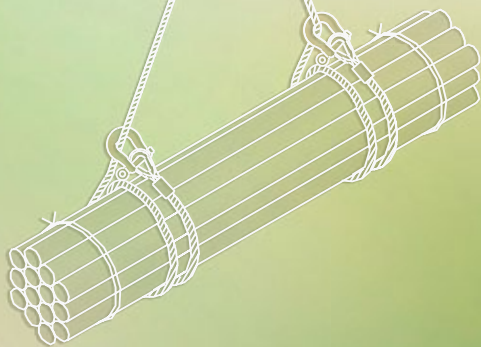


Code of Practice for Safe Use of Mobile Cranes



Occupational Safety and Health Branch
Labour Department

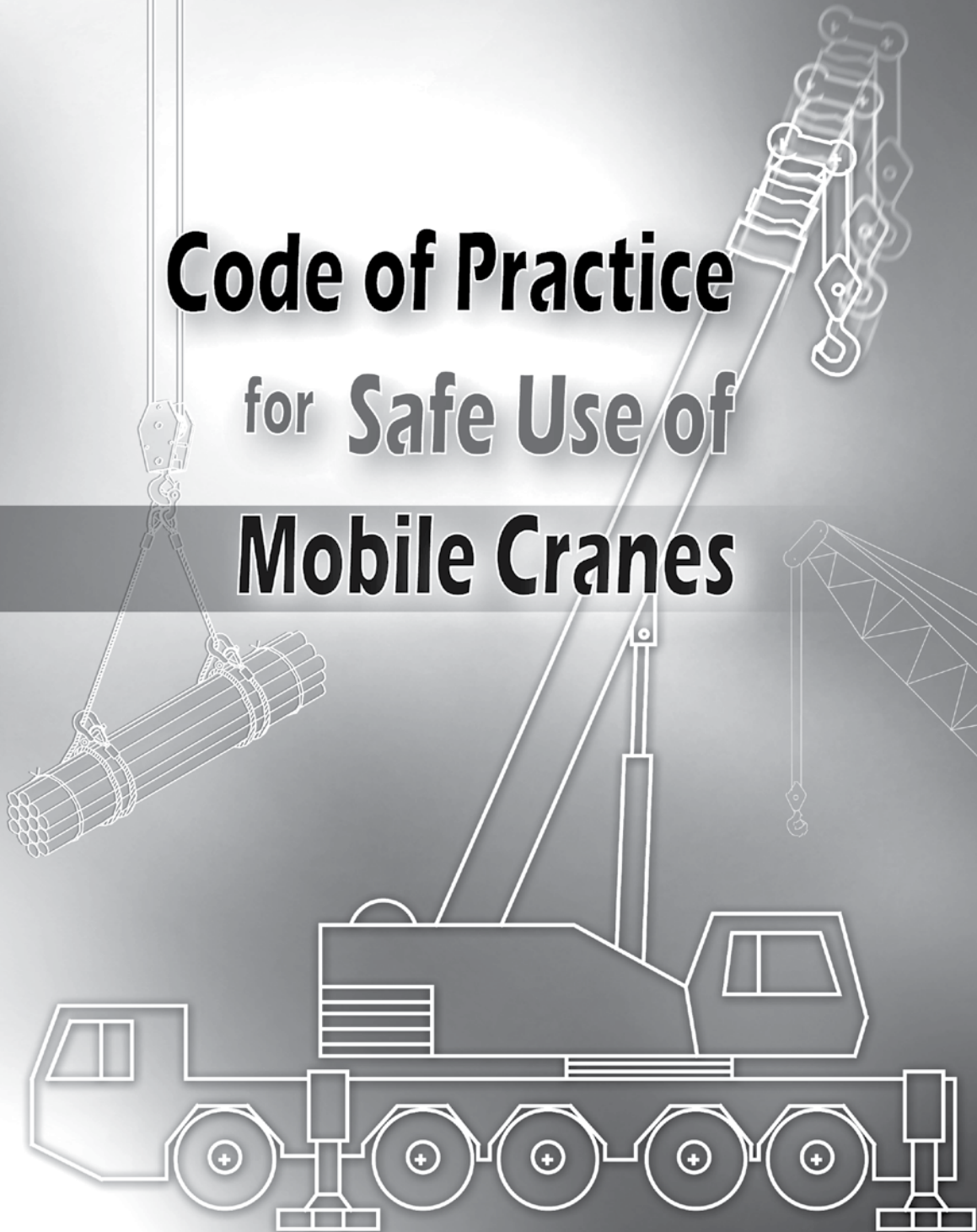
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Code of Practice for **Safe Use of** **Mobile Cranes**



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Foreword

Mobile cranes are widely used for lifting operations in industrial undertakings in Hong Kong especially in the construction industry. Every year, there are quite a number of accidents involving mobile cranes, such as overturning of cranes and displacement of loads being lifted. Property damage and bodily injuries can be avoided if they are properly used.

This Code of Practice (hereafter referred to as this Code) is issued by the Commissioner for Labour under Section 7A of the Factories and Industrial Undertakings Ordinance (Cap. 59). It provides practical guidance to the industry as to how to use mobile cranes safely and properly with a view to assisting the duty holders in preventing accidents.

The provisions in this Code should not be regarded as exhausting those matters which need to be covered by the relevant safety legislation, nor is it intended to relieve persons undertaking the work of their statutory responsibilities. It is important to note that compliance with this Code does not of itself confer immunity from legal obligations.

This Code has a special legal status. A failure to observe a provision of this Code is not in itself an offence. However, that failure may in criminal proceedings be relied on by any party to the proceedings as tending to establish or to negative any liability which is in question in the proceedings, if the said provision is found by the court to be a matter to which a contravention or failure alleged in the proceedings relates (see section 7A(5) of the Factories and Industrial Undertaking Ordinance (Cap. 59)).

Throughout this Code, we have quoted the relevant safety standards of the British Standards Institution. However, if there are some other national, international standards or provisions which are equivalent, they would be acceptable as alternatives. In addition, statutory provisions referred to or cited in this Code are those in force as at 1 September 2017.

1. Scope

- 1.1 This Code provides guidance on the safe use and operation of mobile cranes to ensure the safety of personnel working at or nearby those cranes.
- 1.2 It covers management and planning of the lifting operation of mobile cranes, requirements for operators, slingers and signallers, siting, erection, dismantling, maintenance and testing of mobile cranes. It also contains guidance pertaining to the selection, safe use and specific precautions when mobile cranes are operating within a workplace.
- 1.3 Reference is also made to relevant Hong Kong legislation in particular Sections 6A & 6B of the Factories and Industrial Undertakings Ordinance (Cap. 59) (hereafter referred to as the FIUO), the provisions in the Factories and Industrial Undertakings Regulations (hereafter referred to as the FIUR), the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (hereafter referred to as the LALGR), the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations (hereafter referred to as the GOMR) and the Construction Sites (Safety) Regulations (hereafter referred to as the CSSR). Attention is drawn to the requirements and procedures for testing and examination of cranes under the LALGR and the British Standard BS 7121.

2. Definitions

Automatic safe load indicator

It means a device intended to be fitted to a crane that automatically gives an audible and visible warning to the operator thereof that the crane is approaching its safe working load, and that automatically gives a further audible and visible warning when the crane has exceeded its safe working load (Regulation 3(1) of the LALGR).

Competent examiner

A competent examiner, in relation to the carrying out of any test and examination required by the LALGR, means a person who is -

- (a) appointed by the owner required by those regulations to ensure that the test and examination is carried out;
- (b) a registered professional engineer registered under the Engineers Registration Ordinance (Cap. 409) within a relevant discipline specified by the Commissioner for Labour; and
- (c) by reason of his qualifications, training and experience, competent to carry out the test and examination.

(Regulation 3(1) of the LALGR)

As at the date of this Code, Mechanical Engineering and Marine & Naval Architecture are the disciplines specified by the Commissioner for Labour.

Competent person

A competent person, in relation to any duty required to be performed by him under the LALGR, means a person who is -

- (a) appointed by the owner required by those regulations to ensure that the duty is carried out by a competent person; and
- (b) by reason of training and practical experience, competent to perform the duty.

(Regulation 3(1) of the LALGR)

Condition of tipping

A condition when a crane is subjected to an overturning moment which cannot be increased by even a small amount without causing the crane to fall over.

Owner

Owner, in relation to any crane or lifting gear, includes the lessee or hirer thereof, and any overseer, foreman, agent or person in charge or having the control or management of a crane or lifting gear, and the contractor who has control over the way any construction work which involves the use of the crane or lifting gear is carried out and, in the case of a crane or lifting gear situated on or used in connection with work on a construction site, also includes the contractor responsible for the construction site (Regulation 3(1) of the LALGR).

A contractor is responsible for a construction site if he is undertaking construction work there or, where there is more than one contractor undertaking construction work at the site, if he is the principal contractor undertaking construction work there (Regulation 3(2) of the LALGR).

3. Management of the Lifting Operation

3.1. Safe system of work

3.1.1 A safe system of work should be established and documented. This should be followed for every lifting operation whether it is an individual lift or a group of repetitive operations. This safe system of work should be prepared and endorsed by the owner/contractor of mobile crane, with the advice of the competent person, safety officer and other relevant personnel. The same principle should be applied whether the lifting operations are carried out at a site, in a factory or at a dock. The safe system of work should be effectively communicated to all parties concerned.

3.1.2 The safe system of work should include the following:

- (a) risk assessment;
- (b) planning of the operation;
- (c) taking care of the safety of all workers involved and other persons who may be affected by the lifting operation, including fencing off all lifting zones as far as reasonably practicable;
- (d) selection, provision and use of a suitable mobile crane and equipment;
- (e) maintenance, examination and testing of the mobile crane and equipment;
- (f) the provision of a log-book for the competent examiner/competent person/mechanic to enter the details of testing, examination, inspection, maintenance/repair works which have been carried out for the mobile crane;
- (g) the provision of properly trained and competent personnel who have been made aware of their relevant responsibilities under the Sections 6A & 6B of the FIUO;
- (h) adequate supervision by properly trained and competent personnel;

- (i) observing for any unsafe conditions such as adverse weather conditions that may arise during operation;
- (j) ensuring that all necessary test and examination certificates and other documents are available;
- (k) preventing unauthorized movement or use of a mobile crane at all times; and
- (l) the contingency plan providing procedures to be followed in case of emergency situation.

3.1.3 The lifting operation should be taken to include any necessary preparation of a site, and the siting, erection, alteration and dismantling of the crane.

3.2 Control of the lifting operation

3.2.1 To ensure the implementation of the safe system of work, a responsible person should be appointed by the owner to have overall control of the lifting operation. This appointed person should:

- (a) be fully conversant with crane operation and crane maintenance;
- (b) have adequate practical experience in mechanical engineering;
- (c) be familiar with hazards, limitations and precautions associated with crane operation;
- (d) have properly trained in the safe use of mobile cranes including the theory of crane operation;
- (e) be familiar with the provisions of the LALGR and the contents in this Code;
- (f) ensure the safe system of work is fully understood by the personnel associated with the lifting operation; and
- (g) be capable of performing inspections on mobile cranes and tests in accordance with the manufacturer's instructions.

4. Planning of the Lifting Operation

- 4.1 All lifting operations should be planned to ensure that they are carried out safely and that all foreseeable risks have been taken into account. Planning should be carried out by personnel who have the appropriate expertise and have been appointed for this purpose. In case of repetitive or routine operations, this planning may only be necessary in the first instance, with periodic reviews to ensure that no factors have changed.
- 4.2 Planning should include the consideration of:
- (a) the load such as its characteristics and the method of lifting;
 - (b) the selection of a suitable mobile crane appropriate to the operation ensuring that adequate clearances are maintained between the load and the crane structure;
 - (c) the selection of suitable lifting gear, the weight of which should be taken into account when assessing the load on the mobile crane;
 - (d) the selection of suitable personnel for the operation;
 - (e) the proper position of the mobile crane and the load before, during and after the operation;
 - (f) the proper fencing off of all lifting zones (e.g. providing fencing or barricade) with suitable warning notices displayed; or where it is not reasonably practicable to fence off the lifting zones due to space constraint, etc., the taking of effective measures, such as appointment of sufficient watch-out personnel, to ensure no unauthorized entry into the zones;
 - (g) the site of the operation, taking into account proximity hazards, space availability and suitability of the ground such as the allowable bearing capacity of the ground;
 - (h) any necessary erection, alteration and dismantling of the mobile crane;
 - (i) the environmental conditions that exist or may occur at the site of the operation, which may necessitate stopping the operation when conditions are unsuitable; and
 - (j) the effectiveness of communication among relevant parties, such as that between the operator and the signaller/s.

5. Responsibilities/Requirements of Personnel

5.1 Owner's responsibilities

- 5.1.1 The owner is responsible for putting together the safe system of work, educating all related personnel in safe practices and the assignment of definite, individual safety responsibilities. The owner must plan all phases of the operation involving the mobile crane.
- 5.1.2 It is the responsibility of owner to ensure that the persons who prepare the mobile crane, erect it, operate it, and work with it are well trained in both safety and operating procedures.
- 5.1.3 The owner must ensure that all mobile cranes are operated by trained, experienced, competent and qualified crane operator.
- 5.1.4 The owner must also ensure that the persons who direct, rig and handle the loads have received proper training in the principles of the operation, are able to establish weights and judge distances, heights and clearances, are capable of selecting tackle and lifting gear as well as rigging method suitable for the loads to be lifted, and are capable of directing the movement of the crane and load to ensure the safety of all personnel.

5.2 Mobile crane operator

- 5.2.1 The mobile crane operator should ensure at all times the safe operation of the crane under his control. He should follow the correct operation of the crane in accordance with the manufacturer's instructions and within the safe system of work. He should at any one time only respond to the signals from one slinger/signaller who should be clearly identified. In particular, the mobile crane operator should:
- (a) have attained the age of 18 years and hold a valid certificate issued by the Construction Industry Training Authority or by any

other person specified by the Commissioner for Labour (Regulation 15A(1) of LALGR);

- (b) be fit, with particular regard to eyesight, hearing and reflexes;
- (c) have been trained in the general principles of slinging and be able to establish weights and judge distances, heights and clearances;
- (d) have been adequately trained in the operation of the type of crane he is operating and have sufficient knowledge of the crane and its safety devices;
- (e) understand fully the duties of the slinger and be familiar with the signal code shown in Table 1 in order to implement safely the instructions of the slinger or signaller; and
- (f) understand fully the radio/tele-communication signals between the parties concerned.

5.3 Slinger

5.3.1 The slinger should be responsible for attaching and detaching the load to and from the crane, and for the use of correct lifting gear in accordance with the planning of the operation. In particular, the slinger should:

- (a) have attained the age 18 years;
- (b) be fit, with particular regard to eyesight, hearing and reflexes;
- (c) have been trained in the general principles of slinging and be able to establish weights and judge distances, heights and clearances;
- (d) be capable of selecting tackle and lifting gear as well as rigging method suitable for the loads to be lifted;
- (e) understand fully the signal code shown in Table 1 and be able to give clear and precise signals;
- (f) be capable of directing the movement of the crane and load in such a manner as to ensure the safety of personnel and plant; and
- (g) understand fully the radio/tele-communication signals between the parties concerned.

5.4 Signaller

5.4.1 Where the crane operator of the mobile crane does not have a clear and unrestricted view of the load carried by the crane, its vicinity or the point of attachment for a load where no load is being carried and such view is necessary for the safe working of the crane, a signaller shall be employed to relay the slinger's instructions to the crane operator (Regulation 15B(1) of LALGR).

5.4.2 The signaller should be responsible for relaying the signal from the slinger to the crane operator. He is also responsible for directing the safe movement of the crane. He should not be engaged in other activities while giving signal to the crane operator. In particular, he should:

- (a) have attained the age 18 years (Regulation 15B(2) of LALGR);
- (b) be fit with particular regard to eyesight, hearing and reflexes;
- (c) understand fully the signal code shown in Table 1 and be able to transmit the instructions of the slinger in a clear and precise manner;
- (d) be easily identifiable to the crane operator (e.g. by wearing 'high-visibility' clothing, or other means); and
- (e) understand fully the radio/tele-communication signals between the parties concerned.

6. Selection of Mobile Cranes

6.1 General

- 6.1.1 Each class of cranes possesses certain basic characteristics which will usually dictate the one most suited to a particular application. Mobile cranes must be properly selected to suit the job. If the crane's basic characteristics do not match the job's requirements, unsafe conditions will be created and accidents are prone to happen.
- 6.1.2 Reference should therefore be made to the following sub-section 6.2 for details of different crane types and their operational characteristics.
- 6.1.3 The type of mobile cranes to be used should be considered against the job requirements for a particular application. Points to be considered in making the selection include:
- (a) weights and dimensions of loads;
 - (b) heights of lift and distances/areas of movement of loads;
 - (c) number and frequency of lifts;
 - (d) length of time for which the crane will be required;
 - (e) site conditions, including ground conditions for crane standing, and space available for crane access, erection, operation and dismantling;
 - (f) any special operational requirements or limitations imposed including the existence of other cranes in close proximity; and
 - (g) any dynamic loads involved.
- 6.1.4 In general, all the points in sub-section 6.1.3 can influence the choice of the crane. With the consideration of the above points, the crane to be selected should be:
- (a) capable of making all its lifts in its standard configuration;
 - (b) having at least a 5% working/safety margin with respect to the load capacity on every lift;
 - (c) having sufficient clearance for the boom; and

- (d) having adequate headroom between the load and rigging required to make the lift.

6.2 Types of mounting and jib configuration

6.2.1 The operating characteristics of a mobile crane are largely determined by its type of mounting and type of jib (see Fig. 1 & 2).

6.2.2 *Crawler-mounted crane* (Fig. 1a) - a crane which is mounted on crawler-tracked chassis. The crane can travel under its own power. A crane cabin is usually provided for the crane driving and operation purposes. A single power unit is provided for both the crane driving and operation modes.

This type of crane should be considered under the following conditions:

- (a) the ground is poor to travel over or sloped;
- (b) operation in areas of limited access; or
- (c) handling of dynamic loads such as vibrators.

The tracks of the crane which provide large ground-bearing area have prevented the sinkage of it on soft or unpaved ground to enhance its operational stability. Crawler-mounted crane is highly manoeuvrable and can be turned virtually about its own centre.

6.2.3 *Truck-mounted crane* (Fig. 1b & 1c) - a crane which is mounted on a truck/lorry chassis with or without a spring suspension. Apart from the driving cabin, a crane with higher lifting capacity is usually provided with a separate control cabin. On the other hand, only a control unit is provided for a smaller crane such as a lorry loader (cargo crane). As far as the power to drive the crane is concerned, the crane and the truck/lorry can be driven by either a single power unit or by separate power units.

6.2.4 **Wheel-mounted crane** (Fig. 1d) - a crane which is mounted on wheeled chassis. The crane can travel under its own power. A crane cabin is usually provided for the crane driving and operation purposes. A single power unit is provided for both the crane driving and operation modes.

The following conditions are required for these types of crane:

- (a) operation on hard or compacted ground; and
- (b) good access to the operating area is provided. In this respect, load bearing capacity of access routes should be properly assessed.

6.2.5 In general, local lifting operations would use wheel-mounted or crawler-mounted crane. While those involving considerable travelling between sites during lifting operations would use truck-mounted crane.

6.2.6 Telescoping jib

Its operationally-variable jib length can greatly facilitate manoeuvring and placing the load in confined areas. The operational set-up and strip down times of this kind of jibs are shorter than other type. However, working loads at longer radii are less than those at comparable radii of a lattice-construction strut jib and the maximum length of the jib is restricted due to the jib's relative heavier weight (see Fig. 2a).

6.2.7 Strut-type jib

It would provide greater heights of lift and maximum operating radii, and hence suitable for long range work or high lifts (see Fig. 2b).

6.2.8 Fly-jib

It would be suitable for operations involving the handling of relatively light loads to extremes of height (see Fig. 2b).

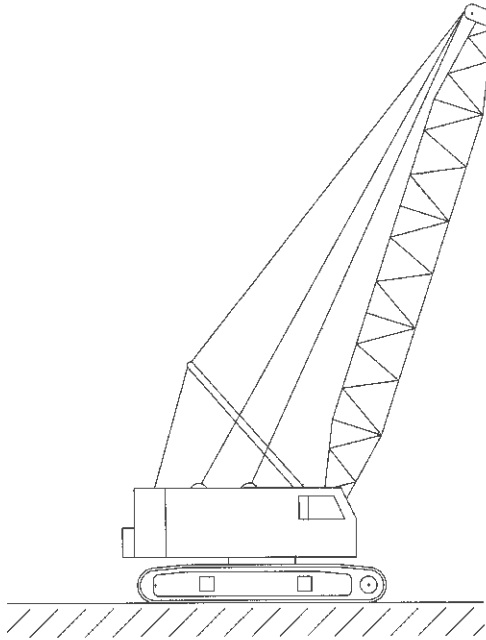


Fig. 1a - Crawler-mounted crane

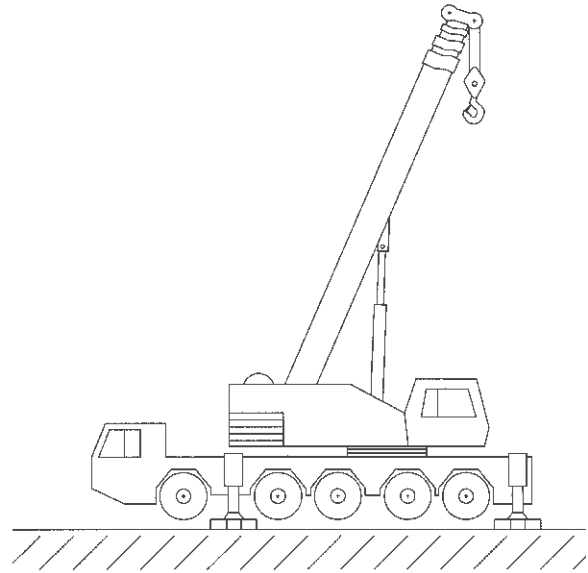


Fig. 1b - Truck-mounted crane

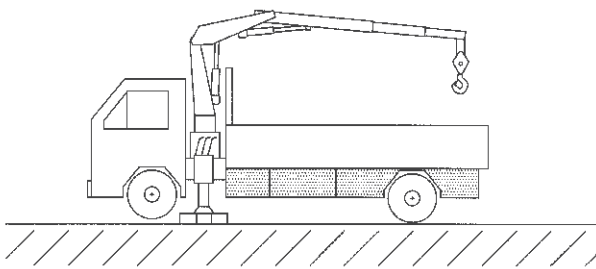


Fig. 1c - Alternative arrangement of
truck-mounted crane

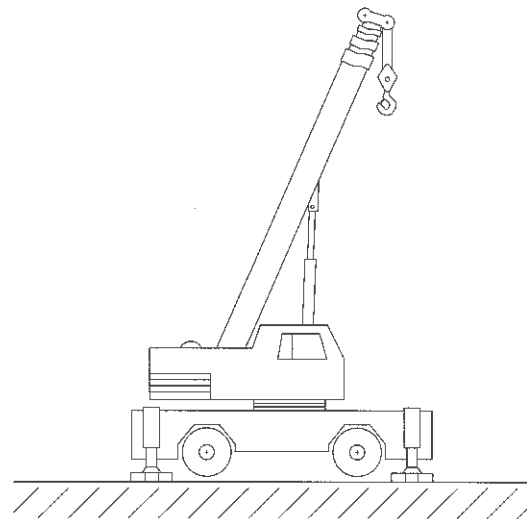


Fig. 1d - Wheel-mounted crane

Fig. 1 Types of mounting for mobile cranes (not relatively scaled)

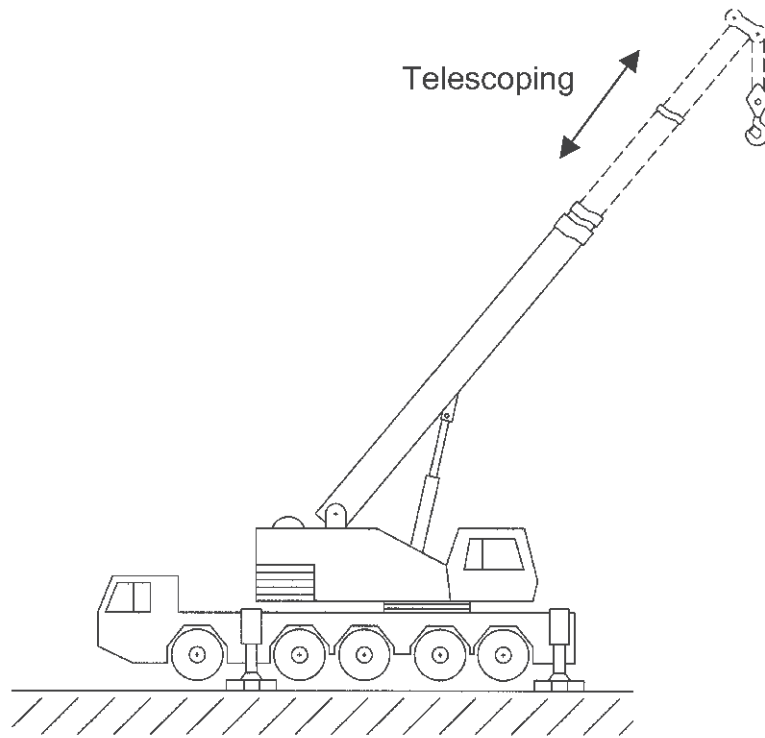


Fig. 2a - Telescoping jib (hydraulic)

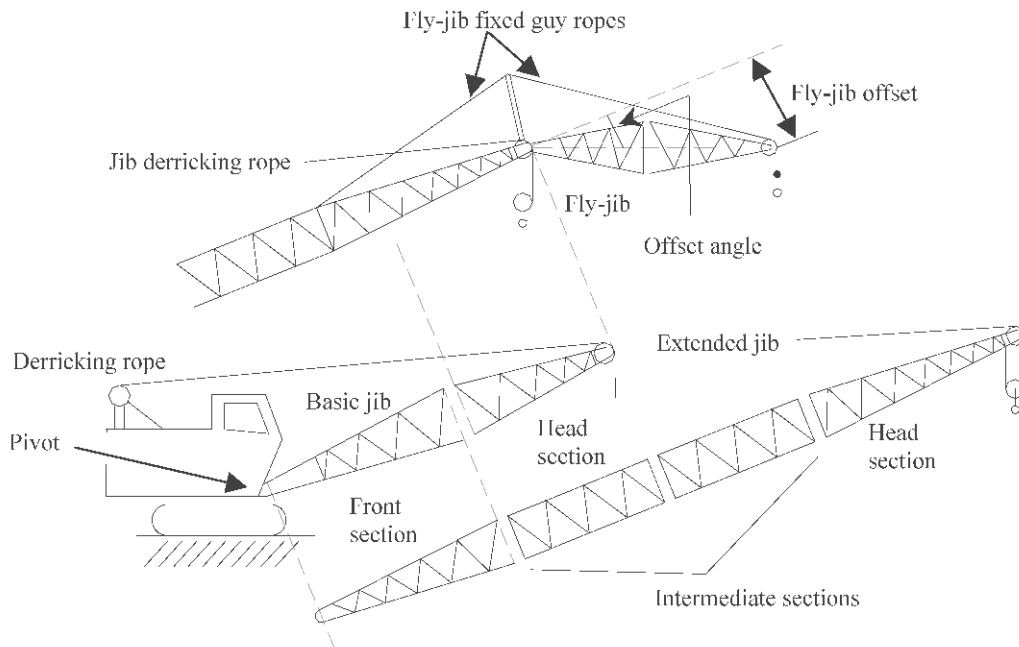


Fig. 2b - Strut-type jib and fly jib (lattice)

Fig. 2 Types of jib on mobile cranes (not relatively scaled)

7. Markings and Documentation

7.1 Identification

7.1.1 The crane should have a permanent durable plate bearing the manufacturer's name, machine model, serial number, year of manufacture and weight of the unit for identification purpose.

7.1.2 Every major structural, electrical and mechanical component of the machine should have a permanent durable plate bearing the manufacturers' name, machine model number, serial number, year of original sale by the manufacturer and weight of the unit. Besides, identification numbers should be clearly marked on all basic removable components and attachments of the machine (such as counterweights etc.) to show that they belong to that machine. It is important that these components should be used only on that machine or identical models or an equipment for which they were specifically intended by the manufacturer.

7.2 Safe working load charts

7.2.1 The crane shall have a substantial/durable safe working load chart which:

- (a) has clearly legible characters in English and Chinese and figures displayed inside the crane (Regulation 11(1) of the LALGR); and
- (b) is easily visible to the crane operator.

7.3 Instruction manuals and log book

7.3.1 Manufacturer's manuals containing all pertinent data relating to operation and maintenance for the specific model of crane in use must be provided with each machine.

- 7.3.2 The language used in the majority of the workforce in Hong Kong, especially among the shop-floor operations and the middle supervisory staff, is Chinese. It is essential that all the written instructions, the documents and literatures given by the crane manufacturers in relation to the safe use and maintenance of the cranes (such as the load charts), if not in Chinese, be translated into Chinese so that the operatives have no difficulty in understanding them. Suitable arrangement should also be made to enhance communication in workplace where people would use languages other than Chinese or English.
- 7.3.3 If the equipment is not supplied with a log book then one should be started, maintained and kept on the work site for the regular, periodic recording of all inspections, tests, repairs, maintenance, and hours of service related to the machine. All entries should be dated and signed by the operator, repairer or supervisor. The crane owner should ensure that the log book remains with the crane and is kept up-to-date throughout its working life in Hong Kong (see section 14 of this Code).

8. Operational Features of Mobile Cranes

8.1 Automatic safe load indicator

8.1.1 All types of crane, except those with a maximum safe working load of 1 tonne or less or those operate with a grab or by electromagnetic means, shall be fitted with an automatic safe load indicator (Regulation 7B of the LALGR). The automatic safe load indicator is usually used in association with overloading cut-out. The specification of automatic safe load indicator should conform to British Standard BS 7262 or equivalent standards.

8.2 Brakes

8.2.1 Fail-safe brakes should be provided so that they will be applied automatically to prevent any “free fall” of the hook or load whenever the hook or load is not in a power raising or power lowering condition. The brakes should be automatically applied if there is a loss of power or pressure. They cannot be released until the restoration of power and only when deliberately released.

8.2.2 Effective swing brake capable of stopping the swing with full load should be provided. Besides, a positive swing lock or house lock designed to prevent accidental engagement or disengagement should be provided.

8.2.3 Fail-safe vehicle brakes should be provided to hold the crane stationary under normal working condition or on the maximum grade for travel recommended by the manufacturer.

8.3 Cabins for operators

8.3.1 The operating cabin attached to the structure of the mobile crane should meet the following requirements:

- (a) be designed and constructed to protect the operator and the controls from the weather (Regulation 10(1) of LALGR);
- (b) be provided with a roof of adequate strength to protect the operator from falling objects;
- (c) be properly ventilated by artificial means where necessary;
- (d) be fitted with a lock to prevent unauthorized entry when the unit is left unattended, unless the control unit can be separately locked;
- (e) be constructed to give the operator a clear and unrestricted view that will enable him to use the crane safely (Regulation 10(1) of LALGR);
- (f) have a safe access to and egress from the cabin.
- (g) have guardrails provided on all outside and access platforms (see Regulation 38 B(1) of the CSSR, Regulation 24 of the FIUR);
- (h) have hand holds and steps to facilitate entrance to and exit from the cabin; and
- (i) all walking surfaces on the crane should be of anti-skid type.

8.4 Operating controls

8.4.1 All controls must be located within easy reach of the operator and allow him ample room for operation. The controls should be of dead man switches in that they return to neutral automatically when released. The main power switch should be lockable and located within easy reach of the operator. Each control must be clearly labelled and marked to show the motion and the direction of movement that it controls. Where practicable, controls should be arranged so that accidental displacement is prevented and inadvertent pressure on them does not cause the crane to be set into motion.

8.5 Guards and protective structures

- 8.5.1 All exposed moving parts of a mobile crane such as gears, pulleys, belts, chains, shafts, flywheels which might constitute a hazard under normal operating conditions shall be effectively guarded (see Regulation 5 of the GOMR).

8.6 Outriggers

- 8.6.1 Outriggers should be securely held in the retracted position while travelling.
- 8.6.2 They should also be securely held in the extended position when blocked for hoisting.
- 8.6.3 If power actuated jacks are used, they should never lose pressure or leak while under load.
- 8.6.4 The outrigger beams should be marked or painted in a manner to indicate the fully extended position.

8.7 Drum assemblies

- 8.7.1 The drum assemblies should have adequate power.
- 8.7.2 The winding and unwinding directions of the drum should be clearly marked in Chinese and English.
- 8.7.3 Rope should be correctly installed on drum.

8.8 Sheaves

- 8.8.1 Grooves should be smooth and slightly larger than the rope to prevent it from being pinched or jammed in the groove.
- 8.8.2 Jib/boom hoisting sheaves should have pitch diameter of not less than 15 times the nominal diameter of the rope used.
- 8.8.3 Load hoisting sheaves should have pitch diameters not less than 18 times the nominal diameter of the rope used, and the load block sheaves should also have pitch diameters not less than 16 times the nominal diameter of the rope used.
- 8.8.4 Depth of sheave grooves should be at least 1.5 times the rope diameter, and the tapered side walls of the grooves should not make an angle of more than 18 degrees with respect to the centre line.
- 8.8.5 Bearings should be permanently lubricated or be equipped with means for lubrication.
- 8.8.6 Sheave should be equipped with cablekeepers or close fitting guards to prevent the rope from leaving the groove.

8.9 Safety features

- 8.9.1 The following should be provided to mobile cranes for the sake of safe operation:
 - (a) jib/boom angle indicators should be installed for jib/boom which is capable of moving in the vertical plane. The indicator should be clearly visible and readable by the operator at his control station to the nearest degree;
 - (b) motion limit devices: These devices should be fitted to limit hoisting, derricking, travelling, slewing or any other crane motion. For example, automatic device should be installed to stop jib/boom drum motion when the maximum permissible jib/boom angle is reached;

- (c) overload cut-out devices, if provided, should cut out crane motions when the crane is in an overload situation. This should not be achieved by stopping the prime mover. Only motions, that permit the crane to return to a safe condition, should remain operative. Besides, the overload cut-out device should be either of fail-safe design or protected from damage by excessive overloading;
- (d) a spirit level for levelling the outriggers should be provided at the outrigger controls;
- (e) a carpenter's level should be equipped at the machined surfaces on the revolving deck which are parallel to the jib/boom foot pins in the horizontal plane for final precision levelling of the crane;
- (f) rear view mirrors of each at least 625 cm² in area should be equipped on both sides of crane;
- (g) a suitable fire extinguisher should be installed and properly maintained;
- (h) a suitable receptacle should be provided where storing tools and lubricating equipment on the crane is required;
- (i) for wheel-mounted crane, wheel chocks should be provided to block movement on slopes when the crane is left unattended or undergoing repair/maintenance; and
- (j) for night operation if required, adequate lighting and back-up lights should be provided.

9. Siting of Mobile Cranes

9.1 General

9.1.1 In siting a mobile crane for operation, particular attention should be paid to two factors: the crane standing or support conditions and the presence of proximity hazards. Consideration should also be given to the projection of the mobile crane beyond the site boundary to avoid potential hazards to the public including those in private areas and public areas.

9.2 Crane standing or supporting conditions

9.2.1 Mobile cranes should only be operated on uniform, level and firm ground with sufficient load bearing capacity to withstand the maximum in-service loadings of the crane. It should be noted that wind loadings and dynamic effect should also be taken into account.

9.2.2 For the wind effect on structure of mobile cranes, reference can be made to the Code of Practice on Wind Effects in Hong Kong - 2004 issued by the Buildings Department. Crane manufacturer's data relating to the dead weight of the mobile crane and the dynamic forces, which can occur during operation of the crane, should always be obtained for determining the maximum in-service loadings.

9.2.3 In calculating the maximum bearing pressures of the crane on the ground or supporting surface, it is incorrect to assume an average value equal to total weight divided by the ground contact area because the maximum values would generally be far in excess of this average bearing pressure.

9.2.4 In order to avoid the sinkage or collapse of the supporting surface and overturning or collapse of the crane, the loading should be distributed over a sufficiently large area. Steel plates of adequate strength, suitable mats or suitable timber blocking should therefore be used.

- 9.2.5 If outriggers are provided, the beams should be fully extended as far as practicable (Fig. 3). The jacks should be suitably extended so that all the crane tyres are clear of the ground.

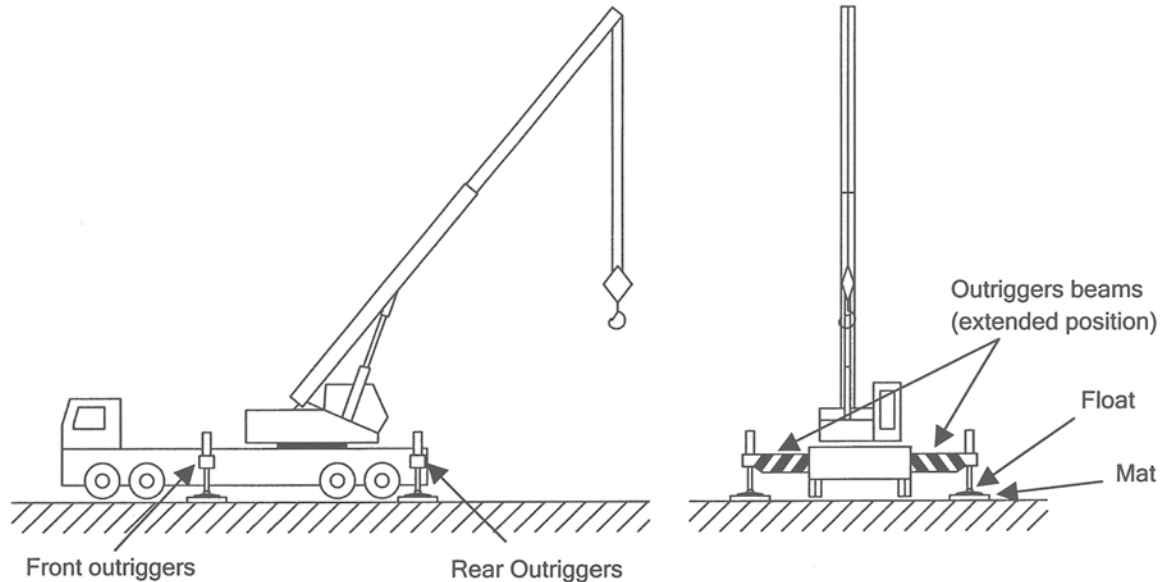


Fig. 3 Typical truck-mounted crane shown with outriggers set

- 9.2.6 Some mobile cranes can lift loads with partially extended outriggers. However, use of partially extended outriggers should be avoided as far as practicable because the stability of the crane may be greatly reduced. Where the use of partially extended outriggers cannot be avoided, it should be carefully planned. It should also be supervised by a competent person. In order to prevent confusion in the interpretation of safe working loads, all outriggers should be extended to the same extension positions. In other words, the outrigger beams should not be set at any other intermediate points apart from the designated partial extension positions.
- 9.2.7 The mat or timber blocking should be at least 3 times larger in area than the float (unless a smaller area is specified by the manufacturer) and completely support the float. For timber blocking, it should be tightly spaced and level to guarantee a right angle (90 degrees) between the cylinder and the float of the outrigger.

- 9.2.8 Advice should be sought from the manufacturer regarding the particular data and information on weights and loadings of the crane. Besides, the supporting surface should be frequently examined during the operation to ensure that there has been no movement or sinkage affecting the crane's stability.
- 9.2.9 The overall stability and safety of a crane should be carefully checked in relation to local conditions and particularly when the crane has to be operated on bridge decks, partially completed building frames, other structural supports, or close to excavations and embankments.
- 9.2.10 When operating close to the edge of a soil slope or an unsupported soil excavation, a mobile crane may collapse as the load bearing capacity there is much lower than those away from the edge. A safety distance at least 4 times the width of the foundation (the mat or timber blocking of the outrigger or the crawler) should therefore be maintained between the foundation and the edge (see Fig. 4). The distance between the foundation and the toe of the slope or excavation should also be at least 2 times the depth of the slope or excavation. Advice on closer distance from the edge for slopes or unsupported excavation with other materials should be sought from a Registered Geotechnic Engineer.
- 9.2.11 Before a mobile crane is put into operation in a land filling, reclamation or demolition site, a thorough investigation on the ground conditions should be conducted to ensure that the crane will not be positioned in areas which have insufficient load bearing capacity.

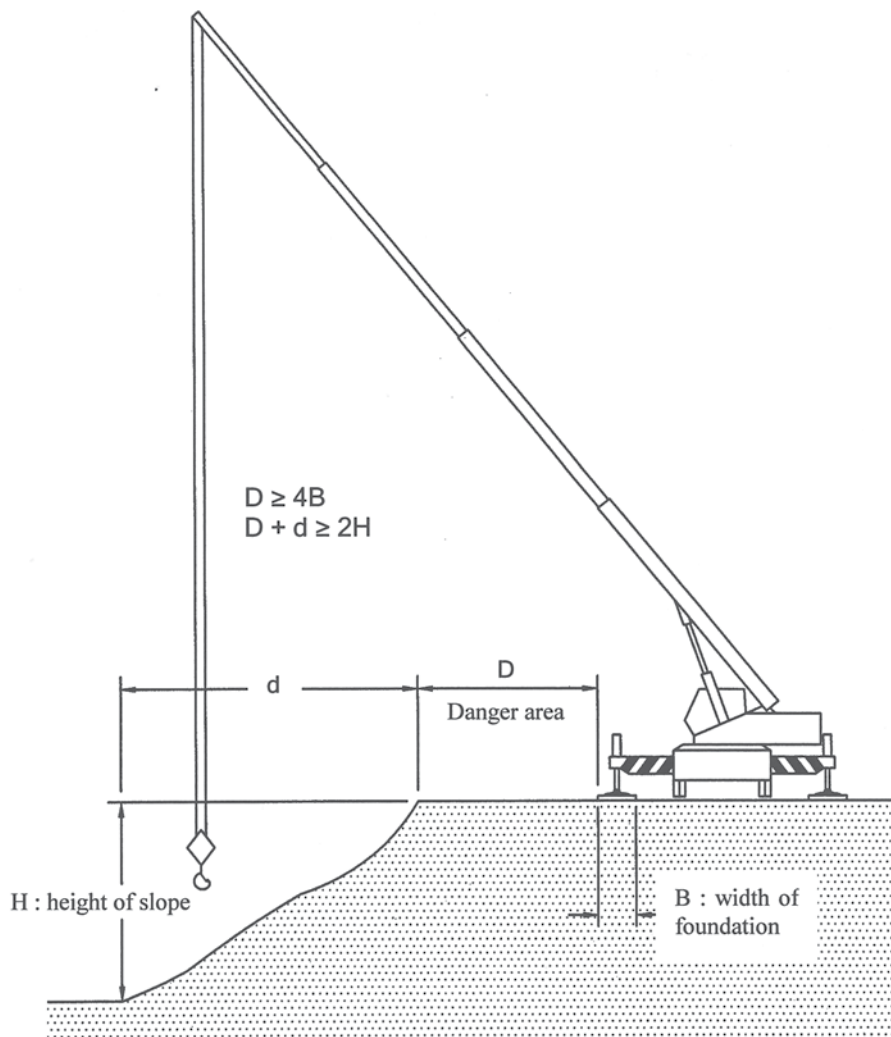


Fig. 4 Position of mobile crane

9.3 Proximity hazards

9.3.1 Consideration should be given to the proximity hazards such as overhead electricity lines and conductors, power cables, radio frequency wave transmitting tower, nearby structure and building, hoists, stacked materials, other construction works, the flight paths of airfields, the routes of aerial ropeway and other cranes, and public access areas including highways and railways.

9.3.2 As far as possible mobile cranes should be sited to avoid loads being handled over occupied premises, highways, the route of aerial ropeway, other construction works, or railways. The danger to or from underground services, such as gas mains or electric cables, should not

be overlooked. Precautions should be taken to ensure that the mobile crane standing is clear of any underground services. Where this is not possible, the services should be adequately protected to safeguard against any damage.

9.3.3 Overhead electricity lines

- 9.3.3.1 Fatal accident may occur when a crane comes into contact with or near to overhead electricity lines. Where a mobile crane has a chance of coming within a horizontal distance of 9 meters from the outermost conductor of any live overhead electricity lines, the crane owner should before works are begun, liaise with the owner of the overhead lines, e.g. a power company, to work out the exact safety requirements and devise the safe work plans. Any person working in the vicinity of overhead electricity lines shall observe the relevant provisions on taking all reasonable steps and all reasonable measures as stipulated in Section 10 of the Electricity Supply Lines (Protection) Regulation (Cap. 406H). In particular, a safe working distance must be maintained between any part of the crane and the overhead line conductor. Reference should be made to the Code of Practice on Working near Electricity Supply Lines published by the Electrical and Mechanical Services Department.
- 9.3.3.2 In ascertaining the safe working distance from the overhead electricity lines, it should be noted that it would vary with different voltages and operating conditions of the lines. For example, an overhead line may swing laterally due to the wind and its vertical clearance may change due to current loading of the line. Additional allowance should therefore be made to the safe working distance based on the advice from the power company.
- 9.3.3.3 All overhead lines or other electric apparatus should be treated as live unless declared dead and safe by the relevant authority.
- 9.3.3.4 Any person working in the vicinity of any electricity supply line should be properly trained to ensure that they are capable of taking necessary safety measures.

- 9.3.3.5 When working parallel to overhead power cables, ground level barriers or a string of warning markers should be erected at a safe distance from the cables. The position of the barriers should be clearly marked. Warning notices of overhead lines nearby should be attached to or displayed on the barriers at intervals of not less than 2 metres.
- 9.3.3.6 Where a crane must travel underneath an overhead line, the crossing route should be plainly marked. Suitable goal posts and crossbars should be erected each side of the crossing approach to ensure that the jib or moving parts are lowered to a safe position (see Fig. 5). In the case where it is not possible to place suitable crossbars due to the width of the passageway, a string of strong non-metallic under tension could be used as a flexible height limiter.

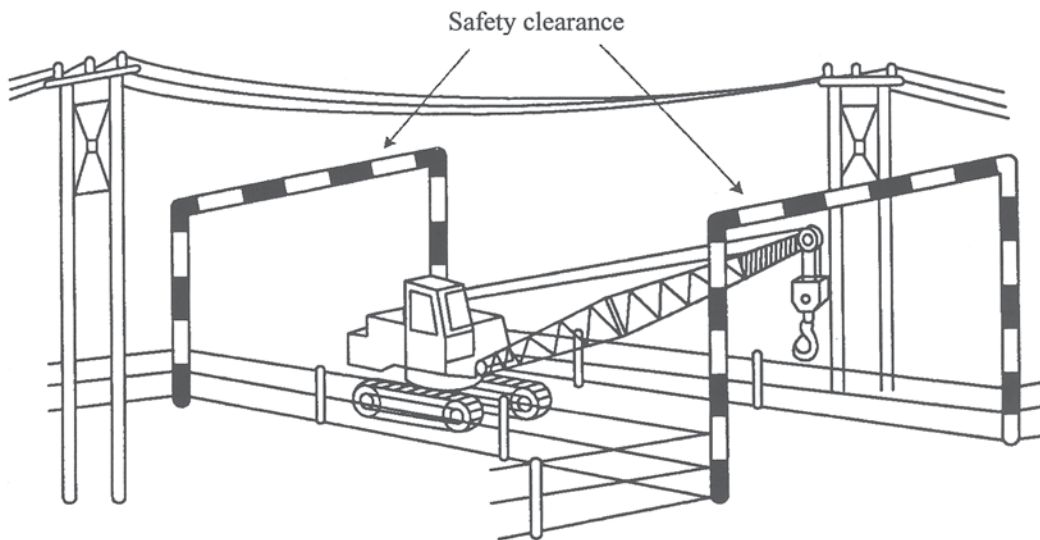


Fig. 5 Travelling under overhead electric lines and cables

- 9.3.3.7 The dimensions of the goal posts and crossbars, and their distances from the nearest power cable are to be decided in consultation with the relevant electric power company. Suitable warning notices should also be erected.
- 9.3.3.8 The operator of the crane should operate under the direction of a signaller who has a clear view of the crane and the obstruction.

9.3.3.9 The signaller should be able to assess whether there is adequate headroom and clearance.

9.3.3.10 The point of the jib and the front and rear of the crane should be painted in a distinctive manner for visual sighting and warning purposes.

9.3.4 Proximity of other cranes

9.3.4.1 When considering the positioning of a mobile crane for operation, care should be exercised regarding the proximity of other cranes. Where overlapping working area/s cannot be avoided, all the crane operations should be co-ordinated and supervised by a competent person. All the personnel involved including operators, slingers and signaller should be fully informed of the lifting arrangements.

10. Erection, Dismantling and Transportation

10.1 General precautions for erection and dismantling

10.1.1 Accidents may occur during crane erection and dismantling operations due to failure to follow the correct procedures specified by the crane manufacturers, use of incorrect parts, the wrong size or type of bolt, the incorrect assembly or sequence of assembly, or taking apart of components. To avoid dangerous and expensive consequences, the following points should be observed:

- (a) it is essential that crane manufacturer's instructions should be strictly adhered to. Any departures from the specified procedures may impose excessive loadings on structural and mechanical parts leading to a failure or collapse of the crane;
- (b) the erection or dismantling operation shall be supervised by a competent person who have been adequately trained and have experience of erecting/ dismantling the particular type of crane involved (Regulation 7H of the LALGR);
- (c) for the erection/dismantling operation, a roped-off area is required which has been clear of other personnel not involved and stacked materials, etc. The area should be large enough to permit the components to be stacked and handled, and the crane to be erected/dismantled without interfering with or risking the other site personnel. Sufficient area must be set aside for the mobile crane or other lifting appliance that will be used to erect/dismantle the mobile crane. Provisions must be made for good access for trucks delivering or taking away the components. Adequate lighting should be provided for all these working areas;
- (d) all major components, particularly those that are load bearing, should be clearly marked for proper identification. Bolts and nuts manufactured from high tensile steel or other special steels should also carry clear identification marks. The re-use of high tensile bolts and nuts should be strictly in accordance with the manufacturer's specifications and instructions;

- (e) all structural components should be inspected to ensure they are free from damage or defects;
- (f) erection/dismantling staff should not improvise or try short-cuts in handling the crane. Only the correct tackle and tools should be used;
- (g) a copy of the manufacturer's instruction manual for the particular machine should be carried at all times on the crane (this should bear the manufacturer's machine serial number and the owner's plant number);
- (h) assemblies should be slung from the points recommended by the manufacturer and in such a way that they will not swing or become unstable or sustain damage when lifted;
- (i) erection/dismantling staff should be fully briefed on and familiar with the prescribed procedures; and
- (j) approval should be obtained from the crane manufacturer before any departure is made from the prescribed procedures.

10.2 Folding or hinging jibs

- 10.2.1 For jib which can be folded down-and-under or hinged sideways, the manufacturer's instructions should be followed when the jib is setting up for operations or performing jib folding operations.
- 10.2.2 It should be ensured that the jib is restrained by the hoist rope or other specified means to prevent it from swinging uncontrollably on release from its stowed position or when pins are removed for folding.
- 10.2.3 Integral pinned folding-hinges should be provided in the jib sections.
- 10.2.4 Before erection of the assembled jib, any gate or hinge section should be positioned or removed in the manner specified by the manufacturer.

10.3 Jib assembly

10.3.1 The following should be noted for jibs which are designed to be extended by the addition of intermediate sections into the basic jib:

- (a) only correct sections for the particular crane should be used;
- (b) the sections should be in good conditions and free of bent bracings/main chords, broken welds, etc;
- (c) jib length should be made up of at least minimum number of intermediate sections according to the manufacturer's specifications;
- (d) sections should be assembled in the correct manner and sequence as specified in the manufacturer's instructions and procedures, and that the bracing pattern continuity is maintained throughout the jib length;
- (e) certain designs of jib employing pin connections instead of bolted joints to link jib sections together, the jib should be supported at the appropriate sections according to the manufacturer's instructions. All personnel should never work or pass underneath a jib during this operation. Besides, all the jib section pins should preferably be inserted from the inside of the jib pointing outwards. The suspension ropes or ties should not foul the locking pins or clips of the pin connections when the jib is being raised from ground level. All the locking pins or spring clips should be in good condition and offer effective security of the jib section pins;
- (f) other than in accordance with the manufacturer's instructions, when extending the length of a strut jib no attempt should be made to lift the jib on the suspension. Should this practice be unavoidable, the suspension rope should attach to the extremity of the part-assembled or fully-assembled jib; and
- (g) when a fly-jib is to be fitted, the angle and/or length of suspension ties between the fly-jib and the main jib should be in accordance with the manufacturer's recommendations. Also, the safety ropes or arrestors should be installed to prevent backwards instability of the fly-jib.

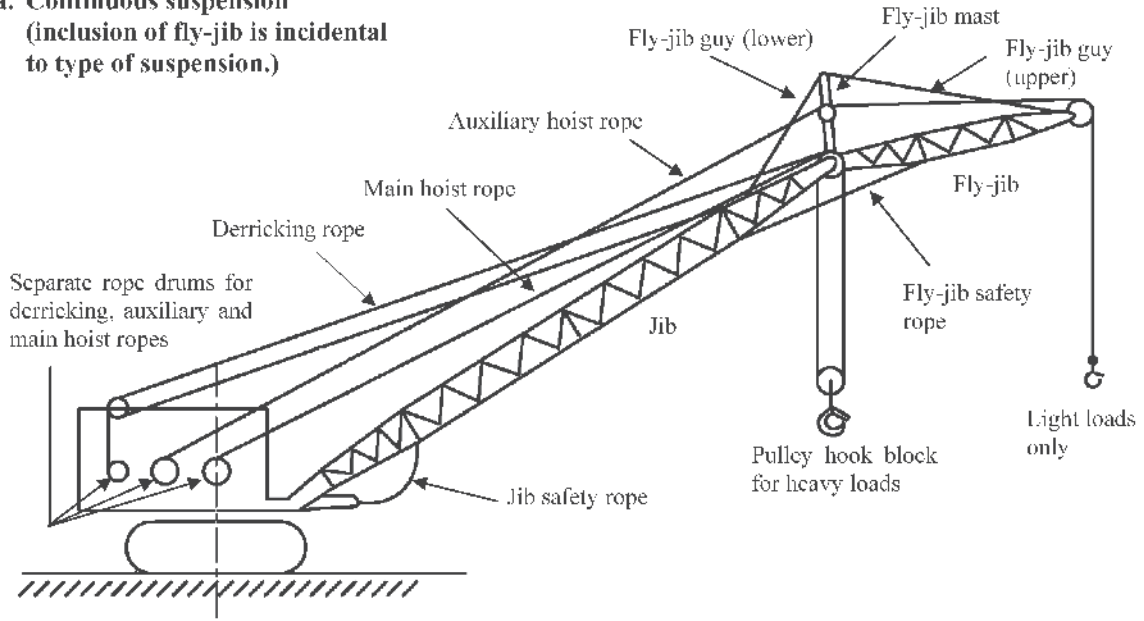
10.4 Jib suspension (see Fig. 6)

- 10.4.1 Correct length of derricking rope and ties should be used for the jib fitted according to the manufacturer's instructions.
- 10.4.2 Longer jibs may require special or auxiliary suspension equipment such as a high gantry, mast, intermediate suspension, etc. Check should be made for the maximum length of jib which can be raised with the crane as specified by the manufacturer.

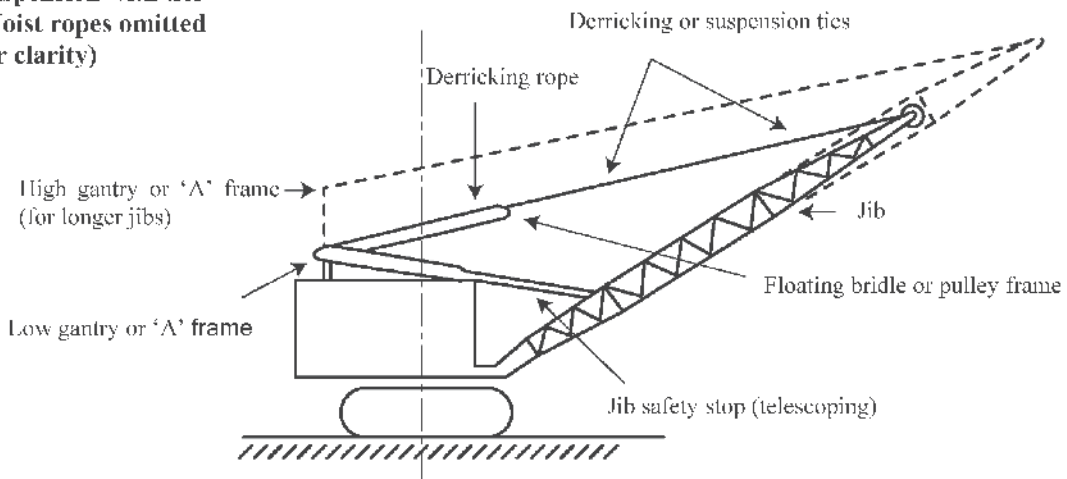
10.5 Load hoist rope

- 10.5.1 The rope system should be strong enough to handle the maximum load required to be lifted on a jib, and the rope is of sufficient length to perform the load lifting or lowering operation.
- 10.5.2 Correct type and length of hoist rope as specified by the manufacturer should be fitted. The steel rope should be made to BS 302: Stranded Steel Wire Ropes or equivalent national standards.
- 10.5.3 The number of falls of hoist rope according to the jib length or maximum load to be fitted should be the same as required by the manufacturer.
- 10.5.4 For the case of an automatic safe load indicator installed, the indicator cam and/or setting should correspond with the jib length fitted and the number of falls of the hoist rope used.
- 10.5.5 Not less than two coils should always remain on the drum and the drum capacity should not be exceeded.

**a. Continuous suspension
(inclusion of fly-jib is incidental
to type of suspension.)**



**b. Suspension with ties
(Hoist ropes omitted
for clarity)**



**c. Mast suspension
(Hoist ropes omitted
for clarity)**

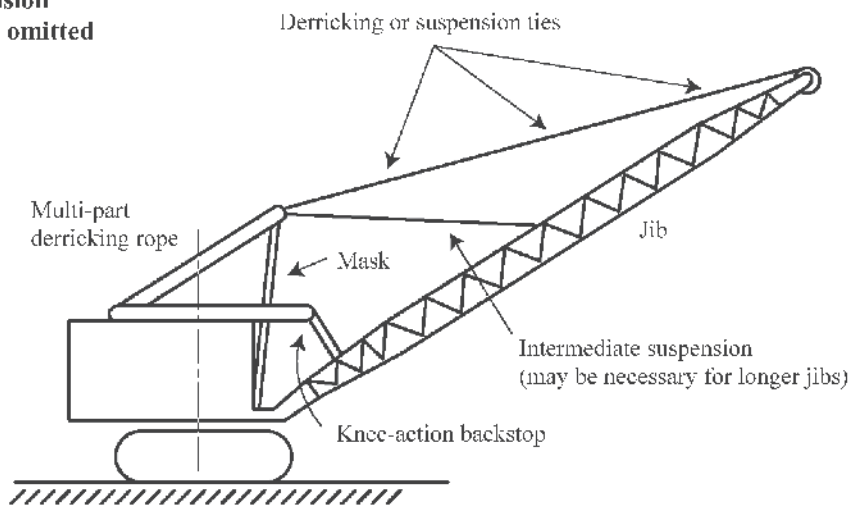


Fig. 6 Typical rope and suspension systems on mobile cranes

10.6 Safety devices

- 10.6.1 Before the crane is put into use, a check should be made to ensure that all disconnected or by-passed safety devices such as load indicator, overload cut-out or motion limit switch, etc. during previous erection or dismantling operations have been reconnected and are functioning properly.
- 10.6.2 Adjustment should be made to the visual load-radius indicator and automatic safe load indicator each time when the crane condition or front-end equipment is varied. For example, such variation would be for changes in jib length, fly-jib length, falls of hoist rope (main or auxiliary), angle of fly-jib off-set, and also between mobile (on tyres) and with outriggers set operations.

10.7 Crane stability, erection and dismantling procedures

- 10.7.1 The correct amount of counterweight should be fitted on the crane and at the appropriate location as specified by the manufacturer's counterweight chart before a jib is elevated.
- 10.7.2 When additional counterweight for longer booms/jibs are fitted, it should be removed if the operating length of jib is restored to original length.
- 10.7.3 For crawler cranes with adjustable track span, retracted tracks for the sake of transportation should be fully extended during operation.
- 10.7.4 Erecting or lowering of long jibs should be performed with the jib axis in the longitudinal axis of the mounting, i.e. in the position offering greatest machine stability. Besides, for the case of crawler-mounted crane operating on a hard concrete surface, wooden packers should be placed under the ends of the crawler tracks to reduce the tendency for the machine to rock during the lowering of long jib to the ground.
- 10.7.5 Appropriate precautions including the re-setting of auxiliary outriggers should be taken prior to the lowering of long jibs to the ground.

- 10.7.6 The hook block should be lowered and rested on the ground before lowering the jib to ground level in order to maintain the best margin of stability.

10.8 Tyres

- 10.8.1 For wheel-mounted cranes and truck-mounted cranes which are fitted with pneumatic tyres, check should be made to ensure the conditions of the tyres and that they are inflated to the recommended pressure prior to any lifting operation.
- 10.8.2 Any replacement tyres fitted should conform to the manufacturer's specification regarding the size, construction and rating.

10.9 Travelling and transportation

10.9.1 Site travelling with long jib fitted

- (a) When it is necessary to travel long jib crane which has been assembled and erected at a remote location to the place of work, it should be handled with great care and under the supervision of a competent person.
- (b) The ground to be traversed should be firm and level.
- (c) The operation should be performed at creep speeds with the jib in line with the direction of travel and with the slewing locks and/or swing brake engaged. A suitable jib angle to maintain the stability of the crane should be determined before the operation. Reference should be made to the manufacturer's instructions.

10.9.2 Loading cranes for transportation

- (a) When loading and off-loading crawler-mounted cranes and wheel-mounted cranes onto the transporter, care should be exercised when negotiating the deceptively steep ramps onto the vehicle to ensure that the crane does not tip over backwards.
- (b) The specified maximum gradient for stability of the crane for transportation should not be exceeded.

10.9.3 Security of crane for transportation

- (a) In case that the mobile crane is transported by road, it should be stowed on and securely attached to the carrying vehicle so as to prevent any movement of crane, or any part of it or its equipment during transit.
- (b) Additionally, the manufacturer's instructions or recommendations for crane transportation should be followed regarding the restrictions in jib length, jib suspension and counterweights.

10.9.4 General precautions to be taken when transporting cranes

- (a) A suitable transporting vehicle of adequate loading capacity and bed dimensions to accommodate the crane should be employed.
- (b) The crane's operational brakes and when fitted, propel or digging locks should be engaged and the crane should be fully chocked against all movement.
- (c) The crane should be securely lashed to the vehicle to prevent the crane from bouncing, tipping or sliding off the bed.
- (d) The upperworks should be cross-chained against possible rotation in addition to setting the swing brake and/or slewing lock of the crane.
- (e) Hook block and any other loose items should be securely lashed to prevent any movement during transit.
- (f) For the case of truck crane, the outrigger beams and feet should be securely stowed and fastened in position to prevent any movement during transit.
- (g) It should be noted that the statutory requirements on the movement of cranes on roads under the Road Traffic Ordinance, Cap. 374 shall also be complied with.

11. Procedures and Precautions

11.1. Suspension of load

11.1.1 No load is allowed to be left suspended unless a competent person is in charge of the crane during the period of suspension (Regulation 12A of the LALGR). The operator should remain in the operating position. The machine should be fully operational to meet any emergency arising and with the hoist brake lock, the boom derricking safety pawl and the swing lock/brake, where fitted, all engaged. Under no circumstances should the crane be left unattended with the load suspended.

11.2. Leaving the crane unattended for a short period

11.2.1 A mobile crane should not be left unattended even for short periods unless the following precautions are adopted:

- (a) the load should be removed from the hook;
- (b) the hook should be raised to a high position at which it would be safely clear of other operations;
- (c) the engine of crane should be stopped and appropriate motions should be braked and locked including those preventing rotation of the upperworks;
- (d) the ignition key and any other keys should be removed from the crane and kept by the operator; and
- (e) for details of methods to safeguard particular types of cranes, reference should be made to the crane manufacturer's instructions.

11.3. Leaving the crane unattended for a long period of time

11.3.1 For longer periods of leaving the crane unattended and for out-of-service conditions, the following precautions should be adopted:

- (a) isolation should be more permanent, e.g. switches should be

locked off, fuel supplies cut off and any doors giving access to machinery or control cabins should be locked to prevent unauthorized access;

- (b) the jib should be secured or lowered according to the manufacturer's instructions for out-of-service conditions;
- (c) if it is not possible to lower the jib due to space restrictions, the hook block should be lowered near to ground level and secured to a substantial anchorage vertically below the jib point;
- (d) the ignition key and any other keys should be removed from the crane; and
- (e) for details of methods to safeguard particular types of cranes, reference should be made to the manufacturer's instructions.

11.4 Routine Checks

11.4.1 At the beginning of each shift or working day, the operator, if competent for the purpose, or a competent person, should carry out the following routine visual inspection, as appropriate:

- (a) checks as required by the manufacturer's instructions;
- (b) check that the automatic safe load indicator is correctly set and that the manufacturer's daily test is carried out;
- (c) check that the correct load-radius scale appropriate to the jib (or fly-jib) length is fitted on the visual indicator;
- (d) check the levelling of the crane to confirm that there has been no change in the original levelling, no sinking of outrigger feet or settling of the foundation;
- (e) check the security of the counterweight or ballast where this is in the form of removable weights, check that the weights fitted correctly correspond to those shown on the counterweight chart for the operating condition [Note: Where the stability of a crane is secured by means of removable weights, a diagram or notice indicating the position and amount of the weights shall be affixed to the crane in a place where it can easily be seen (Regulation 7F of the LALGR)];

- (f) check the oil level(s), fuel level and lubrication;
- (g) check hook for signs of obvious wear and damage;
- (h) check the ropes, and rope terminal fittings and anchorages for obvious damage and wear;
- (i) check the condition and inflation pressure(s) of tyres (where applicable);
- (j) check that all water is drained from any air receivers;
- (k) check the jib structure for obvious damage;
- (l) check the operating pressures in any air and/or hydraulic system(s);
- (m) check leakage of brake fluid and hydraulic oil;
- (n) check the operation of the crane through all motions with particular attention to brakes to ensure that these are operating efficiently;
- (o) check the operation of all limit switches or cut-outs (use caution in making the checks in case of non-operation); and
- (p) for safety and to prevent the risk of fire, the crane cabin is in a tidy state, is free from tins of grease and oil or other fluids; from rags, tools, shackles, and other materials, and that a fire extinguisher suitable for extinguishing both electrical and other types of fire is available in a convenient place in the crane cabin.

11.4.2 At least once a week a full inspection of the crane shall be carried out by a competent person. Apart from those items under section 11.4.1 covered in the daily inspection, attentions should also be paid to all anchorages, fixing and structural members. The check should include identifying of significant cracks and flaking of the paint on structural members and joints, which are usually signs of permanent deformation and loose joints. Bolts should be checked for tightness and welded joints inspected for visual cracks. Check the slewing rings, slewing gears and gusset plates in the mobile ring for defect. This section of the crane takes the direct torsion load of braking and acceleration of the slewing motions which constitute a high proportion of the crane's duty cycle; further, the load is a cyclically reversing head, the worst possible condition for producing fatigue failures. The competent person should also check for any abnormal noise while the crane is in motion as this is usually the sign of crane damage.

- 11.4.3 Use of "Checklist" for carrying out the above mentioned routine checks is recommended. A certificate in an approved form stating that the mobile crane is in safe working order shall be submitted to the owner by the competent person when no defect was found in the weekly inspection.
- 11.4.4 Should the person carrying out an inspection find any defect (such as twisted/broken wires, etc.) or abnormality in the mobile crane or in the operation of the mobile crane, or should the mobile crane be accidentally damaged, this should be reported immediately to the person responsible for the safe use of the crane. The machine should be taken out of service until the faults have been rectified and clearance is given by the person responsible for the safe use of the crane. Sufficient space on the "Checklist" for reporting the defects are recommended.
- 11.4.5 The competent person responsible for the inspection of a mobile crane or any lifting gear should have the responsibility to ensure the mobile crane or the lifting gear under his responsibility has received proper regular inspection according to the schedule set under the safe system of work. He should record the state of every mobile crane or lifting gear. He should ensure that a mobile crane or lifting gear is withdrawn from service should he reveal in the inspection that it is not in safe working order. In particular, the competent person responsible for the inspection of the mobile crane or lifting gear should:
- (a) have attained the age of 18 years;
 - (b) be an experienced mechanic;
 - (c) have properly trained in crane operation and crane maintenance;
 - (d) be familiar with hazards, limitations and safety precautions associated with crane operation;
 - (e) be familiar with the servicing or repairing requirements and limitations as defined in the operation and maintenance manuals of the cranes under his responsibility;
 - (f) be familiar with the provisions related to the use of mobile cranes in the LALGR and the contents in this Code; and

- (g) be capable of performing simple tests in accordance with the manufacturer's instructions.

11.5 Permit to work for maintenance

- 11.5.1 Before any major repairs, adjustments or inspections are carried out on a crane, a proper system of granting permission to work should be considered. Such a permit to work system properly implemented will ensure that the necessary precautions are taken to make the crane safe for maintenance or repair work, etc. (e.g. by isolation and lock-off of electrical equipment, removal of ignition keys, etc.) and will notify all affected persons that the crane is out of service.
- 11.5.2 A permit to work is a specially designed form issued only by the person responsible for the safe use of the crane. It indicates that special precautions have been taken to make it safe for work on the machine to proceed for a specified period of time. The form should also specify any additional precautions which should be observed by persons carrying out the work.
- 11.5.3 Most system requires that the person performing the work should retain the permit in his possession while carrying out this work. Where several persons are involved on the same job, the permit should be held by the senior person (e.g. a foreman). A commendable practice in this respect is for the permit to be placed in a specially designed carrier (e.g. weatherproof transparent plastic jacket) and displayed in a prominent position on the crane involved, such as on the access door or at the crane operator's station, to indicate that persons are working on the machine.
- 11.5.4 When the work is completed, all permits should be returned to and duly endorsed by the person who issued them before the crane is 'handed over' for normal use. This procedure is as important as the original certification. The person responsible for the safe use of the crane should ensure that all persons who worked under the permit are clear of the machine or area. He should also ensure equipment that was brought in for the work is removed, all safety guards on the crane are

replaced and the machine is in all respects safe for normal use, subject to the conditions specified in section 14 of this Code.

11.6 Safe means of access

- 11.6.1 Provision should be made for safe access to the crane cabin or any other areas necessitating periodic maintenance, inspection, or adjustment purposes.
- 11.6.2 Only the crane operator or the person being authorized should be allowed to climb on the crane in order to gain access to the cabin or to carry out tasks such as maintenance or inspection.

12. Safe Working Loads and Operating Conditions

12.1 Mode of operation and control

12.1.1 Each crane control shall be clearly identified to indicate its purpose and the mode of operation (Regulation 16(2)(b) of the LALGR). When practicable, the crane control shall also be provided with suitable spring or other locking arrangement to prevent accidental movement or displacement (Regulation 16(2)(a) of the LALGR).

12.1.2 Before starting any lifting operation with a crane, the operator should ensure:

- (a) that he has a clear and unrestricted view of the load and operational area; if not, he should act under the directions of an authorized signaller who is positioned to have such a clear and uninterrupted view;
- (b) where telephone or radio communications are being used, that the calling signal is functioning and that verbal messages can be clearly heard; and
- (c) that all gauges are reading correctly and that air or hydraulic systems are up to operating pressure.

12.1.3 Handling of loads near persons

12.1.3.1 When loads have to be handled in the vicinity of persons, extreme care should be exercised and adequate clearances should be allowed.

12.1.3.2 Lifting of loads over highways, railways, or other places to which the public have access should be avoided.

12.1.4 Slewing/travelling clearances

12.1.4.1 Where a crane having a travelling or slewing motion is in use, an unobstructed passageway, not less than 600 millimetres wide, shall be

maintained between any part of the crane liable so to move and any nearby guard rail, fence or other fixture (Regulation 8 of the LALGR).

12.1.4.2 Where it is not practicable to maintain such clearance or where only limited slewing or travelling motion of the crane is possible, special precautions should be taken to avoid a trapping hazard:

- (a) personnel should not be allowed to approach near a crane when it is operating or travelling as there is a danger of being struck or trapped between fixed and moving parts of the crane;
- (b) 'Keep Clear 切勿接近' notices in English and Chinese which are visible from the sides and rear of the machine should be painted on the slewing upperworks;
- (c) for safety awareness purpose, the counterweight or rear-end of the crane should be painted distinctively (e.g. striped high visibility yellow and black); and
- (d) a further notice in English and Chinese should also be displayed on the crane to the effect:

'NO PERSON IS ALLOWED ACCESS TO ANY PART OF THE CRANE WITHOUT THE PERMISSION OF THE OPERATOR

沒有操作員的許可,任何人士都不能進入起重機任何部份的範圍'.

12.2 Safe working loads

12.2.1 The safe working load of a crane is defined in the LALGR as the appropriate safe working load for operating the crane as specified in the current certificate of test and thorough examination delivered in the approved form by a competent examiner in respect of that crane (Regulation 3(1) of the LALGR). In other words, the safe working load is the maximum load under specified conditions for which a crane can lift safely.

12.2.2 Mobile cranes and their associated lifting gear shall be clearly marked with their safe working loads. Means of identification shall be provided (Regulations 11(2) and 18 of the LALGR).

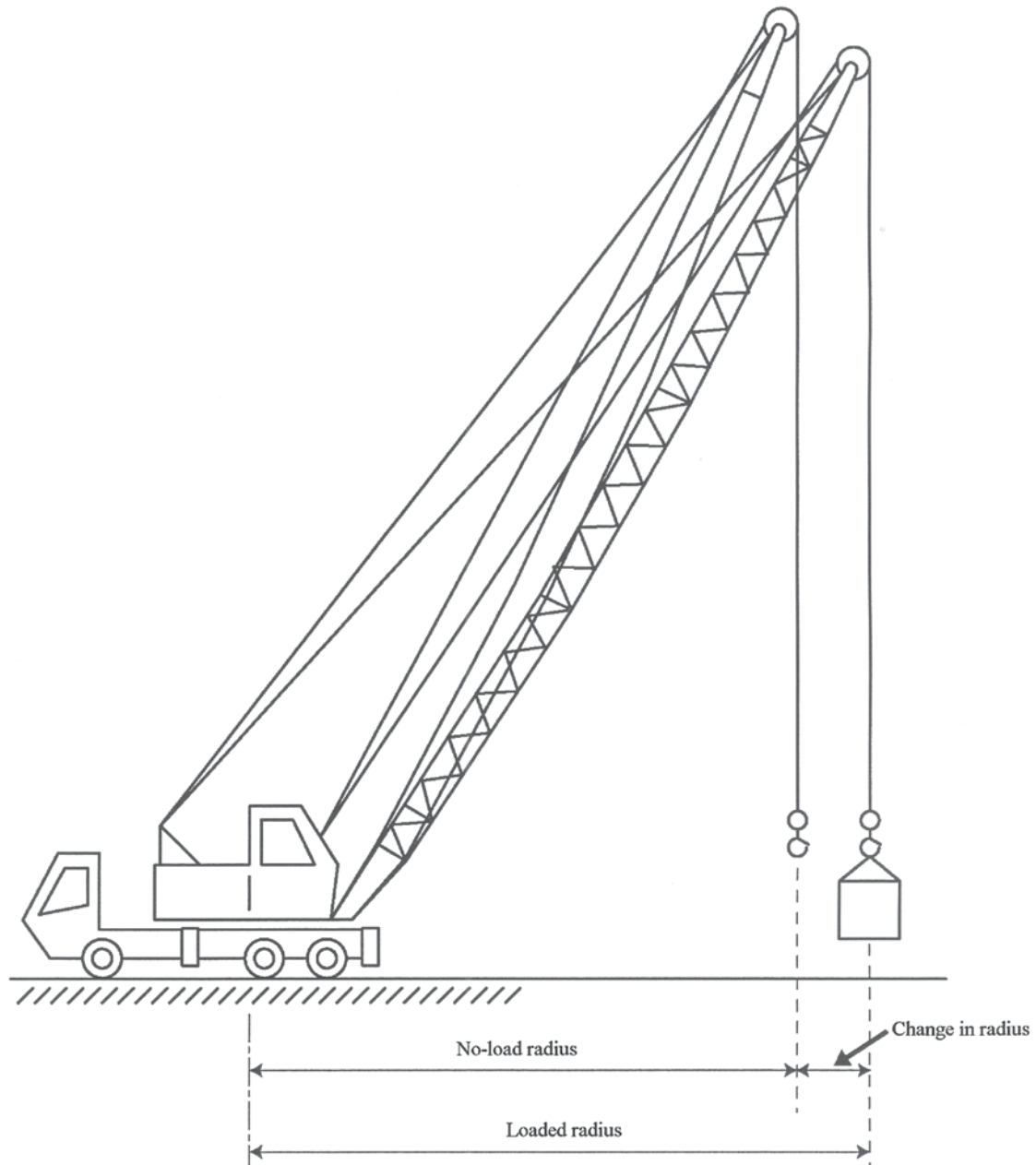
- 12.2.3 Safe working loads apply only to freely-suspended loads. Before lifting a load the hoist line should be plumb. Using the crane hook or slewing motion of a crane to drag any load along the ground, etc should be forbidden. Similarly, sideward pushing/pulling the load whether with bare hands or by chain block/s or by similar equipment should be discouraged. Failure to observe these points may endanger the stability of the crane or introduce loadings (stresses) into the jib for which it has not been designed. Even with an automatic safe load indicator fitted, a structural failure may result without any prior warning being given.
- 12.2.4 In case a mobile crane is used to drag a load not in a vertical direction, steps shall be taken to ensure that no undue stress is imposed on any part of the structure or mechanism of the crane thereby endangering the stability of the crane and such use is supervised by a competent person (Regulation 15(1) of the LALGR).
- 12.2.5 Reference should always be made to the crane manufacturer's manual of appropriate machine specification to establish the restriction, limitations or special conditions applicable to a particular crane.
- 12.2.6 Only the correct table of safe working loads appropriate to the design capacity of the jib, the counter-weight fitted and the specification of the mounting should be used.
- 12.2.7 Due to the variations in the weight of the hook blocks and slings which can be used on mobile crane lifting operations, the weight of the hook block and slings should be considered as part of the safe working load.
- 12.2.8 Allowance on the safe working load should be made according to the manufacturer's instructions when auxiliary equipment such as fly-jib or additional lifting attachments are used.
- 12.2.9 When working at depths below ground level, the actual loading of the crane is affected by the weight of the long hoist rope. The weight of the hoist rope should therefore be taken into consideration of the safe working load.

- 12.2.10 Working at extremes or reach of safe working load should be avoided wherever possible.
- 12.2.11 The crane should be positioned in the most favourable position so as to operate with as short a jib as possible and at a mid-radius position.
- 12.2.12 The safe working load at any given radius generally varies with jib length and any extension in jib would reduce the safe working load.
- 12.2.13 Derricking-out the jib to increase the radius of the load would generally result in a reduced lifting capacity.
- 12.2.14 The load-radius dimension is the radius of the hook with the safe working load suspended, unless otherwise specified. When a load is picked-up, owing to the stretch of the guy ropes of loaded jib and/or deflection of the jib structure, the hook radius will increase. With the approach of maximum safe working load, this increase may take the load outside the permitted radius. Before the lift is made, the jib should be derricked-in to bring the load back into radius, as necessary (see Fig. 7). Conversely when settling down loads with the jib positioned at steep angles, it should be ensured that the jib is not damaged by extreme tensioning in the jib guy ropes. Sudden settling-down or release of loads should always be avoided in order to prevent the jib springing backward or the machine becoming unstable in a backward direction.
- 12.2.15 Fierce movements of any operational control even without a load on the hook should be avoided because these could be dangerous and damaging to the structure or machinery of the crane.
- 12.2.16 For cranes fitted with long jibs (and particularly extended telescopic jibs) at large radii, the influence on overturning moment due to the weight and dynamic effects of the jib itself would be very large by comparison with that due to the suspended load. Therefore, the operational controls such as the jib derricking control should be operated sensitively and smoothly.

12.2.17 Zone of operation for cranes

- (a) Cranes would usually be restricted to different duties over the front, rear-end or sides of the crane. The lifting or movement of loads over the front of the crane may overload the front axle(s) or chassis frame owing to the weight distribution of the machine. The safe working load applicable to the zone of operation should be observed.
- (b) In some instances, operation of the hydraulic cranes with telescopic jibs should be restricted to the blocked condition with outriggers set and free-on-wheels duty may not be permissible (see sub-section 6.2.6).
- (c) Reference should be made to the manufacturer's manual for details of restrictions.

12.2.18 Where a means for locking out or reducing the spring effect of the suspension is used during crane operations for truck crane, the manufacturer's instructions should be followed in respect of its use.



CHECK THE LOAD RADIUS DURING OPERATION

The figure shows the effect on radius when picking-up or setting down loads due to stretch in jib suspension ropes, jib and machine deflection. Where necessary re-adjust the radius after lifting the load just clear. Always place loads gently. Otherwise the jib may collapse or be damaged.

Fig. 7. Influence of rope stretch on board operation

12.3 Near maximum working loads

12.3.1 When handling load which approaches the maximum working load for an operating radius (95% - 100%), crane motions should be operated with extreme care. The load should initially be lifted just clear of the supporting surface and brought to rest in order for the slings, balance of the load, etc., are checked before proceeding further. Proper care should be exercised by the operator, at all times, to avoid shock or side loadings on the jib. Care should also be taken to avoid the hook contacting the jib head structure, either through overhoisting or when derricking out the jib. In the latter case, as the jib is derricked out the hook should be lowered off in order to maintain an adequate clearance between the hook and jib head structure.

12.3.2 The safety precautions regarding the operations near maximum working loads are as follows:

- (a) the weight of the load should be ascertained as reliable as possible, for example, by the use of a proving ring or other means before lifting the load;
- (b) a trial lift should then be made to check the operational stability by raising the load just clear of the ground and at a radius corresponding to the maximum radius at which the load is to be handled;
- (c) the load should then be placed on the ground to check if adjustments to the outriggers, slinging and radius are required prior to the final lift;
- (d) the operator should exercise proper care to avoid shock or side loadings being imposed on the jib; and
- (e) any automatic safe load indicator fitted should not be solely depended upon and only be used as a check that the load is within the capacity of the crane.

12.4 Travelling with suspended loads

12.4.1 Travelling with suspended loads should be handled with great care and under the supervision of a competent person.

12.4.2 Safe working loads appropriate to free-on-wheels or mobile operation should not be exceeded when travelling with suspended loads.

12.4.3 Any special restrictions imposed by the manufacturer should also be followed.

12.4.4 The operation should be performed at creep speeds with the jib in line with the direction of travel and with the slewing locks and/or swing brake engaged. A suitable jib angle to maintain the stability of the crane should be determined before the operation. Reference should be made to the manufacturer's instructions.

- 12.4.5 The load should be carried forward in case of crawler-mounted or wheel-mounted cranes.
- 12.4.6 The load should be carried at the rear of the truck in the case of truck-mounted cranes (see sub-section 12.2.17). The crane operator should remain in the crane cabin to control the load and a second person should be deployed to drive the vehicle.
- 12.4.7 In general, travelling acceleration, slewing motions and braking action should be operated gently to limit the swing of the load.
- 12.4.8 Steady lines should be attached to the load which in turn should be carried as near to the ground as possible to prevent pendulum motion.
- 12.4.9 Ground preparation
- 12.4.9.1 The ground to be traversed should be prepared to ensure a firm and level access route for the crane where necessary.
- 12.4.9.2 To prevent the crane tilting laterally or in the direction of travelling, ground depressions or pot-holes if any should be filled.
- 12.4.9.3 Mats or other suitable travelling surfaces should be laid where sinkage of the wheels or crawlers could occur in soft ground.
- 12.4.10 Slopes
- 12.4.10.1 Mobile cranes travelling with suspended loads should avoid to travel on slopes wherever possible.
- 12.4.10.2 If unavoidable, a competent person should be consulted for the precautions prior to the negotiation and in attendance to advise on the feasibility of the operation. The following points should be particularly noted:
- (a) for safety sake, any crane used in the negotiation of slopes should have a generous margin in capacity over the loads to be lifted;
 - (b) the load should always be carried on the uphill side of the crane, irrespective of the travel direction;
 - (c) the load should always be placed on the uphill side of the crane and precautions taken to ensure that neither the jib nor crane become unstable on release of the load;
 - (d) the load should always be carried as near to the ground as possible;
 - (e) the swing brake and/or slewing lock should be engaged during the negotiation;
 - (f) no slewing should be allowed except to maintain the load in the uphill direction;

- (g) before starting up a gradient by a crawler-mounted crane, digging locks, where fitted, should be engaged in the position to prevent the crane from running backwards. The digging locks should be engaged again when arriving at the working location to prevent any movement of the crawlers before shifting the clutch from travel to slew; and
- (h) a suitable jib angle to maintain the stability of the crane should be determined before the operation. Reference should be made to the manufacturer's instructions.

12.5 Carrying of persons by crane

12.5.1 A crane can only be used to carry persons where the use of a builder's lift, a tower working platform or a suspended scaffold is impracticable. The carrying of persons by a crane is subject to certain statutory requirements which include:

- (a) the person shall be carried in a chair, cage, skip or other receptacle at least 900 mm deep, the receptacle is of good construction, sound material and adequate strength, and is provided with suitable means to prevent any occupant from falling out and does not contain material or tools liable to interfere with his hand hold or otherwise endanger him;
- (b) suitable measures are taken to prevent such chair, cage skip or other receptacle from spinning or tipping in a manner dangerous to any occupant;
- (c) if a hook is fitted to the lifting appliance, it is so designed and maintained as to prevent the accidental displacement of such chair, cage, skip or other receptacle from the hook; and
- (d) where the person is carried in a boatswain's chair or other similar plant or equipment less than 900 mm deep, a suitable safety belt attached to an independent lifeline should be provided to and worn by the occupant and the lifeline should be securely suspended.

(Regulation 18B of the LALGR)

- 12.5.2 The receptacle should also be so designed that in case of falling or failure of the receptacle:
- (a) the occupant will not be trapped between any part of the receptacle (including the sling) and the safety belt or the lifeline; and
 - (b) no part of the receptacle will give rise to a serious bumping hazard to the occupant.

12.6 Communication system

- 12.6.1 In the interests of safety, a standard signalling code (see Table 1) may be adopted. It is recommended that copies of the signal code shown in Table 1 be issued to all crane operators, slingers and any other persons concerned.
- 12.6.2 In certain situations and where special lifts are involved, it may be necessary to supplement the hand signals by other forms of communication such as radio, walkie-talkie or telephone.
- 12.6.3 If tele-communication equipment such as radio or walkie-talkie is used in a multi-crane situation, suitable arrangement should be made to ensure that the radio frequency is not interrupted for whatever reason at any time during the crane operation period and correct message is received by persons using such equipment.

12.7 Weather conditions

- 12.7.1 Cranes shall not be used under weather conditions likely to endanger its stability or affecting its safe operation. Before a crane is taken into use after exposure to weather conditions likely to have affected the stability of the crane, the crane's anchorage or ballast, where applicable, shall be tested by a competent examiner (Regulation 7G of the LALGR).
- 12.7.2 Any instructions issued by the crane manufacturer advising conditions under which a crane should be taken out of service and recommending the conditions in which it should be placed should be strictly followed. During adverse weather conditions such as rainstorm and lightning,

adequate precautions should be taken to prevent personnel associated with the use of the crane from being endangered.

- 12.7.3 Cranes are generally designed to operate in conditions of normal steady wind speed and should not be operated in wind speeds that are in excess of those specified in the operating instructions for the crane. Gusty wind conditions may have an adverse effect on safe working loads and machine stability. Even in relatively light wind conditions it is prudent to avoid handling loads presenting large wind-catching surfaces. The large surfaces might result in loss of control of the load or overturning of the crane despite the dead weight of the load being within the normal working capacity of the machine.
- 12.7.4 Where a load has a large surface area in relation to its weight, for example a large timber shutter or panel, the action of the wind or the load may give rise to unsafe working conditions in respect of the strength or stability of the crane, or because the load cannot be adequately secured against swinging or spinning; with some loads this can occur at wind speeds below that specified for in-service conditions. Under such circumstances the size of the load should be limited to that which can be safely handled by the crane and which will not create unsafe conditions for operatives. Furthermore, a tag line or control rope should be used for assisting in the control of the swing or rotation of the load.
- 12.7.5 Name boards or other items presenting a wind catching area should not be fitted to the jib of a mobile crane without the express approval of the manufacturer.
- 12.7.6 Before a lifting operation is started, information on wind conditions should be obtained through the weather forecast to ensure the wind speed limit specified by the manufacturer is not exceeded.
- 12.7.7 Any lifting operation should be stopped and the mobile crane should be secured in an appropriate out-of-service condition whenever the wind speed limit specified by the manufacturer is exceeded.

12.8 Mobile cranes for other duties

12.8.1 General

- 12.8.1.1 A mobile crane should not be used for piling operations, grabbing, magnet service or any other duty which might impose excessive and/or indeterminate loadings onto the crane structure unless it is also designed for such operation. Reference should also be made to the manufacturer's manual on the limitations and conditions where such operation can be used.
- 12.8.1.2 Working loads are often required to be reduced in accordance with the duty conditions of a mobile crane to be used for such duties. Manufacturer's recommendations should therefore be strictly followed for each specific usage.

12.8.2 Piling Service

- 12.8.2.1 Piles are usually driven into the ground by means of an impact or reciprocating hammer. Bored-pile techniques, with or without casings, may also be used whereby the pile is cast in its location by pouring concrete into a hole driven or bored into the ground. Piling operations, on occasions, are to withdraw or extract the pile (or pile casing) once their useful purpose has been served.
- 12.8.2.2 Piling service necessitates the use of special equipment. Depending on the type or sophistication of piling, this equipment may either be in the simple form of a temporary attachment to a crane or, at the other extreme, may form a permanent special-purpose installation on a machine.
- 12.8.2.3 For pile extraction, an extractor, which is usually of reciprocating or vibratory type (and may be used either for driving-in or pulling-out piles) strikes the pile upwards and loosens its adhesion in the ground. The actual pull to withdraw the pile is done by the hoist line from which the extractor is suspended. Extraction should be effected by a 'smooth' pull on the hoist line and under no circumstances should the hoist rope

be jerked, the jib be swung or the machine be tipped to achieve faster results.

- 12.8.2.4 In assessing the required capacity of a crane for pile extraction duty, in addition to the weight of the extractor and pile, account should be taken of the frictional forces occurring between the soil and the pile during extraction, and the induced vibrating effect of the load. In the case of sheet pile extraction a further allowance is necessary for the friction between the clutches of the pile being extracted and the adjacent pile remaining in the ground. As the frictional effects are largely unknown factors, until extraction commences, the largest crane on site with ample safety allowance available will always give the safest and quickest results providing the pull does not exceed the extractor rating.

12.8.3 Grabbing and magnet crane service

- 12.8.3.1 When using cranes for grabbing or magnet crane service, allowance should be made not only for the weight of the grab, magnet or other attachments, together with load, but also for additional loadings imposed on the crane resulting from fast slewing, grab suction effects, impacts, etc. In general, for grabbing or magnet crane service the weight of the grab and contents, or the weight of the magnet and load will be less than the corresponding safe working loads for crane service. Reference should be made to the manufacturer's specification for details of special duty ratings.

12.8.4 Tandem Lifting by mobile cranes

- 12.8.4.1 Lifting a load with two cranes is a potentially dangerous operation which should be avoided except where the physical dimensions, characteristics or weight of the load prevent this being handled by a single crane. There are statutory requirements governing the lifting operation in which more than one crane is used (Regulation 7I of the LALGR). Tandem lifting requires extremely careful planning and an accurate assessment of the share of the load which is to be carried by each crane. There should be a full appreciation of how and to what extent this can vary should the load come out of level or should one or

both cranes have to derrick, travel or slew, resulting in the hoist ropes coming out of plumb.

12.8.4.2 If any of these circumstances occur an additional load can be thrown on either or both cranes which may affect crane stability or cause a structural collapse.

12.8.4.3 Special lifting tackles may be also necessary to suit the maximum variation in load distribution and direction of application which can occur during tandem lifting.

12.8.4.4 All tandem lifting operations should be thoroughly planned in advance by a competent person. Where possible cranes of equal capacity and similar characteristics should be used. The cranes and lifting tackle to be used should be selected to have a capacity margin greater than that needed for the proportioned load when handled as a single lift.

12.8.4.5 A competent person should be specially appointed to supervise the operation, and the signals to each crane operator should be clear and well rehearsed.

12.8.5 Other special uses of hydraulically driven mobile cranes

12.8.5.1 In Hong Kong, hydraulically driven mobile cranes which are operated with hydraulic pumps and motors are sometimes used in driving other machineries in foundation work. Beside lifting work, these cranes can deliver their pressurized fluid to drive other hydraulic machineries such as vibrators and drilling machines. For the safe operation of hydraulically driven mobile cranes when driving other machineries, the following hazards should be observed:

- (a) bursting of hydraulic hoses of machinery causing interruption of supply of fluid to the crane;
- (b) decrease in stability of crane when attached with these machineries;
- (c) increase in back pressure which may affect the safety of crane; and
- (d) overheating of hydraulic fluid due to extra loading.

13. Maintenance

13.1 Statutory requirements

- 13.1.1 Cranes shall be properly maintained (Regulation 4(b) of the LALGR). Table 2 gives the legal requirements under the LALGR for the testing and examination of cranes after substantial repair.

13.2 Planned maintenance

- 13.2.1 In order that mobile cranes may operate safely and efficiently, it is essential to carry out preventive maintenance work so that the risk of accidents due to breakdowns is reduced to a minimum. Manufacturer's instruction manuals recommend that specific tasks be carried out at stated intervals and these should be followed. Any repairs or replacement of components should be in accordance with the manufacturer's recommendations or specifications.
- 13.2.2 In addition to any statutory regulations, a record or log should be kept for all cranes, giving information such as diameter, length and construction details of ropes, hours worked, adjustments, insulation checks, renewal of parts, thorough examinations and repairs. The availability and source of replacement items should be checked and noted in the record.

13.3 Competence of maintenance personnel

- 13.3.1 All maintenance staff should be fully aware of the hazards involved in working on cranes. Maintenance staff should have an adequate working knowledge of the machinery they are required to maintain and have access to the manufacturer's relevant literature.

14. Inspection, Examination and Testing

- 14.1 There are statutory requirements governing the testing, examination and inspection of mobile cranes (Regulations 5, 7A, 7B, 7E and 7G of the LALGR). Inspection shall be carried out by a competent person whilst test and examination shall be carried out by a competent examiner. Reference can be made to Table 2 which is a summary of the legal requirements of testing, thorough examination and inspections of mobile cranes. Testing of mobile cranes should conform to British Standard BS 7121 or equivalent standards. Reference should also be made to the Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by The Labour Department.
- 14.2 Any components or jib/boom sections designed and manufactured or altered by anyone other than the original manufacturer should be examined and certified by a competent examiner to be safe to accommodate all the loads which the jib/boom or components of the original manufacturer can sustain. Prior to the examination and certification, the competent examiner should consult the original manufacturer on the suitability of such a replacement.
- 14.3 Where an inspection as required under Regulation 7A of the LALGR shows that the crane is in a safe working order, the competent person shall deliver forthwith, or within a reasonable time thereafter, to the owner the certificate of such inspection. (Regulation 22(1) of the LALGR)
- 14.4 Should the competent person carrying out an inspection find any defect (such as twisted/broken wires, etc.) or abnormality in the mobile crane or in the operation of the mobile crane, or should the mobile crane be accidentally damaged, this should be reported immediately to the person responsible for the safe use of the crane. The machine should be taken out of service until the faults have been rectified and clearance is given by the person responsible for the safe use of the crane. Sufficient space on the "Checklist" for reporting the defects is recommended.

- 14.5 Where a test or a thorough examination shows that a crane is in a safe working order, the competent examiner shall deliver the test or examination certificate to the owner of the crane within 28 days after the test or the thorough examination (Regulation 6A(1)(a) of the LALGR).
- 14.6 Where a test or a thorough examination shows that a crane cannot be used safely unless certain repairs are carried out, the competent examiner shall immediately inform the owner of the crane of that fact and shall, within 14 days after the test or the thorough examination, deliver a report to the owner of the crane and a copy of it to the Commissioner for Labour (Regulation 6A(1)(b) of the LALGR).
- 14.7 A competent examiner or competent person shall not deliver to an owner a certificate or make a report which is to his knowledge false as to a material particular (Regulation 21(2) and 22(2) of the LALGR).
- 14.8 All test certificates and related documents shall be kept in a safe place and be made available for inspection by any occupational safety officer. A copy of the relevant and the most recent certificate or report shall be displayed in the driving cabin or other prominent place on the equipment to which it relates or in a prominent place nearby (Regulation 18C of the LALGR).

15. Securing of Loads before Lifting

15.1. Loads to be safely secured

15.1.1 The owner of a lifting appliance shall, before it is used, ensure that every part of any load to be raised or lowered by the lifting appliance is:

- (a) securely suspended or supported; and
- (b) adequately secured so as to prevent danger arising to persons or property as a result of the slipping or displacement of any part of the load.

(Regulation 7J(1) of the LALGR)

15.1.2 The risk of the slipping or displacement of any part of the load as well as the falling down of the load as a whole should be properly considered during the establishment of the safe system of work (see section 3 of this Code).

15.1.3 Particular attention should be paid to the provisions of proper rigging procedures and precautions. It should also be noted that it is the responsibility of owner to ensure that the persons who direct, rig and handle the loads have received training in the principles of the operation, are able to assess weights and judge distances, heights and clearances, are capable of selecting tackle and lifting gear as well as rigging method suitable for the loads to be lifted, and are capable of directing the movement of the crane and load to ensure the safety of all personnel.

15.1.4 It should also be noted that loose materials, such as stones, bricks, tiles, slates or other objects have to be lifted in a receptacle of adequate strength. Where a receptacle is used for raising or lowering stones, bricks, tiles, slates or other objects, the owner of the lifting appliance or lifting gear shall cause the receptacle to be enclosed or to be so constructed or designed as to prevent the accidental fall of any such objects (Regulation 7J(3) of the LALGR).

15.2 Precautions to be taken before the lifting operation

- 15.2.1 The weights of loads to be handled should be determined or properly assessed.
- 15.2.2 Proper rigging methods should be established. Consideration should be given to the effect of increasing tension on the sling with increasing sling angle to the vertical or with increasing choker angle to the vertical. It should be noted that the angle between any sling leg and the vertical should not be greater than 45 degrees unless a proper assessment with detailed calculation has been conducted. Anyhow, in no circumstances should the angle be greater than 60 degrees. Consideration should also be given to the strength of the load to resist the induced lateral force when a sling is applied across it.
- 15.2.3 It should be noted that long bars should be securely tied up before a sling is being applied and a tag line or control rope should be provided to prevent the swing or rotation.
- 15.2.4 Suitable lifting gear, equipment and tackle should be employed. Particular consideration should be given to the balance of the loads to be lifted. As far as reasonably practicable, designed lifting points should be provided. If lifting points are not provided, the position of the centre of gravity should be assessed. It is important that the supporting hook should be positioned directly above the centre of gravity. The type of sling and the slinging methods used should ensure that the load would not topple or slip. Attention should also be paid to the provision of an effective safety latch on the lifting hook of the crane to prevent displacement of the sling.
- 15.2.5 Every lifting gear, equipment or tackle to be used should comply with the statutory requirements concerning the construction, safe working loads, marking of safe working loads, testing, examination, inspection, etc. laid down in Part III of the LALGR.
- 15.2.6 It should be noted that a wire rope sling should be withdrawn from service if any of the following is revealed during an inspection/examination:

- (a) the markings on the wire rope sling disappear or become illegible;
- (b) there is a reduction of more than 10% in nominal rope diameter due to wear;
- (c) the total number of visible broken wires in any length of 10 diameters exceeds 5% of the total number of wires in the rope;
- (d) there are 3 or more broken wires located at a particular point on the rope;
- (e) there is significant distortion of the rope due to kinking or crushing, excessive corrosion or other obvious defects; or
- (f) there is an obvious damage on any fitting, ferrule or splice of the sling.

15.2.7 It should be noted that a chain sling should be withdrawn from service if any of the following is revealed during an inspection/examination:

- (a) the markings on the chain sling disappear or become illegible;
- (b) there is a reduction of more than 10% in nominal diameter on any link due to inter-link wear;
- (c) there is noticeable elongation on any link or any sling leg;
- (d) there is an obvious crack, significant cut/nick/gouge, bent/twisted link, excessive corrosion or other obvious defects; or
- (e) there is an increase of more than 10% in throat opening of any hook of the chain sling.

15.2.8 Where a sling is employed, the sling should not be allowed to damage the load, nor should the sling itself be damaged. If the sling is to be attached to the load, the points used for attachment, e.g. lugs and eyebolts, should be suitable and adequate for the purpose of lifting the whole load.

15.2.9 Suitable packing/padding should be provided and used to prevent damage to slings by sharp edges on loads.

15.2.10 When lifting rigid objects with slings having three or four legs, any two of the slings, after considering the angle between the legs, must be sized in capable of supporting the total load.

- 15.2.11 When using multi-legged slings to lift loads in which one end is much heavier than the other, the decision to select the appropriate sling should be based on the most heavily loaded leg.
- 15.2.12 As far as reasonably practicable, the effective diameter of any pin, hook or other component over which soft eyes are used should not be less than twice the rope diameter for single part legs, and four times the rope diameter for double part legs.
- 15.2.13 It is important to note that the weights of loads, the rigging methods adopted as well as the safe working loads of the lifting gear, equipment and tackle should be made known to the rigging crew.

15.3 Methods of slinging, their application and limitations

- 15.3.1 There are many rigging methods for different kinds of loads being handled. It should be noted that a rigging method which is suitable for handling one load might not be suitable for handling another load. In fact, each rigging method has its limitations. The methods shown in this section are intended to be typical examples and should not be regarded as exhaustive.
- 15.3.2 It should be noted that though wire rope slings are used for illustration, the methods shown in this section are also applicable to the use of suitable chain sling, fibre rope or fibre sling.
- 15.3.3 The owner of any double or multiple sling shall ensure that it is not used in raising or lowering or as a means of suspension if:
- (a) the upper ends of the sling legs are not connected by means of a shackle, ring or link of adequate strength; or
 - (b) the safe working load of any sling leg is exceeded as a result of the angle between the sling legs.
- (Regulation 18A of the LALGR)

15.3.4 Single-leg sling

- (a) *Vertical or straight lift* (Fig. 8) - A vertical or straight lift is only suitable for lifting a load that will be stable when suspended from a single lifting point.
- (b) *Basket hitch* (Fig. 9) - A basket hitch should only be used when the sling is passed through part of the load and the load is balanced on the sling. The lifting should not commence until a shackle is connected to the sling legs. The included angle of the sling should not exceed 90 degrees.
- (c) *Simple Choker Hitch* (Fig. 10) and *Double and Choked* (Fig. 11) - These two slinging methods do not grip the loads completely and should be used only when the loads are easily stabilized or cannot slip out of the sling.
- (d) *Choker hitch double wrapped* (Fig. 12) - The general limitations for this sling method is similar with simple choker hitch, except that with the double wrapped choker hitch the load is gripped more fully, and hence is secured more effectively.

Note : The simple choker hitch or choker hitch double wrapped method should not be used for handling composite loads such as loose bundles of tubes, or bars or wooden battens unless the friction grips between the parts is sufficient to prevent them slipping from the sling. As far as possible, such composite loads should first be tied up securely at their ends by steel wires or similar means of adequate strength.

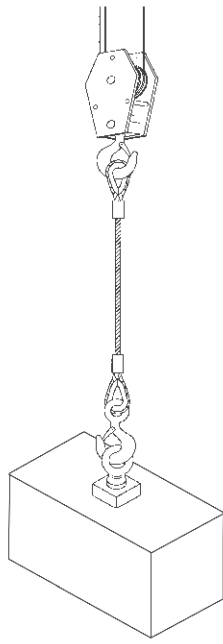


Fig. 8 Vertical or straight lift

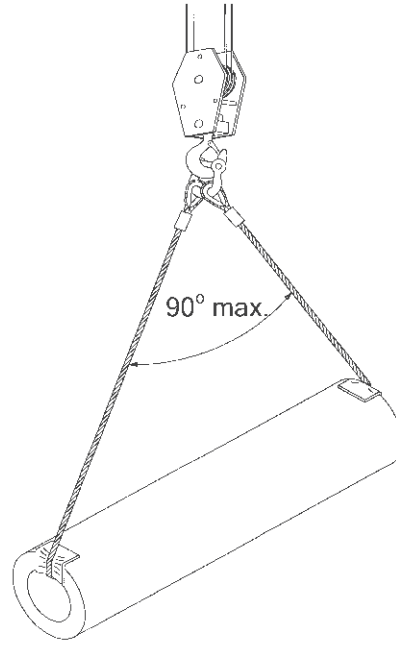


Fig. 9 Basket hitch

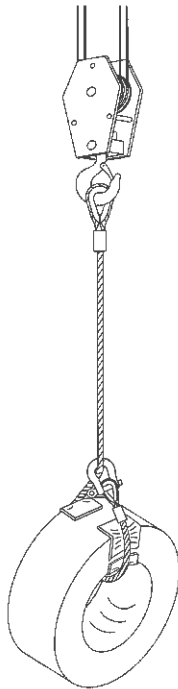


Fig. 10 Simple choker hitch

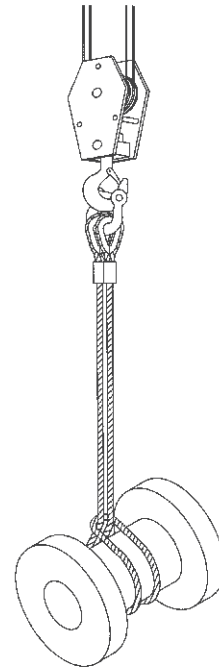


Fig. 11 Double and choked

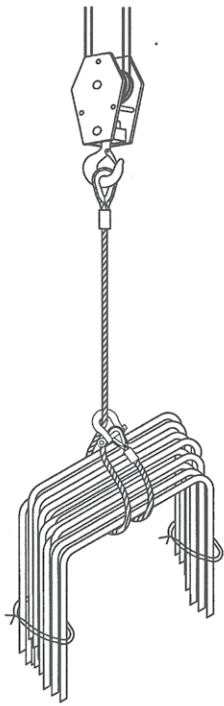


Fig.12 Choker hitch double wrapped

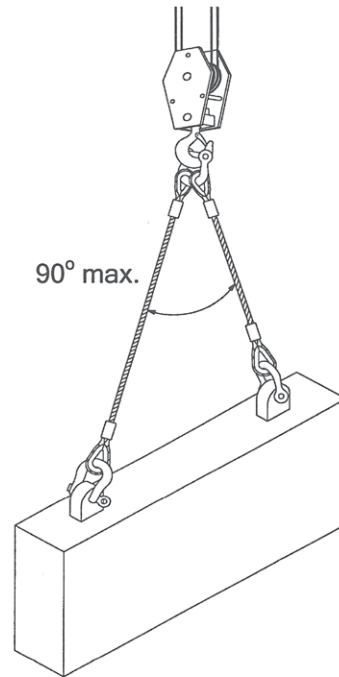


Fig. 13 Two single-leg slings used with direct attachment

15.3.5 Multi-leg sling

15.3.5.1 A multi-leg sling may have two, three, four or more legs (Fig. 13 to 19). It provides a more stable lifting arrangement than a single-leg sling.

15.3.5.2 Generally multi-leg sling methods are:

- (a) two-leg slings used with direct attachment (Fig. 13);
- (b) two-leg slings used in choker hitch (Fig. 14);
- (c) two-leg slings used in basket hitch (Fig. 15);
- (d) two-leg slings used in double wrap choker hitch (Fig. 16);
- (e) two-leg slings used in double wrap basket hitch (Fig. 17);
- (f) three-leg slings used with direct attachment (Fig. 18); and
- (g) four-leg slings used with direct attachment (Fig.19).

15.3.5.3 When using multi-leg slings, care should be taken to ensure that:

- (a) the slings are of the same length;
- (b) where the slings have different safe working load ratings then the load that can be lifted is related to the least safe working load; and
- (c) the attachment points of a two-leg sling to the load are far enough apart to give stability without exceeding 90 degrees (Fig. 13, 14 & 16). In the case of a two-leg sling used in basket hitch or a four-leg sling, the angle between any two diagonally opposite legs should not exceed 90 degrees (Fig. 15, 17 & 19). For a three-leg sling, any one leg should make an angle of not greater than 45 degrees with the vertical.

Note: The two-leg slings used in choker hitch, basket hitch, double wrap choker hitch or double wrap basket hitch should not be used for handling composite loads such as loose bundles or tubes, bars of wooden battens unless the friction grip between the parts is sufficient to prevent them slipping from the sling. As far as possible, such composite loads should first be tied up securely at their ends by steel wires or similar means of adequate strength.

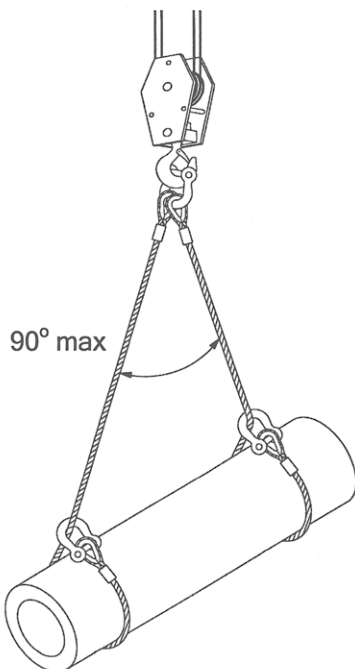


Fig. 14 Two single-leg slings used in choker hitch

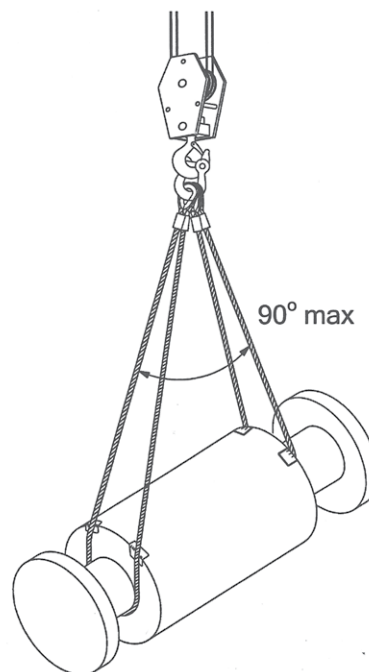


Fig. 15 Two single-leg slings used in basket hitch

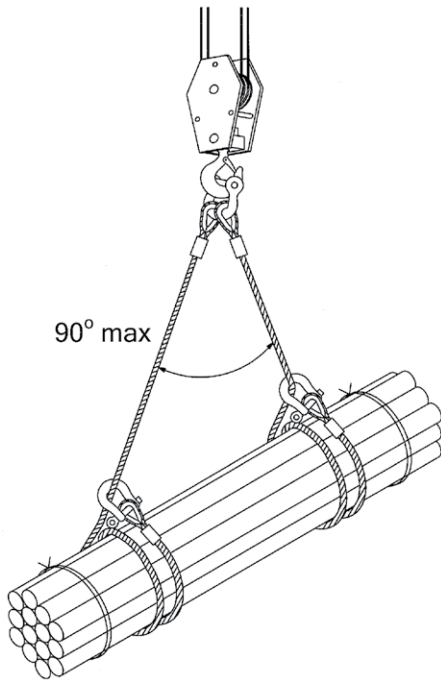


Fig. 16 Two single-leg slings in double wrap choker hitch

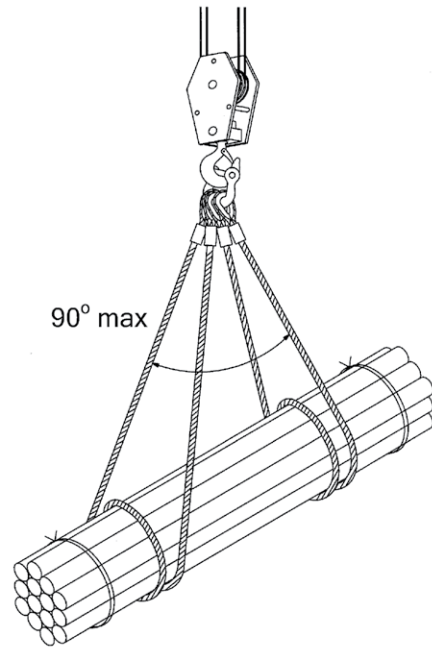


Fig. 17 Two single-leg slings in double wrap basket hitch

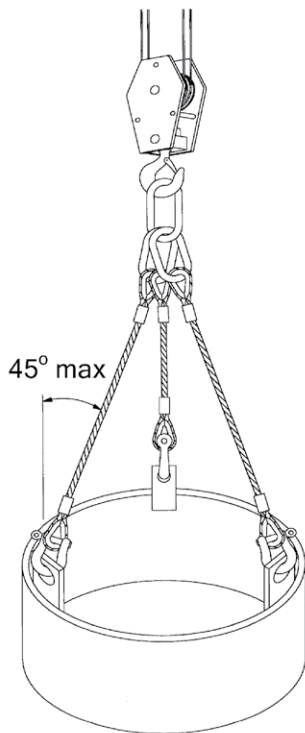


Fig. 18 Three-leg sling

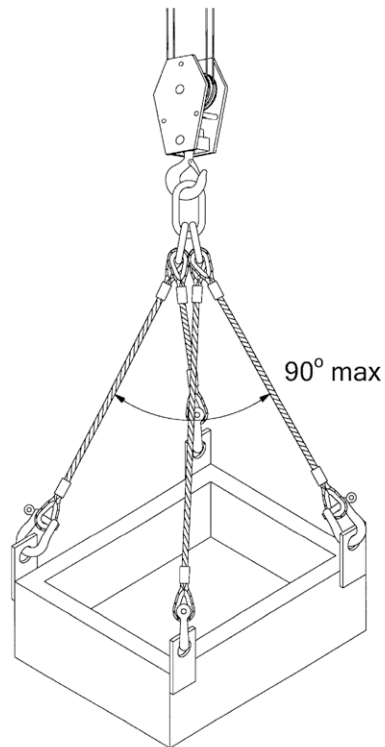


Fig. 19 Four-leg sling

15.4 Precautions to be taken in fitting the slings

15.4.1 When fitting the sling to a load, steps should be taken to ensure that:

- (a) sling legs are free of kinks or any tendency to kink;
- (b) only the eye termination with thimble is placed on the crane hook;
- (c) the terminations are properly seated without overcrowding;
- (d) the load is effectively secured by the sling;
- (e) the relevant leg angle does not exceed that for which the sling is rated and marked;
- (f) the sling is not bent around any corners that might damage or reduce the effective strength of the sling. Where necessary suitable packing pieces should be used;
- (g) when using choke hitch:
 - (i) the angle of choke is allowed to form itself naturally and is not forced;
 - (ii) a thimble or stirrup is used where practicable at the eye to reduce damage to the rope and thereby prolong the life of both the eye and the main part of the rope; and
- (h) a tag line or control rope is available for assisting in the control of the swing or rotation of the load.

Table 1 - Recommended hand signals
















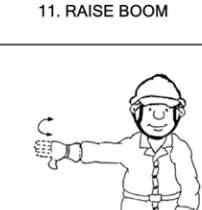

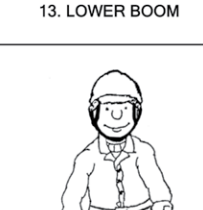
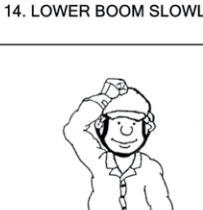

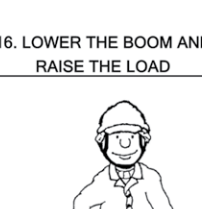

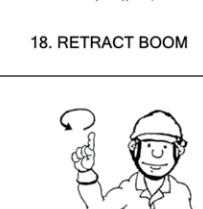

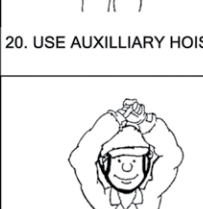
				
1. EMERGENCY STOP	2. STOP	3. TRAVEL	4. TRAVEL TO ME	5. TRAVEL FROM ME
				
6. INDICATING DISTANCE TO TRAVEL	7. TURN TO DIRECTION INDICATED	8. TURN TO DIRECTION INDICATED	9. SWING IN DIRECTION INDICATED	10. SWING IN DIRECTION INDICATED
				
11. RAISE BOOM	12. RAISE BOOM LOWLY	13. LOWER BOOM	14. LOWER BOOM SLOWLY	15. RAISE THE BOOM AND LOWER THE LOAD
				
16. LOWER THE BOOM AND RAISE THE LOAD	17. EXTEND BOOM	18. RETRACT BOOM	19. USE MAIN HOIST	20. USE AUXILLIARY HOIST
				
21. LOWER HOIST	22. LOWER HOIST SLOWLY	23. RAISE HOIST	24. RAISE HOIST SLOWLY	25. STOP EVERYTHING

Table 2 - Frequency of test, thorough examination and inspection of mobile cranes under the LALGR

Regulation No.	Testing & Thorough Examination	Testing	Thorough Examination	Inspection	Approved Form No.
5(3) 7B	during the preceding 4 years before use (includes the test of the automatic safe load indicator)				3
5(5) 7B	before use, after undergoing substantial repair, re-erection, failure, overturning or collapse (includes the test of the automatic safe load indicator)				3
5(1)			at least once in the preceding 12 months before use		5
7A 7B				within the preceding 7 days before use (includes the inspection of the automatic safe load indicator)	1
7E		after erection, removal to a new location, or adjustment of any component member (being a removal or adjustment which involves changes in the arrangements for anchoring or ballasting), the crane shall be tested before use.	all the devices used for the anchoring or ballasting of the crane shall be thoroughly examined before the crane is erected.		2
7G		after exposure to weather conditions likely to have affected the stability of the crane, the crane shall be tested before use.			2

Note 1: The requirements for testing/examination of lifting gear are not included in the above table.

Note 2: Reference should be made to the full text of the LALGR.

Note 3: Repair includes renewal, alteration or addition and examples of substantial repair include replacement of wire rope, replacement of brake, alteration of boom length or jib length, changing of hook block, and any repairs on steel structure which may affect the integrity of the crane.

References

1. BS 7121-1:2016 : Code of Practice for Safe Use of Cranes – Part 1: General
2. BS 7121-2-1:2012 : Code of Practice for the Safe Use of Cranes Part 2-1: Inspection, maintenance and thorough examination – general
3. BS 7121-2-3:2012 : Code of Practice for the Safe Use of Cranes Part 2-3: Inspection, maintenance and thorough examination – Mobile cranes
4. BS 7121-2-4:2013 : Code of Practice for the Safe Use of Cranes Part 2-4: Inspection, maintenance and thorough examination – Loader cranes
5. BS 7121-3:2000 : Code of Practice for Safe Use of Cranes – Part 3: Mobile cranes
6. BS 7262:1990 : Specification for Automatic Safe Load Indicators
7. BS EN 818-6:2000 : Short Link Chain for Lifting Purposes – Safety –
+A1:2008 Part 6: Chain Slings – Specification for information for use and maintenance to be provided by the manufacturer
8. BS EN 12077-2:1998 : Crane safety - Requirements for health and safety -
+A1:2008 Part 2: Limiting and indicating devices
9. BS EN13414-2:2003 : Steel Wire Rope Slings – Safety – Part 2:
+A2:2008 Specifications for information for use and maintenance to be provided by the manufacturer
10. ASME B30.5:2014 : Mobile and Locomotive Cranes

11. Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by the Labour Department, Hong Kong SAR
12. Crane Hazards and their Prevention - David V. MacCollum, ASSE, USA
13. Cranes and Derricks - Howard I. Shapiro, Jay P. Shapiro, Lawrence K. Shapiro, McGraw Hill, Inc., USA
14. Rigging manual - Construction Safety Association of Ontario, Canada
15. Lifting Tackle Manual - Donald E. Dickie, Construction Safety Association of Ontario, Canada
16. Mobile Crane Manual - Donald E. Dickie, Construction Safety Association of Ontario, Canada
17. Crane Handbook - Donald E. Dickie, Construction Safety Association of Ontario, Canada
18. HSE Guidance Note PM3: Erection and dismantling of mobile cranes, Health and Safety Executive, UK
19. HSE Guidance Note PM9: Access to mobile cranes, Health and Safety Executive, UK
20. HSE Guidance Note GS39: Training of crane operators and slingers, Health and Safety Executive, UK
21. A Safety Handbook for Slingers and Crane Operators, RoSPA, UK
22. Code of Practice on Working near Electricity Supply Lines issued by the Electrical and Mechanical Services Department, Hong Kong SAR
23. Code of Practice on Wind Effects in Hong Kong – 2004, Buildings Department, Hong Kong SAR

Enquiries

If you wish to enquire about this Code of Practice or require advice on occupational safety and health matters, please contact the Occupational Safety and Health Branch of the Labour Department through:

Telephone: 2559 2297 (auto-recording service available outside office hours)

Fax : 2915 1410

E-mail : enquiry@labour.gov.hk

Information on the services offered by the Labour Department and on major labour legislation is also available on our website at <http://www.labour.gov.hk>.

For details on the services offered by the Occupational Safety and Health Council, please call 2739 9000.

Complaints

If you have any complaints about unsafe workplaces and work practice, please call the Labour Department's occupational safety and health complaint hotline at 2542 2172. All complaints will be treated in the strictest confidence.

