

# Foreword

Mobile cranes are widely used for lifting operations in the construction industry in Hong Kong. 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 as the Code) is approved and 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. Although failure to observe any guidance contained in this Code is not in itself an offence, that failure may be taken by a court in criminal proceedings as a relevant factor in determining whether or not a person has breached any of the provisions of the regulations to which the guidance relates.

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 **(date to be fixed)**.

# 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 near by 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 as the FIUO), the provisions in the Factories and Industrial Undertakings Regulations (hereafter referred as the FIUR), the Factories and Industrial Undertakings (Lifting Appliances and Lifting Gear) Regulations (hereafter referred as the LALGR), the Factories and Industrial Undertakings (Guarding and Operation of Machinery) Regulations (hereafter referred as the GOMR) and the Construction Sites (Safety) Regulations (hereafter referred 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 specified disciplines specified by the Commissioner.

### *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*

In relation to any crane, includes the lessee or hirer thereof, and any overseer, foreman, agent or person in charge or having the control or management of a crane and, in the case of a crane 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, 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) planning of the operation;
- (b) selection, provision and use of a suitable crane and equipment;
- (c) maintenance, examination and testing of the crane and equipment;
- (d) 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 crane;
- (e) 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;
- (f) adequate supervision by properly trained and competent personnel;
- (g) observing for any unsafe conditions such as adverse weather conditions that may arise during operation;
- (h) ensuring that all necessary test and examination certificates and other documents are available;
- (i) preventing unauthorized movement or use of a crane at all times;
- (j) the safety of other persons who may be affected by the lifting operation;

(k) 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 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 to have overall control of the lifting operation. This appointed person should have adequate training and experience to enable these duties to be carried out competently.

## 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 crane appropriate to the operation ensuring that adequate clearances are maintained between the load and the crane structure;
  - (c) the selection of lifting gear, the weight of which should be taken into account when assessing the load on the crane;
  - (d) the position of the crane and the load before, during and after the operation;
  - (e) the site of the operation, taking into account proximity hazards, space availability and suitability of the ground or foundation such as the allowable bearing capacity of the ground;
  - (f) any necessary erection, alteration and dismantling of the crane;
  - (g) 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
  - (h) 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 It is the responsibility of owner to ensure that the men who prepare the equipment, erect it, operate it, and work with it are well trained in both safety and operating procedures.
- 5.1.2 The owner must ensure that all mobile cranes are operated by trained, experienced, competent and qualified crane operator.
- 5.1.3 The owner must also ensure that the men 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.
- 5.1.4 The owner is also responsible for putting together a crane safety programme, 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 crane.

## 5.2 Mobile crane operator

- 5.2.1 The mobile crane operator should be responsible for 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) have been adequately trained in the operation of the type of crane he is driving and have sufficient knowledge of the crane and its safety devices;
- (c) 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
- (d) 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) be agile and have the physique to enable him to handle lifting tackle;
- (d) have been trained in the general principles of slinging and be able to establish weights and judge distances, heights and clearances;
- (e) be capable of selecting tackle and lifting gear as well as rigging method suitable for the loads to be lifted;
- (f) understand the signal code shown in Table 1 and be able to give clear and precise signals;
- (g) 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
- (h) 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 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. 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 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 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 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; and
- (f) any special operational requirements or limitations imposed including the existence of other cranes in close proximity.

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** - 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; or
- (b) operation in areas of limited access.

The tracks of the crane which provide large ground-bearing area has 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 or wheel-mounted crane

**Truck-mounted crane** - a crane which is mounted on a truck or lorry chassis with or without a spring suspension. A driving cabin is usually provided on the truck to drive the crane from one location to the other. Besides, the crane can be operated from a separate control cabin or just from the same driving cabin. In practice, the crane and truck can be operated by either a single power unit or by separate power units.

**Wheel-mounted crane** - a crane which is mounted on wheeled or 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.

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.

6.2.4 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.

#### 6.2.5 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 also Fig. 2a).

#### 6.2.6 Cantilever jib

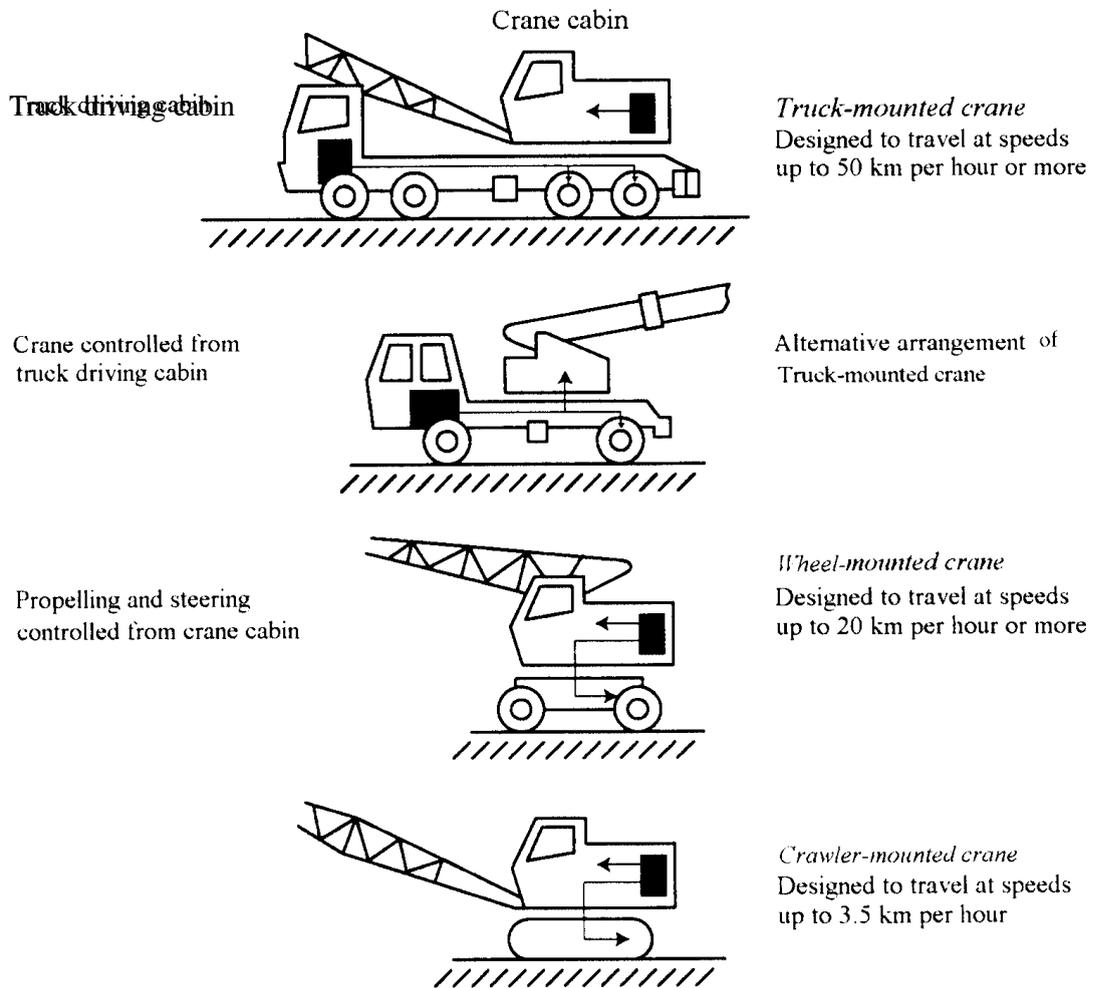
It would give the greatest clearance under the jib for handling bulky loads (see also Fig. 2b).

#### 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 also Fig. 2c).

#### 6.2.8 Fly-jib

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



In the above diagrams the symbols shown ◀■ represent the power unit(s) and transmission(s) (Ropes and other crane details are omitted for clarity.)

**Fig. 1 Types of mounting for mobile cranes**

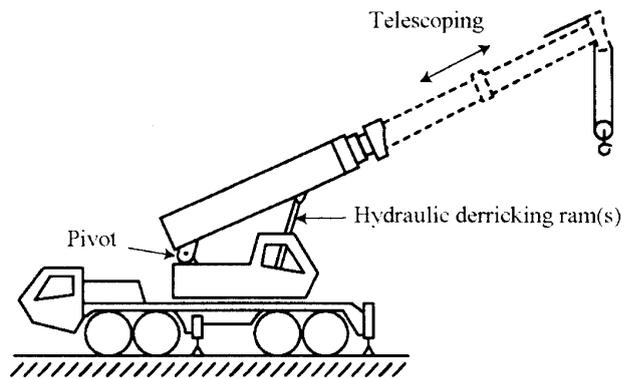


Fig. 2a - Telescoping jib (hydraulic)

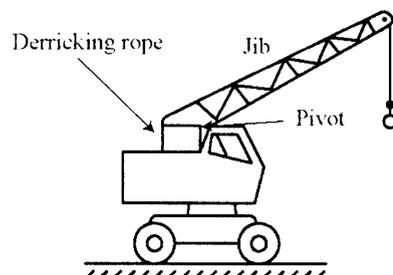


Fig. 2b - Cantilever jib (lattice)

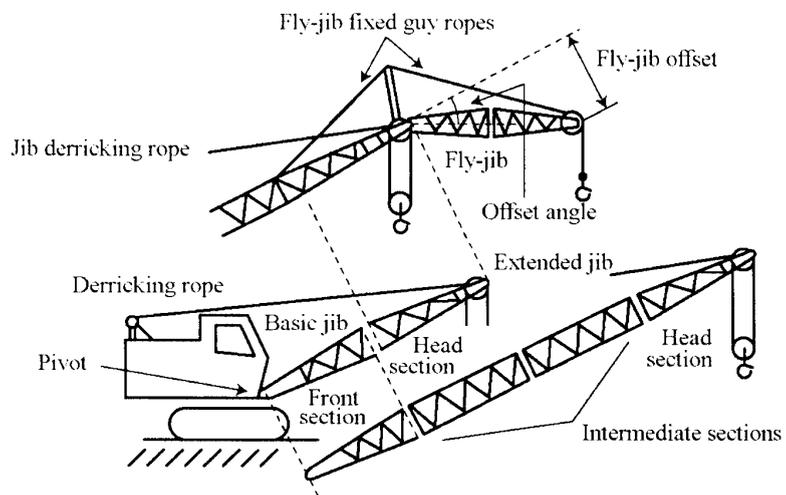


Fig. 2c - Strut-type jib and fly jib (lattice)

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 should 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 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, repairman and supervisor. The crane owner should ensure that the log book remains with the crane and is kept up-to-date throughout the working life of the crane (see section 14).

# 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 7262 or equivalent standards.

## 8.2 Brakes

8.2.1 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 Fail-safe brakes should be provided so that it will 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.

8.2.3 Swing brakes should consist of a fail-safe mechanical unit capable of not only stopping the swing with full load but also holding the full jib/boom in winds of up to 50 kilometres per hour.

8.2.4 Besides, a positive swing lock or house lock designed to prevent accidental engagement or disengagement should be provided.

8.2.5 For wheel-mounted cranes:

The fail-safe brakes provided should be able to bring the crane to a stop on level ground within a distance of 9.6 m from a speed of 25 kilometres per hour, and hold it stationary on the maximum grade for travel recommended by the manufacturer.

#### 8.2.6 For all mobile cranes other than wheel-mounted cranes:

Fail-safe brakes should be provided to hold the crane stationary under normal working conditions, and 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. The means of access to the cabin should ensure that there is no danger of the operator being trapped in 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 Jib/boom stops**

8.5.1 Jib/boom stops should be provided to prevent the jib/boom from toppling or being pulled backwards over the top of the cabin. The stops should disengage the master clutch and physically stop the jib/boom as it reaches a predetermined maximum angle.

## **8.6 Guards and protective structures**

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

## **8.7 Outriggers**

8.7.1 Outriggers should be capable of being securely held in the retracted position while travelling.

8.7.2 They should also be securely held in the extended position when blocked for hoisting.

8.7.3 If power actuated jacks are used, they should never lose pressure or leak while under load.

8.7.4 The outrigger beams should be marked or painted in a manner to indicate the fully extended position.

## **8.8 Drum assemblies**

8.8.1 The drum assemblies should have adequate power.

8.8.2 Indicators for drum rotation should be provided.

8.8.3 Rope should be correctly installed on drum.

## **8.9 Sheaves**

8.9.1 Grooves should be smooth and slightly larger than the rope to prevent it from being pinched or jammed in the groove.

8.9.2 Jib/boom hoisting sheaves should have pitch diameter of not less than 15 times the nominal diameter of the rope used.

8.9.3 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.

8.9.4 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.

8.9.5 Bearings should be permanently lubricated or be equipped with means for lubrication.

8.9.6 Sheave should be equipped with cablekeepers or close fitting guards to prevent the rope from leaving the groove.

## **8.10 Other safety features**

8.10.1 The followings should be provided to mobile cranes for the sake of safe operation:

- (a) Fuel tanks should be equipped with self-closing filler caps and flame arrestors.
- (b) A metal receptacle for storing tools and lubricating equipment should be provided and secured permanently on the crane.
- (c) For night operation if required, adequate lighting and back-up lights should be installed on the crane.
- (d) For wheel-mounted crane, wheel chocks should be provided to block movement on slopes when the crane is left unattended or undergoing repair/maintenance.
- (e) Rear view mirrors of each at least 625 cm<sup>2</sup> in area should be equipped on both sides of crane.
- (f) A suitable fire extinguisher should be installed and properly maintained.
- (g) 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.
- (h) For telescopic jib/boom, jib/boom length indicator should be provided and clearly visible and readable by the operator at his control station.
- (i) With the exception of the telescopic jib/boom, shock absorbing jib/boom stops and jib/boom safety shutoffs should be provided.
- (j) 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.
- (k) 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.

- (l) A spirit level for levelling the outriggers should be provided at the outrigger controls.
- (m) 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.
- (n) A plate should be installed in the vicinity of the jib/boom foot pins which can clearly show the distance of a well defined point from the centre of rotation.

# 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 Hong Kong – 1983. 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.

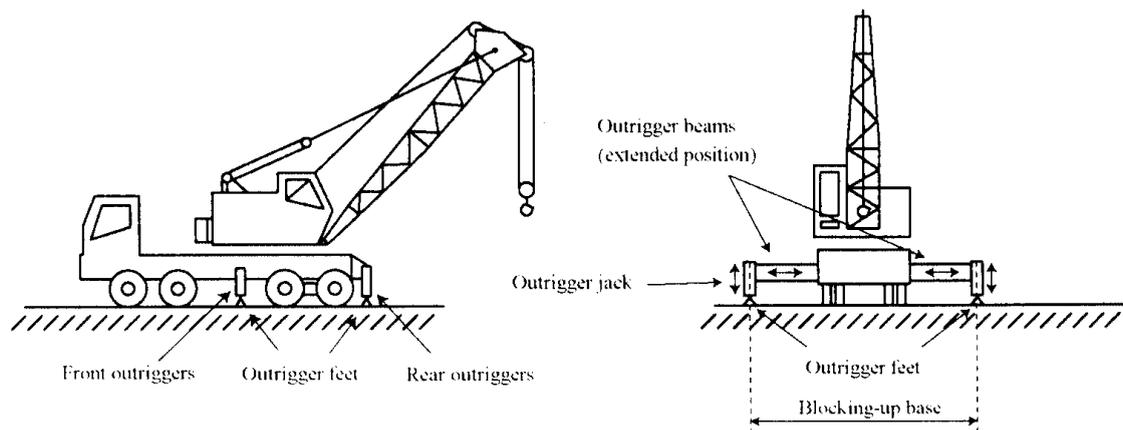
9.2.5 If outriggers are provided, the beams should be fully extended as far as

practicable (Fig. 3). The jacks should be suitably extended so that all the crane tyres are clear of the ground.

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 and controlled by the responsible person.

9.2.7 It should be noted that partial and full extension of outriggers should not be used simultaneously. Outrigger beams should also not be set at any other intermediate points apart from the designated partial or full extension position.

9.2.8 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.

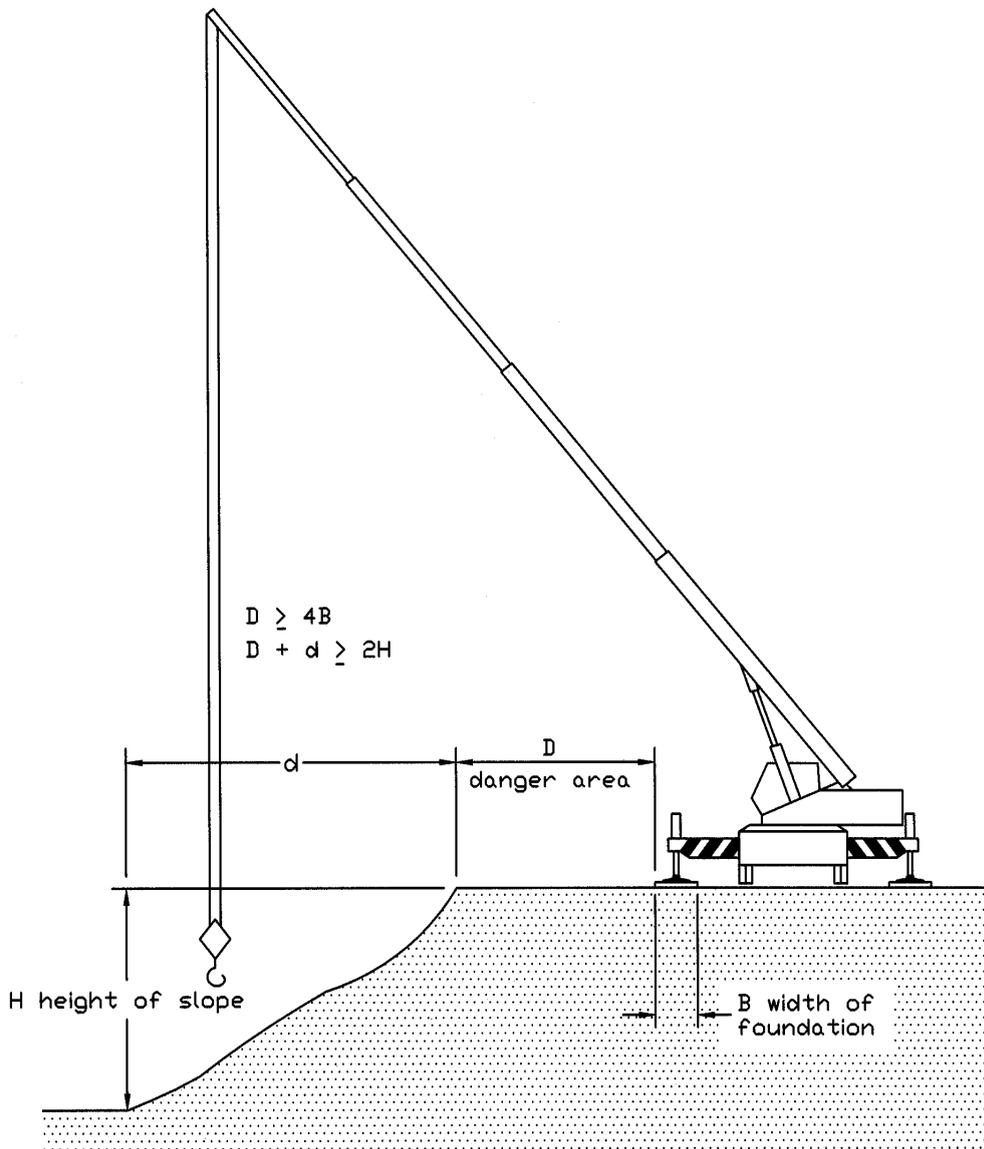


**Fig. 3 Typical truck-mounted crane shown with outriggers set**

- 9.2.9 Advice should be sought from the manufacturers 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.
- 9.2.10 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.
- 9.2.11 When operating close to the edge of a slope or an unsupported 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.
- 9.2.12 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.

### **9.3 Proximity hazards**

- 9.3.1 Consideration should be given to the proximity hazards such as overhead electric 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 route of aerial ropeway and other cranes, public access areas including highways and railways, etc.



**Fig. 4 Position of mobile crane**

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 electric lines and cables

9.3.3.1 Fatal accidents may occur when a crane comes into contact with or near to overhead electric lines or cables. Where a mobile crane has a chance of coming close to any live overhead electric lines or cables, the crane owner should liaise with owners of the overhead lines, e.g. the power companies, to work out the exact safety requirements and devise the safe work plans. Reference should be made to the Electricity Supply Lines (Protection) Regulation (Cap. 406 sub. leg.) and the Code of Practice on Working near Electricity Supply Lines issued by the Electrical and Mechanical Services Department.

9.3.3.2 All overhead lines or other electric apparatus should be treated as live unless declared dead and safe by the relevant authority.

9.3.3.3 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 and safe system of work.

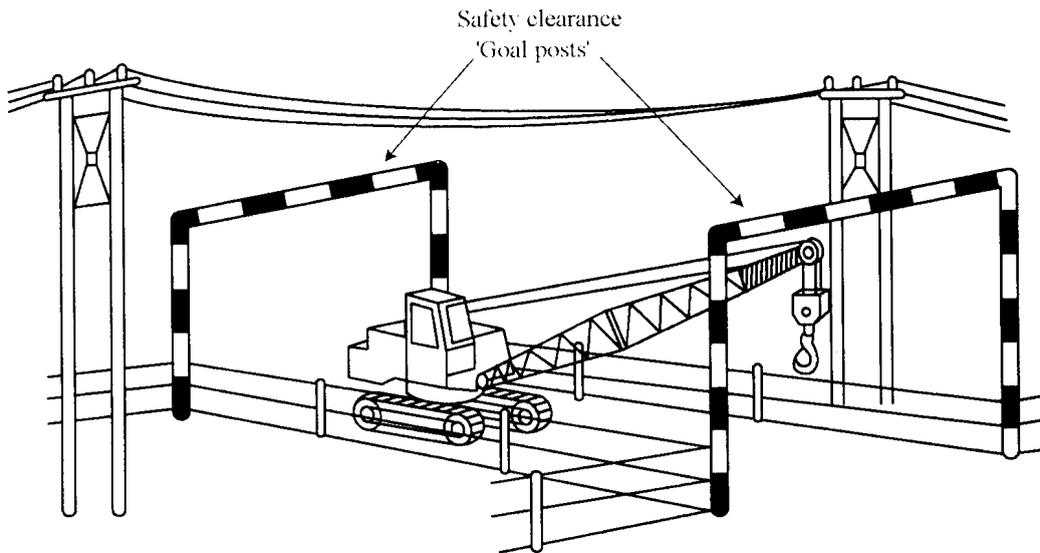
9.3.3.4 When working parallel to overhead power cables, a string of warning markers should be erected at a safe distance from the cables. The string should be supported on posts at convenient intervals and each post should carry the warning notice stating:

**'DANGER ! OVERHEAD ELECTRIC LINES !'**

**「危險！架空電線！」**

9.3.3.5 A crane should not be operated in the vicinity of overhead electric lines unless guided by an experienced slinger or signaller. The crane operator should always try to keep the overhead lines in view when maneuvering the crane. It is worthwhile to note the difficulty to estimate the heights or distances of the lines by normal methods of observation.

9.3.3.6 Where a crane must travel underneath an overhead line, the crossing route should be plainly marked and 'goal posts' erected each side of the crossing approach to ensure that the jib or moving parts are lowered to a safe position (see Fig. 5).



**Fig. 5 Travelling under overhead electric lines and cables**

9.3.3.7 The dimensions of the goal posts and their distances from the nearest power cable are to be decided in consultation with the EMSD and the relevant electric power company. Large notices in English and Chinese should be posted stating:

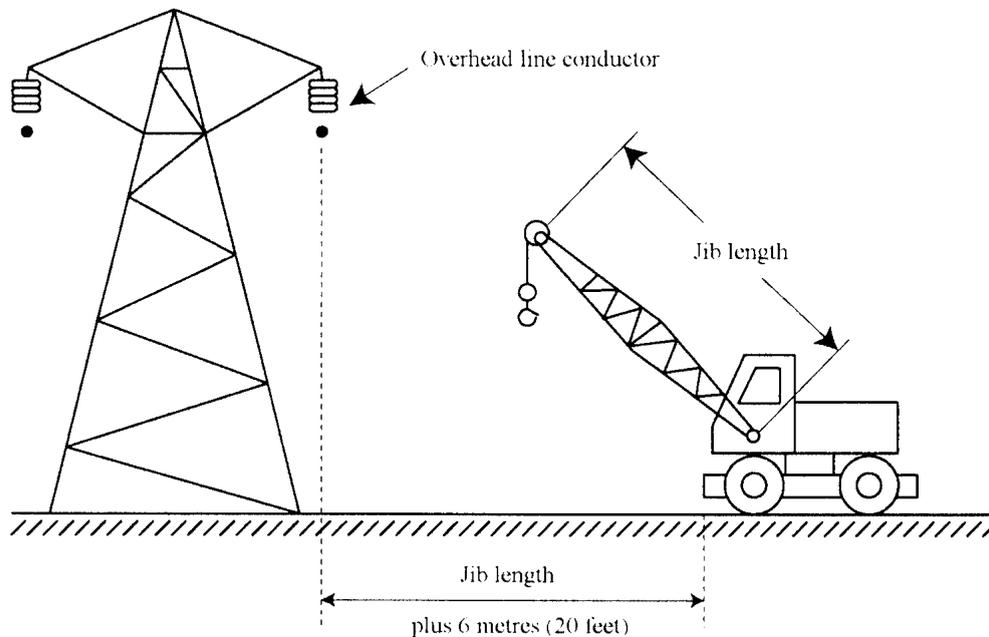
**‘DANGER ! OVERHEAD ELECTRIC LINES !’**  
**「危險！架空電線！」**

9.3.3.8 In the absence of this expert advice, a general safe rule for crane operations is to position the machine with a safe clearance distance from the overhead lines. The distance should be larger than the length of the crane jib fitted, plus six metres (20 feet) measured along the ground and the plumb of the nearest line or cable (see Fig. 6). It should be noted that in certain cases of overhead lines with long spans, the line may swing laterally due to the wind. Allowance should be made to maintain the safe clearance distance at all times.

9.3.3.9 The operator of the crane should operate under the direction of a slinger or signaller who has a clear view of the crane and the obstruction.

9.3.3.10 The slinger or signaller should be able to assess whether there is adequate headroom and clearance.

9.3.3.11 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.



**Fig. 6 Overhead electric lines**

#### 9.3.4 Proximity of other cranes

9.3.4.1 When considering the position of the crane for operation, care should be exercised regarding the proximity of other cranes, the overlapping of the working areas and the possibility of the hoisting rope or suspended load fouling the lower crane even though they are operating with different jib lengths or at different levels.

9.3.4.2 Crane should be sited in such a way that the operator has a clear view of any other crane operating in the collision danger area.

# 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 of an erection crew 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) It is prohibited to improvise or to 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.
- (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 followings 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 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. Also 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, and all the locking pins or spring clips should be in good condition and offer effective security of the jib section pins.
  - (f) Other than manufacturer's instruction, 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.

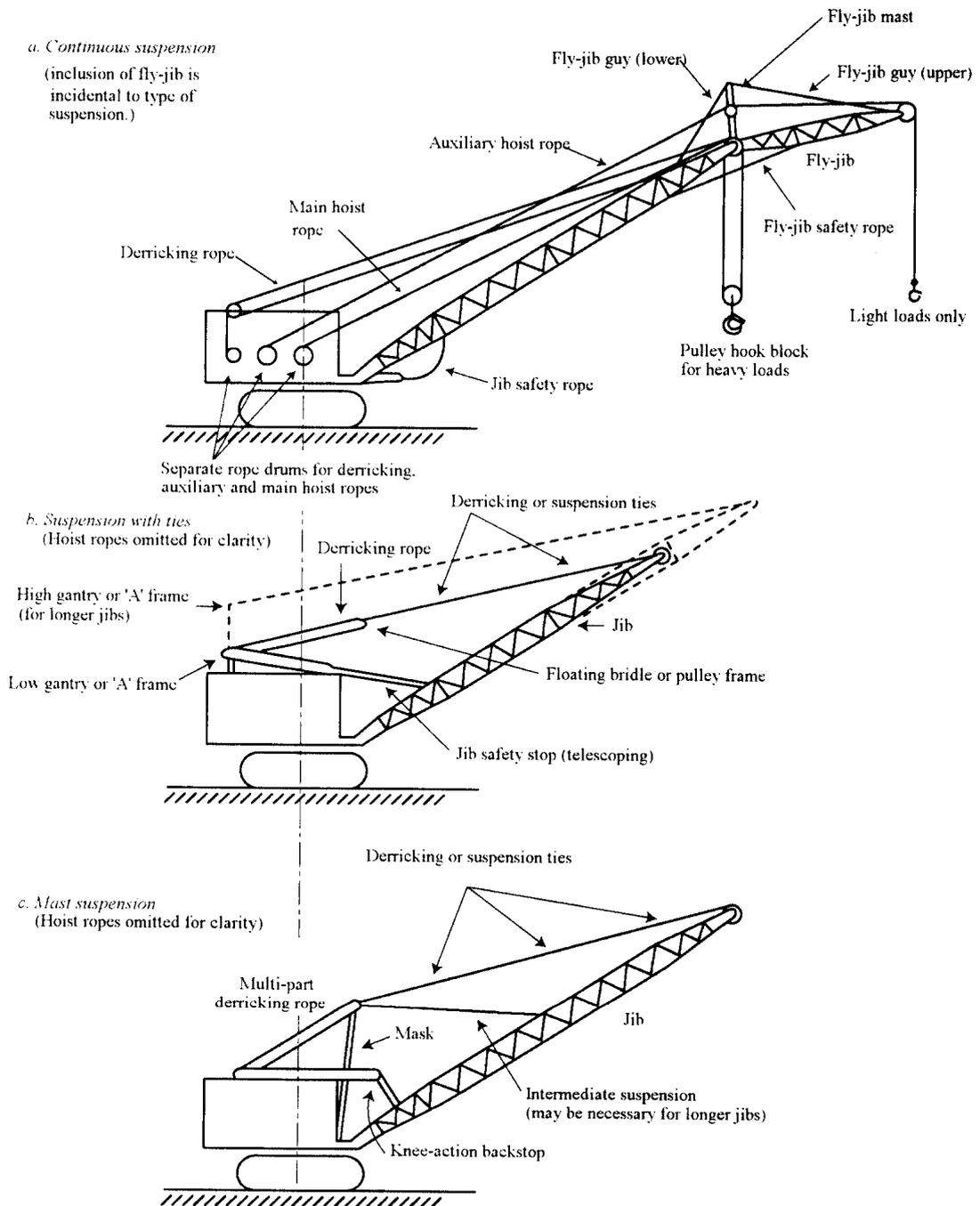
- (g) When a fly-jib is to be fitted, the angle and/or length of suspension ties between the fly-jib and the main jib should be in accordance with the manufacturer's recommendations. Also, the safety ropes or arrestors should be installed to prevent backwards instability of the fly-jib.

## **10.4 Jib suspension (see Fig. 7)**

- 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.



**Fig. 7 Typical rope and suspension systems on mobile cranes**

- 10.5.5 Not less than two coils should always remain on the drum and the drum capacity should not be exceeded.
- 10.5.6 Reference should be made to the rope manufacturer's manual or crane instruction manual for details regarding the rope examination.

## **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 prior to elevate a jib.
- 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 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.

- 10.7.4 Appropriate precautions including the re-setting of auxiliary outriggers should be taken prior to the lowering of long jibs to the ground.
- 10.7.5 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 including the 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 of mobile crane**

### **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 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.

### **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 shortest and 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 as equipped 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 slewing 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) and the operator should remain in the driving 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 motion brakes and locks including those preventing rotation of the upperworks have been applied to put the machine in a safe condition.
- (d) The ignition key and any other keys should be removed from the crane and kept by the operator.
- (e) For details of methods to safeguard particular types of cranes, reference should be made to the crane manufacturer's instruction book.

## **11.3 Leaving the crane unattended for a long period of time**

11.3.1 For longer periods 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.
- (e) For details of methods to safeguard particular types of cranes, reference should be made to the crane manufacturer's instruction book.

## **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 checks, as appropriate:

- (a) checks as required by the manufacturer's instructions;
- (b) check that the automatic safe load indicator is correctly set and/or fitted with the correct jib length (or jib and fly-jib lengths) and falls of hoist rope;
- (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 cracks and wear;
- (h) check loosening of pins, bolts and nuts;
- (i) check the ropes, and rope terminal fittings and anchorages for obvious damage and wear;
- (j) check the condition and inflation pressure(s) of tyres (where applicable);
- (k) check that all water is drained from any air receivers;
- (l) check the jib structure for damage;
- (m) check the operating pressures in any air and/or hydraulic system(s);
- (n) check leakage of brake fluid and hydraulic oil;
- (o) check the operation of the crane through all motions with particular attention to brakes to ensure that these are operating efficiently;
- (p) check the operation of all limit switches or cut-outs (use caution in making the checks in case of non-operation);
- (q) check the operating pressures in any air and/or hydraulic system(s);
- (r) check leakage of brake fluid and hydraulic oil; and
- (s) 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 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 cracks. Check the slewing rings, slewing gears and gusset plates in the mobile ring for cracks. 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 "Check List" 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 mobile crane. The machine should be taken out of service until the faults have been rectified and clearance is given by the responsible person. Sufficient space on the "Check List" for reporting the defects are recommended.

## 11.5 Permit to work

- 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 may not be used.
- 11.5.2 A permit to work is a specially designed form issued only by a responsible person. 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. The responsible person should be the person in charge of the site.
- 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 men 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 responsible person in charge 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.

## **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 authorized person 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 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 Adequate clearance of at least 600 mm should be allowed between any part of a crane and the nearest obstruction to prevent trapping of

personnel when the crane is slewed or starts the travelling motion.

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.
- (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**

**沒有駕駛員的許可,任何人士都不能進入起重機的任何部份'.**

## 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 may be used.

12.2.2 The safe working load of a mobile crane is the hook load specified for a given radius, with the appropriate rope reeving and length of jib, and with the crane standing on a firm, level base. In assessing the weight of the useful load, allowance should therefore be made for the weight of slings or other tackle used to attach the load to the hook.

Consideration should also include the dynamic effects such as jerking and impact.

- 12.2.3 Safe working loads are generally calculated as a percentage of the ultimate load of a crane. The ultimate load will be the tipping load for certain cranes.
- 12.2.4 But for others, a structural failure would occur before the crane reached a tipping condition, and, in these cases the ultimate load will relate to the manufacturer's design capacity of the crane.
- 12.2.5 The margin between the safe working load and the ultimate load is a safety margin to allow for the various forces which will act on the crane in operation. These include allowances for wind loading and for dynamic forces set up by normal operational movement of the crane and load.
- 12.2.6 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).
- 12.2.7 Safe working loads apply only to freely-suspended loads. Before lifting a load the hoist line should be plumb. It is expressly forbidden to use the crane hook or slewing motion of a crane to drag any load along the ground, etc. 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 for. Even with an automatic safe load indicator fitted, a structural failure may result without any prior warning being given.
- 12.2.8 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).

12.2.9 Reference should always be made to the crane manufacturer's handbook of appropriate machine specification to establish the restriction, limitations or special conditions applicable to a particular crane.

12.2.10 Crane manufacturer's safe working loads may be limited either by:

(a) stability of the crane which is a function of the weight and weight-distribution of a crane and the physical size of the supporting base; or

(b) the structural or mechanical strength of the crane or components, i.e. the jib, machinery, ropes, etc.

Therefore, the published safe working loads should not be exceeded under any circumstances.

12.2.11 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.

12.2.12 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.

12.2.13 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.

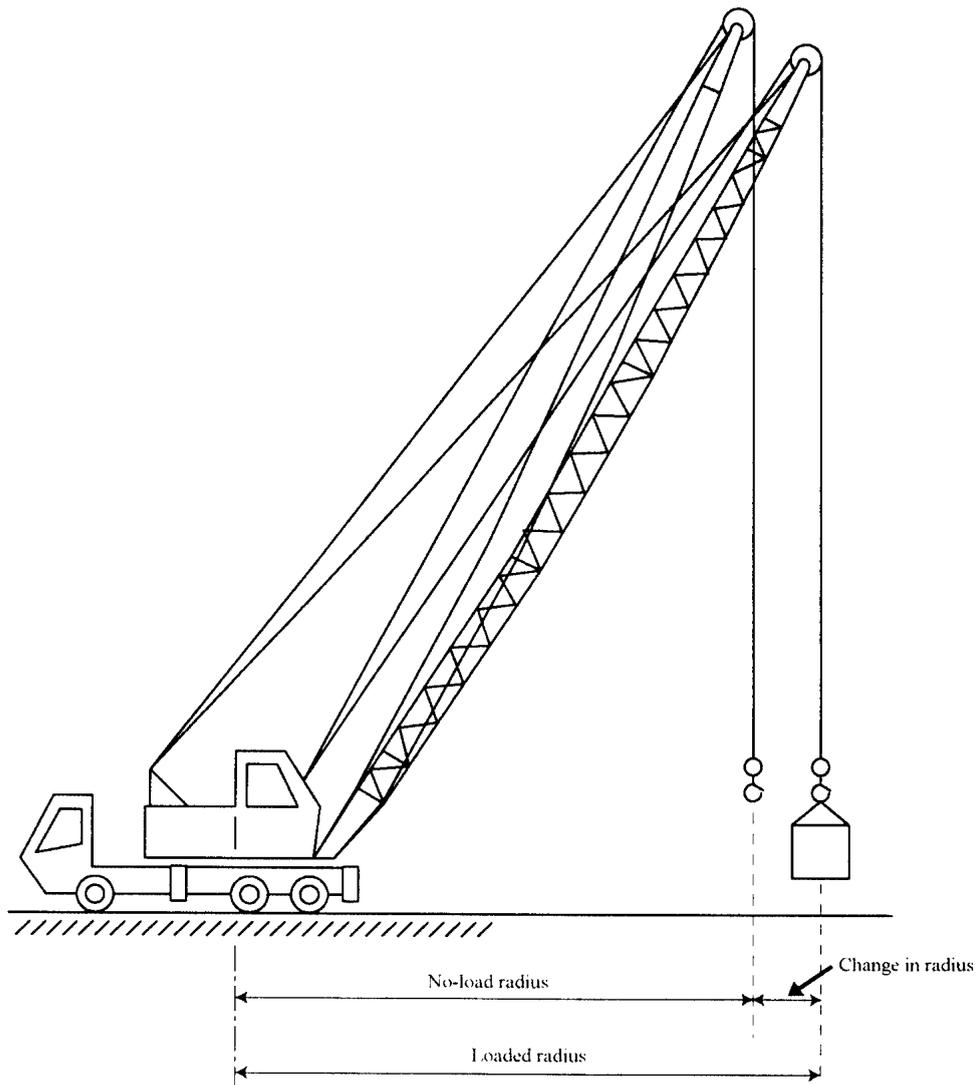
12.2.14 When working at depths below ground level, deductions on the safe working load should also be necessary for the weight of hoist rope.

12.2.15 Working at extremes or reach of safe working load should be avoided wherever possible.

12.2.16 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.

- 12.2.17 The safe working load at any given radius generally varies with jib length and any extension in jib would reduce the safe working load.
- 12.2.18 Derricking-out the jib to increase the radius of the load would generally result in a reduced lifting capacity.
- 12.2.19 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. 8). Conversely when settling down loads with the jib positioned at steep angles, it should be ensured that the jib is not damaged by contacting the 'closed' jib safety backstops or 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.
- 12.2.20 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.
- 12.2.21 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.
- 12.2.22 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 6.2.5).
- (c) Reference should be made to the manufacturer's manual for details of restrictions.



**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. When operating near to minimum radius ensure jib does not strike closed back stops when load set down. Otherwise the jib may collapse or be damaged.

**Fig. 8 Influence of rope stretch on board operation**

- 12.2.23 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.

## **12.3 Near maximum working loads**

- 12.3.1 When handling load which approaches the maximum working load for an operating radius, 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.
  - (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 Safe working loads appropriate to free-on-wheels or mobile operation should not be exceeded when travelling with suspended loads.
- 12.4.2 Any special restrictions imposed by the manufacturer should also be followed.
- 12.4.3 The jib should be positioned in the line of travel of the machine.
- 12.4.4 The load should be carried forward for the full view of the operator in case of crawler-mounted or wheel-mounted cranes.
- 12.4.5 The load should be carried at the rear of the truck in the case of truck-mounted cranes (see sub-section 12.2.22). The crane operator should remain in the crane cabin to control the load and a second man should be used to drive the vehicle. Besides, a further competent person should co-ordinate the operation and warn of hazards.
- 12.4.6 In general, travelling acceleration and braking motions should be operated gently to limit the swing of the load.
- 12.4.7 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.
- 12.4.8 Ground preparation:
  - 12.4.8.1 The ground to be traversed should be prepared to ensure a firm and level access route for the crane where necessary.
  - 12.4.8.2 To prevent the crane tilting laterally or in the direction of travelling, ground depressions or pot-holes if any should be filled.
  - 12.4.8.3 Mats or other suitable travelling surfaces should be laid where sinkage of the wheels or crawlers could occur in soft ground.

#### 12.4.9 Slopes:

12.4.9.1 Mobile cranes travelling with suspended loads should be avoided to travel on slopes wherever possible.

12.4.9.2 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.

## 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 or a suspended scaffold is impracticable. The carrying of persons by a crane is subject to certain statutory regulations. Requirements include provision of a properly designed safety chair, skip or cradle.

Suitable measures are to be taken to prevent such chair, skip or cradle from spinning or tipping in a manner dangerous to any occupant. It is recommended that personnel should not be lowered other than by an engine-power-controlled load-lowering mechanism. The occupant of the chair, skip or cradle should wear a safety belt secured to a suitable anchorage (Regulation 18B of the LALGR).

## **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. 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 manufacturers 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 hook load should be limited to that which can be safely handled by the crane and which will not create unsafe conditions for operatives.
- 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 Mobile cranes should not be used for grabbing, magnet or demolition ball service, tandem lifting, piling operations or any other duties which might impose excessive and/or indeterminate loadings onto the crane structure unless prior approval for such specific operation has been obtained from the manufacturer.

12.8.1.2 Working loads are often required to be reduced in accordance with the duty conditions applying for a mobile crane to be used for other duties such as magnet or grabbing crane service. Manufacturer's recommendations should be strictly followed for each specific usage.

## 12.8.2 Demolition ball service

12.8.2.1 In this service a round or pear-shaped weight, known as a demolition ball, is suspended from the hoist rope of a crane and caused to move to strike the building, structure or other object to be demolished so that the impact causes collapse.

12.8.2.2 By the nature of demolition ball service, dynamic loadings are imposed on the jib structure and other parts of the crane by the movement and impact of the ball. In rating a machine for this service, special attention should be paid to the facts that the magnitude of these dynamic loadings will vary widely according to the method of using the demolition ball, the skill of the operator at controlling the ball and the impact resistance of the building being demolished. Lesser loads and/or shorter jibs should therefore be adopted by the demolition contractor.

## 12.8.3 Piling Service

12.8.3.1 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.

- 12.8.3.2 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.
- 12.8.3.3 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 or the machine tipped to achieve faster results.
- 12.8.3.4 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 ground and the pile during extraction. 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.
- 12.8.4 Grabbing and magnet crane service
- 12.8.4.1 When using cranes for special duties such as 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 for any machine.

## 12.8.5 Tandem Lifting by mobile cranes

- 12.8.5.1 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 71 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.
- 12.8.5.2 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.
- 12.8.5.3 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.
- 12.8.5.4 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.
- 12.8.5.5 A competent person should be specially appointed to supervise the operation, and the signals to each crane operator should be clear and well rehearsed.

## 12.8.6 Other special uses of hydraulically driven mobile cranes

12.8.6.1 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 oscillators 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 should 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 and stoppages owing to breakdowns are 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 components should be in accordance with the manufacturer's recommendations or specifications. To avoid excessive down-time, expendable items such as ropes, friction linings, etc., should be kept in stock.
- 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. Based on this record a programme of planned maintenance and repair work should be introduced to contribute towards trouble free and safe operation.

## 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.

13.3.2 The maintenance foreman should be responsible for instructing the staff in all aspects of safe working. Where special machinery is involved, personnel should be properly instructed, such as by attending maintenance, service and operating courses given by the manufacturer of the equipment.

## 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). Daily 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 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.
- 14.3 A competent examiner or competent person who has carried out any test, inspection or examination shall deliver forthwith, or within a reasonable time thereafter, to an owner a report or certificate of such test, inspection or examination (Regulations 21(1) and 22(1) of the LALGR).
- 14.4 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).
- 14.5 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).

- 14.6 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).
- 14.7 All test certificates or copies of certificates and related documents shall be kept in the cranes or be available on the site of operation (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).

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 men who direct, rig and handle the loads have received 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.

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.
- 15.2.3 Suitable lifting gear, equipment and tackle should be employed.
- 15.2.4 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.
- 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 Where a wire rope 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.
- 15.2.7 Suitable packing should be provided and used to prevent damage to slings by sharp edges on loads.
- 15.2.8 When lifting rigid objects with slings having three or four legs, any two of the slings must be sized in capable of supporting the total load. In other words, after considering the angle between the legs, the slings should be considered as having only two legs when sizing the sling requirement. Where the object is flexible and able to bend to adjust itself to the sling legs, each leg can be assumed to take its own share of load.

- 15.2.9 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 rather than the total weight.
- 15.2.10 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.
- 15.2.11 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 Single-leg sling

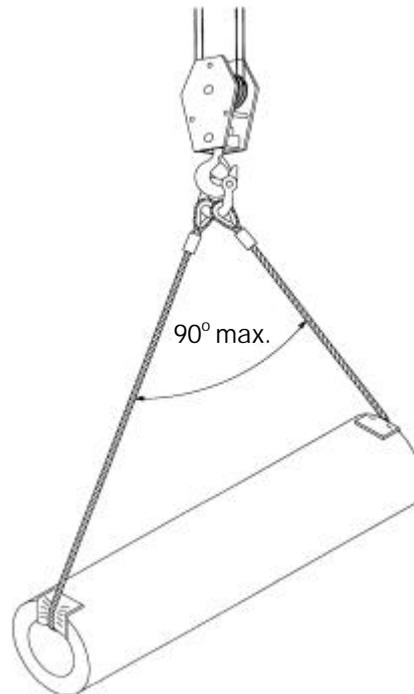
- (a) *Vertical or straight lift* (Fig. 9) - A vertical or straight lift is only suitable for lifting a load that will be stable when suspended from a single lifting point.
- (b) *Basket hitch* (Fig. 10) - A basket hitch should only be used when the sling is passed through part of the load and the load 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. 11) and *Double and Choked* (Fig. 12) – 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. 13) - 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.

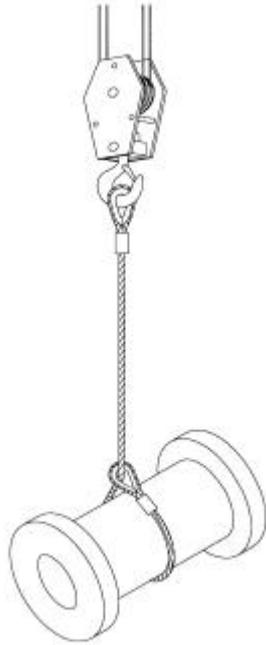
Note : The simple choker hitch or choker hitch double wrapped method should not be used for handling composite loads such as loose bundles of tubes, or bars or wooden battens unless the friction grips between the parts is sufficient to prevent them slipping from the sling. As far as possible, such composite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



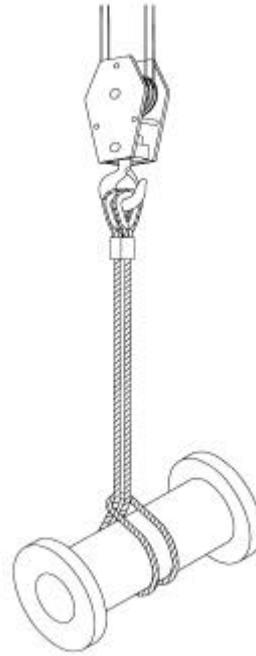
**Fig. 9 Vertical or straight lift**



**Fig. 10 Basket hitch**



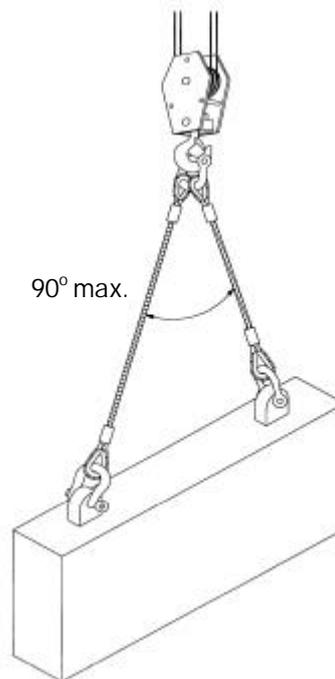
**Fig. 11 Simple choker hitch**



**Fig. 12 Doubled and choked**



**Fig.13 Choker hitch double wrapped**



**Fig. 14 Two single-leg slings used with direct attachment**

### 15.3.3 Two single-leg slings used together

15.3.3.1 Two single-leg slings used at an angle (or a multi-leg sling with two legs similarly used) provide a more stable lifting arrangement than a single-leg sling.

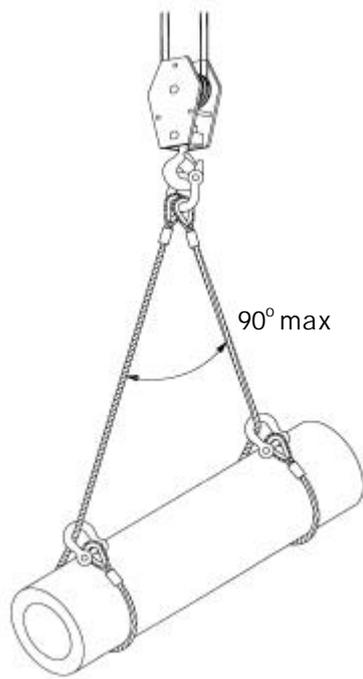
15.3.3.2 Generally two-single-leg sling methods are:

- (a) Two single-leg slings used with direct attachment (Fig. 14);
- (b) Two single-leg slings used in choker hitch (Fig. 15);
- (c) Two single-leg slings used in basket hitch (Fig. 16);
- (d) Two single-leg slings used in double wrap choker hitch (Fig. 17);  
and
- (e) Two single-leg slings used in double wrap basket hitch (Fig. 18).

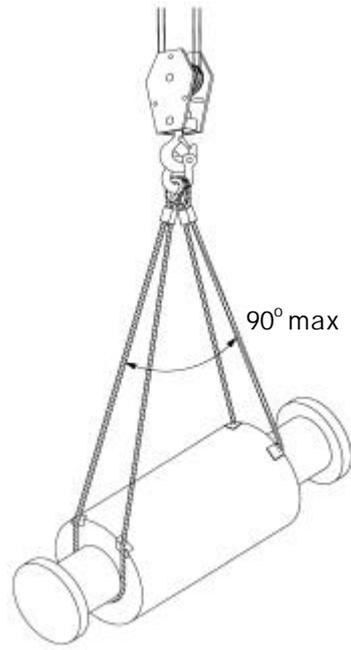
15.3.3.3 When using two single-leg slings together, care should be taken to ensure that:

- (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 lesser safe working load;  
and
- (c) the attachment points of the slings to the load are far enough apart to give stability without exceeding 90 degrees. In the case of two single-legs used in basket hitch, the angle between any two diagonally opposite legs should not exceed 90 degrees (Fig. 17 & 18).

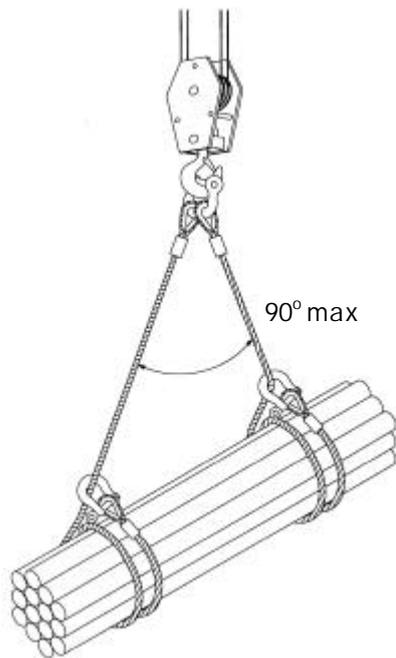
Note : The two slings used in choker hitch, basket hitch, double wrap choker hitch and double wrap basket hitch should not be used for handling composite loads such as loose bundles or tubes, bars or wooden battens unless the friction grips between the parts is sufficient to prevent them slipping from 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.



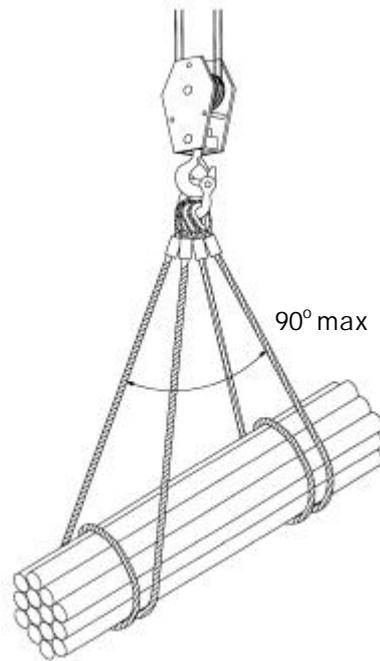
**Fig. 15** Two single-leg slings used in



**Fig. 16** Two single-leg slings used in



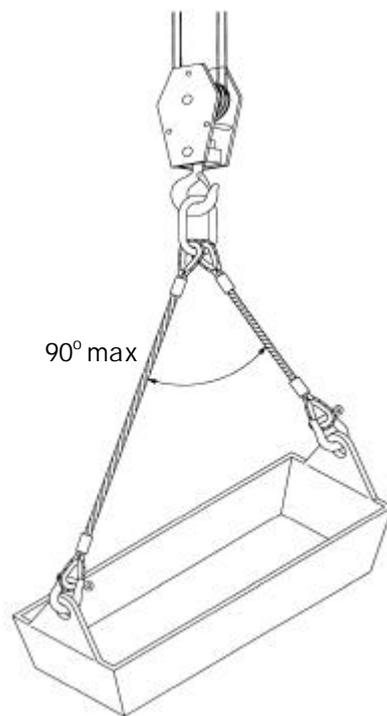
**Fig. 17** Two single-leg slings in double wrap



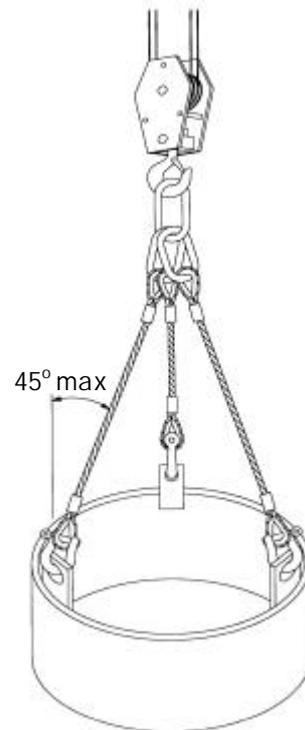
**Fig. 18** Two single-leg slings in double wrap basket

### 15.3.4 Multi-leg sling

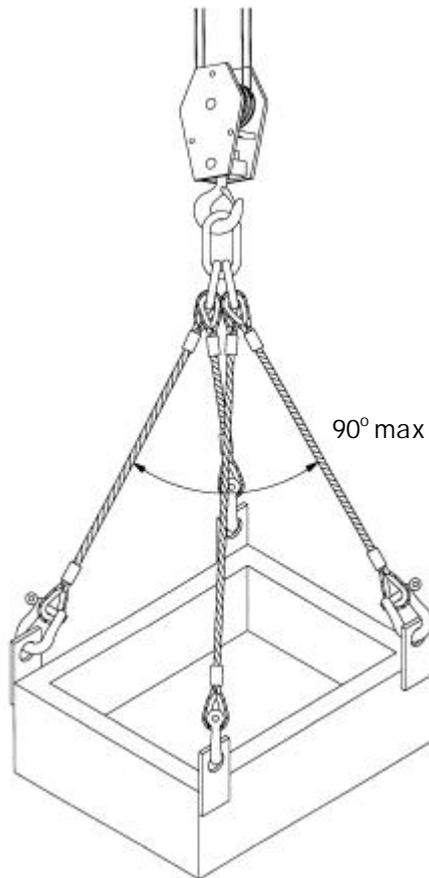
15.3.4.1 A multi-leg sling may have two, three or four legs (Fig. 19 to 21). A two-leg and four-leg sling should not be used at an included angle greater than 90 degrees unless the sling is so marked. In no circumstances should the included angle exceed 120 degrees. A three-leg sling should not be used if any one leg makes an angle to the vertical greater than 45 degrees.



**Fig. 19 Two-leg sling**



**Fig. 20 Three-leg sling**



**Fig. 21 Four-leg sling**

15.3.5 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.

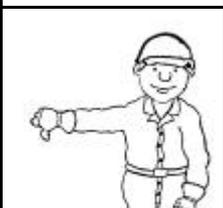
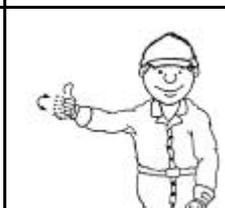
(Regulation 18A of the LALGR)

## 15.4 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 any tendency to kink;
- (b) only the eye termination or link 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;
- (h) a sling in choke hitch is not used to turn, rotate or drag a load unless special precautions are taken to ensure that neither the sling nor the load is damaged; and
- (i) 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 FORWARD  | 5. TRAVEL BACKWARD  |
|    |    |    |    |    |
| 6. INDICATING DISTANCE  | 7. TRAVEL CRAWLER TURN LEFT   | 8. TRAVEL CRAWLER TURN RIGHT  | 9. SWING TURN LEFT   | 10. SWING TURN RIGHT  |
|   |   |   |   |   |
| 11. RAISE BOOM  | 12. RAISE BOOM SLOWLY   | 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 WHIP LINE   |
|  |  |  |  |  |
| 21. LOWER   | 22. LOWER HOIST SLOWLY  | 23. HOIST   | 24. MOVE SLOWLY  | 25. STOP EVERYTHING HANDS ON HEAD   |

**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)<br>7B     | during the preceding 4 years before use (includes the test of the automatic safe load indicator)  |   |   |  | 3                 |
| 5(5)<br>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  |  | 5                 |
| 7A<br>7B       |   |   |   | within the preceding 7 days (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 CP 3010: British Code of Practice for safe use of cranes - Mobile cranes, mobile cranes and derrick cranes
2. BS 6210 : British Code of Practice for – The safe use of wire rope slings for general lifting purposes
3. BS 7121 Part 1: British Code of Practice for safe use of cranes – General
4. BS 7121 Part 2: British Code of Practice for safe use of cranes – Inspection, testing and examination
5. BS 7121 Part 3: British Code of Practice for safe use of cranes – Mobile cranes
6. BS 7262: British Code of Practice for - Automatic safe load indicators
7. BS EN 12077: Crane safety - Requirements for health and safety - Part 2: Limiting and indicating devices
8. ANSI/ASME B30.3: Construction mobile cranes
9. Guidance Notes on Inspection, Thorough Examination and Testing of Lifting Appliances and Lifting Gear issued by The Labour Department.
10. Crane hazards and their prevention - David V. MacCollum, ASSE, USA
11. Cranes and derricks - Howard I. Shapiro, Jay P. Shapiro, Lawrence K. Shapiro, McGraw Hill, Inc., USA
12. Rigging manual - Construction Safety Association of Ontario, Canada
13. Mobile crane manual - Donald E. Dickie, Construction Safety Association of Ontario, Canada

14. Crane handbook - Donald E. Dickie, Construction Safety Association of Ontario, Canada
15. HSE Guidance Note PM3: Erection and dismantling of mobile cranes, Health and Safety Executive, UK
16. HSE Guidance Note PM9: Access to mobile cranes, Health and Safety Executive, UK
17. HSE Guidance Note GS39: Training of crane operators and slingers, Health and Safety Executive, UK
18. A Safety Handbook for Slingers and Crane Operators, RoSPA, UK