device must be checked for proper operation.

➢ Swaying of the load must be avoided.

UNIT
2.9.- BRIDGE CRANE MAINTENANCE

Maintenance, testing and inspection of these machines must be carried out **by qualified and sufficiently trained personnel.**

A log book must be kept for each bridge crane, in which dates, checks and faults are recorded.

UNIT
2.10.- SAFETY IN THE MAINTENANCE OF CRANE BRIDGES

The installation of a bridge crane shall be carried out in an area where it does not hinder the movement or work of other bridge cranes that may operate on the same runways. To this end, the bridge crane and the working area must be isolated by means of signs and stops on the crane runways.

The main safety measure is to switch off the bridge crane completely by means of the main switch. If this is not possible, the controls of the crane bridge will be blocked, preventing anyone from acting on them or the work equipment from being accidentally switched on.

UNIT
2.11.- PARTICIPATION OF THE CRANE OPERATOR IN THE MAINTENANCE OF THE BRIDGE CRANE

➢ Revisio visual of elements that are subjected to stress. Review to be carried out daily.

➢ Brake check. Checking to be carried out daily.

➢ Checking for possible deviations in machine operation. Checking at

to perform daily.

➢ Checking of the correct functioning of the safety latch on the hook. Checking to be carried out weekly.

UNIT
2.12.- MAINTENANCE PLAN FOR BRIDGE CRANES

Companies should establish preventive maintenance programs based on the manufacturer's recommendations or the experience of qualified persons.

Preventive maintenance of bridge cranes should include the identification of parts subject to wear or critical parts.

The main **spare parts** for bridge cranes are listed below:

1. Brake discs, coils and/or brake mechanisms.
2. Safety limits.
3. Contactors, contact kits.
4. Jumper and carriage wheels.
5. Lifting cable.
6. Translation and hoisting motors.
7. Hook

IMPORTANT!!

Deteriorated parts must be replaced by qualified personnel and it is advisable to use original spare parts to ensure their interchangeability and the correct functioning of the parts.

UNIT

2.13.- INSPECTION OF THE BRIDGE CRANES

The frequency of inspections to be carried out on bridge cranes will depend on the type of service to which they are subject, mainly because there are no specific regulations governing this type of work equipment.

Cranes used permanently or continuously will require more attention than those used sporadically.

It is recommended to carry out periodic inspections/revisions (daily and/or monthly) that include

1. Visual inspection of the cables to detect possible breaks or damage to the cables.
2. Visual inspection of the hook to detect possible deformation, breakage or excessive wear.
3. Checking of lifting limits (upper and lower) and travel limits.
4. Check for abnormal noise or vibration.

IMPORTANT! These last four points should be carried out before the operator uses the bridge crane, in each corresponding shift or working day, as they are considered to be of safety.

They should be inspected annually (before normal or regular operation) by qualified personnel:

1. The state of the connections, tightening of nuts, bolts, etc.
2. The breakage, wear, deformation or formation of rust on rails, wheels, etc.
3. The breakage, wear or mechanical deformation of shafts, bearings, chains, etc.
4. Wear and tear of brakes.
5. Condition of the winding drum, pulleys, etc.
6. The correct functioning of the motors.
7. The state of the hook and its accessories.
8. The electrical installation of the machine (wear on contactors, relays, etc.)

MODULE III
INHERENT HAZARDS TO THE CRANE BRIDGE AND PREVENTIVE MEASURES

In this training manual, it is intended that in addition to having **the necessary knowledge of the structure and basic operation of a bridge crane**, **the main risks of the bridge crane operator's workplace are also covered.**

Specific and non-specific professional risks will be dealt with, and the tasks or areas where this type of risk is most likely to occur will be explained, as well as the actions or preventive measures to be taken to avoid these risks leading to accidents at work.

Before dealing with the risks to which the bridge crane operators are exposed, as well as the personnel who may be within the radius of action of the work equipment, we should ask ourselves

What are the risks and why do they exist?

The law of prevention of labour risks defines them as:

"the possibility that a worker, in the course of his normal working day, suffers a certain damage"

We must first understand that if the damage to the worker can occur, it will be directly related to the sources of risk associated with the risk that produces the damage.

To better understand this, the sources of risk are the activities, installations, machines, etc. that may exist in a company. And if these sources of risk that exist in the company are controlled, they do not have to mean that the worker will be affected. In the workplace, depending on what we do, how we do it, where we are located, etc., we will have more or less risk or will have these risks under control.

UNIT
3.1.- RISKS INHERENT TO THE BRIDGE CRANE

A very important specific risk to be taken into account within the risks associated with the bridge crane is **the collapse of heavy objects**. This risk includes other similar risks also associated with the bridge crane such as the collapse of loads, the collapse of machine elements, the collapse of the machine itself or its supporting structures, etc.

Another specific risk, which is no less important, is that of **impact by moving objects**; it should also be borne in mind that such impact may be caused by the loads themselves, by parts of the machinery or its accessories or even directly by the load-lifting machinery itself.

Any of the risks mentioned above will affect all personnel operating within the radius of action of the work equipment.

Non-specific risks may also affect the operators of the overhead crane; these risks may include entrapment, falls from height, electrical contacts, inhalation of toxic products (the cabin of the overhead crane in some cases moves over the production areas), etc.

Covering both specific and non-specific risks in a general way, these are more commonly present in the following cases:

➢ Risks due to **habitual use**.

These are risks derived from falling loads. Mainly risks derived from the transfer of loads (breakage of slings, defective cables, etc.) and risks derived from the lack of and/or non-compliance with regulations.

➢ Risks resulting from **improper use**.

These risks include not respecting the permissible load limits, working with higher than the maximum required performance, improper use of safety devices (limit switches, main switch, emergency stop), transport of unauthorised persons or loads, or using the bridge crane as a means of dragging. This last risk resulting from improper use of the crane as a towing device is strictly forbidden due to the serious consequences it can have; it is also strictly forbidden to pull a load at an angle in order to tow it, the loads always being lifted and lowered vertically.

➢ Risks in **maintenance operations**.

Risks with very serious or even fatal consequences. Among them we can mention the most
important:

- Untimely starts.
- Mechanical risks of entrapment.
- Electrical risks: direct and/or indirect electrical contacts. Improper connections to the electrical network.
- Falling from height.

The following module will develop the preventive measures to be taken into account for the control of risks derived from maintenance operations.

UNIT
3.2.- PREVENTIVE MEASURES FOR THE HANDLING OF BRIDGE CRANES

Among the preventive measures in lifting operations with these equipments we can mention the following:

➢ Do not exceed the maximum load of the bridge crane.

➢ Regulatory and/or periodic maintenance.

➢ Keep the places of passage free of obstacles.

➢ Use of planned accesses.

➢ Do not climb on the load to move.

➢ When working on a crane, the controls must be locked to prevent untimely movement and it is essential to use a safety harness.

➢ Do not transport loads on people.

➢ Do not go underneath raised loads.

➢ Do not leave loads suspended.

➢Prevent the hook from resting on the ground.

The usual PPE´s for lifting loads should include the use of a safety helmet, safety shoes, protective gloves and safety goggles.

UNIT

3.3.- PREVENTIVE MEASURES FOR THE HANDLING OF AUXILIARY ELEMENTS

The auxiliary elements are lifting accessories, located between the work equipment and the load (slings, cables, chains, hooks) and among the preventive measures to be taken into account for the handling of these auxiliary elements we can mention the following:

➢ **For polyester slings:**

Safety coefficient: 1/7.
Periodic checks on the state of conservation of the sling
Reject slings with tears, cuts, etc.

➢ **For ropes:**

The diameter of the ropes to be used must be greater than 8 mm. The working load: maximum 1/10 of the breaking load. Periodic checks to detect defects in the ropes.

➢ **For ropes:**

Working load: maximum 1/6 of the breaking load.
Periodic checks of the ropes.
Avoid bending, knots, crushing, etc.
Grease periodically with suitable grease. Follow the manufacturer's instructions.
At least three clamps should be used for the formation of eyelets, with the fixed part towards the short end and the screws of the clamps on the longer branch.

➢ **For networks:**

The working load: maximum 1/5 of the breaking load
Periodic checks of the chains' state of conservation. Reject links that are cracked, deformed, corroded, worn, etc. Working load: maximum 1/6 of the breaking load.

➢ **For hooks:**

The safety factor on the hooks shall be at least 4 for the nominal load
maximum and 5 when hazardous material has to be transported.
The hooks must be fitted with a safety latch. Hooks with cracks, corrosion, deformations, etc. must be rejected.

All the auxiliary elements for lifting loads described above must be stored correctly, must not be left lying around in places where they can be damaged and must be checked before use to ensure that they are in good condition. They must also be marked with the working load and the CE mark.

The actual working load shall be calculated by multiplying the weight of the load by the coefficient indicated, depending on the angle formed by the branches.

UNIT

3.4.- ADVICE ON THE USE OF TEXTILE SLINGS

➢Never overload the slings

➢Pay attention to loading mode and angle of inclination.

➢Take account of the centre of gravity of the load to prevent it from destabilising.

➢Never hook a strap or sling on the end or tip of the cutting hooks.

➢Protect the strap or sling from edges.

➢Never tie knots.

➢Use straps or slings at temperatures between - 40o and 10

UNIT
3.5.- USE BY THE OPERATOR

In load handling work, the key figure in safety, while using the work equipment necessary for handling such loads, **is undoubtedly the operator of the work equipment, who must also meet minimum physical and/or psychological conditions to be able to perform their work.**

Among these minimum conditions are the following:

➢ Quick decision-making in the event of unforeseen circumstances.

➢ Good muscular coordination.

➢ Good reflexes.

➢ Aptitude for balance.

➢ Absence of vertigo

➢ Visual acuity, relief perception and colour.

➢ Age (over 18 years old)

The operator of the bridge crane must be trained to reach the qualification that allows him to handle the bridge crane safely. This training is theoretical and practical and must be reinforced every four or five years (retraining).

The following are **some general basic safety rules for the bridge crane operator**:

➢ **Always lift loads vertically.**

➢ **If the load, after being lifted, is found to be incorrectly positioned, it will**

you have to go down slowly and put it back.

➢ **If the load is dangerous, other workers will be warned in good time to take extreme precautions.**

➢ **The machine's control unit must not be abandoned while a load is suspended from the hook.**

➢ **The load must be observed at all times during handling.**

➢**Debe avoid handling high loads on persons who are**

found in the work area.

➢ **You must not transport people on the hook, slings or loads.**

➢ **When working without a load, the hook will remain in the raised position to free people and objects.**

➢ **Do not operate the overhead crane unless you are in perfect physical condition.**

Finally, **specific safety rules are indicated for the crane operator depending on the tasks to be performed at any given time:**

START OF MANOEUVRES

Before using the bridge crane, the crane operator will carry out the following checks:

➢ Make sure no one is on the bridge or on the tracks.
➢ Make sure that all controls are in zero position.
➢ Turn on the main switch (in the cab).
➢ Test all bridge crane movements without load (no load) and at low speed.
➢ Check that the brakes are functioning correctly.
➢ Check that the overspeed governor works properly in a clear, free area.
elevator ride.
➢Check correct operation of horn, siren or warning sound system.

LIFTING OF LOADS

➢ Before lifting the load, tighten the slings and lift them slightly to check their balance.
➢ If the load is not correctly attached or is not balanced properly, it must be placed on the floor and secured again.
➢ If the load offers abnormal resistance do not insist, it may not be free.
➢ Carry out lifting tasks in areas that are as clear as possible.
➢ No worker should remain on top of a suspended load.
➢ Do not exert oblique traction on the load.
➢ Avoid colliding with stops.
➢ NEVER leave suspended loads on personnel.

LOAD SHEDDING

Once the load has been moved to its destination, the crane operator must deposit it:

➢ Perform the operation when the load does not have any oscillation.
➢ The lowering speed of the load must not exceed the lifting speed.
➢ Do not try to place the load further away by printing balancing movements.
➢ When placing the load on the ground, take care not to trap the slings.
➢ Once the load has been deposited, loosen the slings a little and check that the load is keeps it stable.

END OF OPERATIONS

Once his task is completed, the crane operator must

➢ Place the hook at the top of his career (upper third).
➢ Drive the bridge to its stop position next to its access.
➢ Lock the crane bridge in its stopping position using the braking device.
➢ Before leaving the cabin, ensure that all controls are in the zero or stop position.
➢ Set the main switches to the "open" or zero position.
➢Avisar to the crane operator who relieves you or to the person in charge of any malfunctions detected.

MODULE IV
COLLECTIVE
AND INDIVIDUAL PROTECTIONS

4.1.- COLLECTIVE PROTECTIONS

We understand by collective protections, those that protect the collective of workers against risks that could not be reduced or avoided.
In our case they must be machine protections that meet the essential safety requirements such as bridge railings, protective stops, limit switches, etc.

4.2.- PERSONAL PROTECTIVE EQUIPMENT

Individual protection is considered to be the last measure between the risk and the worker, as well as the last technique to protect workers from occupational risks. We must be clear that PPE´s does not eliminate the risks to which workers may be exposed or prevent accidents, but it minimizes the consequences that these may cause.

Before using Personal Protective Equipment, risks must be assessed and appropriate and necessary preventive measures must be adopted, using, if possible, collective protections that avoid or eliminate the risk.

When this is not possible to avoid or eliminate the risk, it is when we will resort, as a last resort, to individual protection which, in many cases, can be complementary to collective protection.

4.2.1.- Definition of personal protective equipment (PPE)

Article 2 of Royal Decree 773/1997 of 30 May 1997 on minimum health and safety requirements for the use by workers of personal protective equipment states

"Any equipment intended to be worn or held by the worker to protect him/her from one or more risks that may threaten his/her safety or health at work, as well as any supplement or accessory intended for that purpose".

The following equipment is excluded from this definition

➢ Ordinary working clothes and uniforms not specifically designed to protect the health or physical integrity of the worker.
➢ Equipment of the rescue and relief services.
➢ Personal protective equipment for the military, police and other persons from the law enforcement services.
➢ Personal protective equipment for road transport
➢ Sports equipment.
➢ Self-defence or deterrence equipment
➢ Portable equipment for the detection and signalling of risks and nuisance factors.

4.2.2.- Criteria for the use of PPE´s

The PPE´s are devices that workers must use when there are risks that have not been avoided or totally eliminated by technical means (collective protections) or by procedures of the work organization.

We will always have to take into account two very important aspects about the PPE´s, these are the last physical protection that workers have against risks since the signalling, also very important in terms of safety, only informs, warns of dangers or even forces, for example, the use of PPE´s, but does not protect from these risks. The second aspect is that PPE´s, in most cases does not totally eliminate the damage that the worker may suffer in an accident, but it does minimize the consequences that such damage may produce. For example, the safety harness prevents even fatal accidents, but this does not mean that the worker is not harmed during the fall from height.

The following diagram indicates when PPE should be used.

Based on the Risk Assessment of the workplaces, some PPE will be used´s or others depending on:

➢ Risk or risks against which protection should be offered.

➢ Parts of the body to be protected.

➢ Type of PPE to be used by the worker while exposed to the risk.

In addition, as specified in the Law on Prevention of Occupational Risks, the employer must provide free PPE´s for the performance of work in the positions that require it, always ensuring the use of this protective equipment by workers.

4.2.3.- Conditions that must be met by the PPE´s

PPIs´s should be an effective protection for workers against the risks to which they are exposed. Therefore, they must not produce unnecessary discomfort by their use and they will have to be adapted to the user with the necessary adjustments. Furthermore, as it is protective equipment for the worker, it must not pose a risk or cause additional risks during use.

When using a PPE and observing its certification, you must at least know what it means and which category it belongs to.

4.2.4.- Types of PPE category

Category I:

These are simple design PPE´ s that provide minimum protection, e.g. gloves for handling hot parts below 50o C, footwear for atmospheric or exceptional agents, and extremes, etc.

The CE mark must appear somewhere on the PPE.

Category II:

These are medium design PPIs´s that provide protection that is superior to that offered by a category I PPI, but without offering the protection of a category III PPI. Almost all PPE´s is category II, around 80%, and among them we find specific hand and/or arm protection equipment, specific foot and/or leg protection equipment, all helmets, all full or partial face protection equipment, etc.

Each PPE or its packaging must bear the CE mark.

Category III:

These are PPE´s of a more complex design than those in the previous categories and are mainly intended to protect workers from mortal dangers or dangers that could seriously and irreversibly damage their health. Among these category III PPE´s we find all devices protecting against falls from height and all respiratory protection equipment protecting against solid and liquid contaminants or gases.

Each PPE and packaging of the PPE must bear the CE XXXX mark, where XXXX is the distinctive number of the notified body involved in the production stage.

4.2.5.- Obligations of workers and managers

In order to protect themselves adequately, with the means provided by the employer, workers must use and take proper care of the PPE´s, store them in suitable places after use and inform the direct controls of any anomaly or damage detected in them.

The controls shall ensure that the workers have the necessary PPE´s and shall demand the use of the same when necessary without exception.

MODULE V
SAFETY SIGNS

Signaling, beyond any preconceived ideas you may have, is something that has not been invented by man since it has existed in nature since the beginning of time. There are an infinite number of signs of all kinds that in most cases serve to warn of danger, for example, the striking color of some animals serves as a warning about their toxicity, the smell of rotting food prevents us from eating them, etc.

All that has been said so far indicates that man's ability to grasp and understand warning messages is a matter of course. The only difference between **these natural and artificial signals** is t**hat the latter are created by us and in order to understand them and be effective their meaning must have been learned in advance.**

The current legislation, mainly through the **Royal Decree 485/1997**, establishes minimum guidelines for effective signage in the workplace.

For signage to be effective it must have certain **characteristics**:

➢ **Suitable location.**
➢ **Just the right distance from the receiver to be seen.**
➢ **It must be warned well in advance.**
➢ **Prior knowledge of its meaning is required.**
➢ **It must have a single, simple interpretation.**

5.1.- Forms of Signaling

The signaling can be applied in many different ways, they can be

➢ By means of colours.
➢ In panel form.
➢ Light or acoustic signals.
➢ Verbal communication.
➢ Gesture signals, i.e. using gestures

5.1.1.- Safety Colors

The safety colours shall be as shown in the table below, which indicates the colour and its meaning, as well as examples of key applications for which the colours are used.

5.1.2.- Signalling in the form of a Panel

In most cases, the dangers are intrinsic to the jobs they perform and the reason they are signalled is because it is impossible to completely eradicate them. In fact, signalling informs, warns and obliges, but does not protect by itself, signalling is above all a tool for raising awareness.

Among the most usual panel-shaped signage we find within the work environment, it stands out:

5.1.3.- Light or sound signals

They indicate a higher degree of attention and are generally associated with machine movement.

WARNING SIGNS

PROHIBITION SIGNS

MANDATORY SIGNS

SIGNS RELATING TO FIRE-FIGHTING EQUIPMENT SIGNS

RESCUE OR DISTRESS SIGNALS

5.1.4.- Verbal Communication

The main characteristic is that the workers concerned have a good knowledge of language.

Verbal communication should be tried to replace or complement gestural signals.

5.1.5.- Gesture Signalling

One of the above-mentioned types of signalling, very important for work with crane bridges, is the gesture signalling to be used by crane operators and signallers.

This type of signalling is used in situations where the crane operator has difficulty in seeing, even in special risk operations because of the types of cargo to be handled.

There are regulations at state level concerning the use of this type of gesture and a code of signals is also indicated in Royal Decree 485/1997, 14 April, on provisions minimum standards for health and safety signs at work.

Organizations are free to choose signal codes to be used in their bridge crane loading and unloading operations. However, the most important thing is that both crane operators and signallers know and understand these signal codes signals for which they will need to be trained.

In the case of handling very large and heavy or dangerous materials, the presence of a Preventive Resource with sufficient training in occupational risk prevention will be necessary. The mission of this figure will be to monitor compliance with safety applicable to the mechanical handling of loads with a crane bridge.

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