

# TRAINING MODULE FOR COMPETENT PERSON (TOWER CRANE)

## Contents

CHAPTER 1	Legislations
CHAPTER 2	Introduction to cranes
CHAPTER 3	Tower crane basic components
CHAPTER 4	Application documents of installing and dismantling crane towers
CHAPTER 5	Process of building crane towers site base
CHAPTER 6	The process of installing tower cranes
CHAPTER 7	Safety tools
CHAPTER 8	Cranes inspection and maintenance
CHAPTER 9	Tower cranes climbing process
CHAPTER 10	Dismantling tower cranes process
CHAPTER 11	Personal protective equipment
CHAPTER 12	General safety

# COMPETENT PERSON

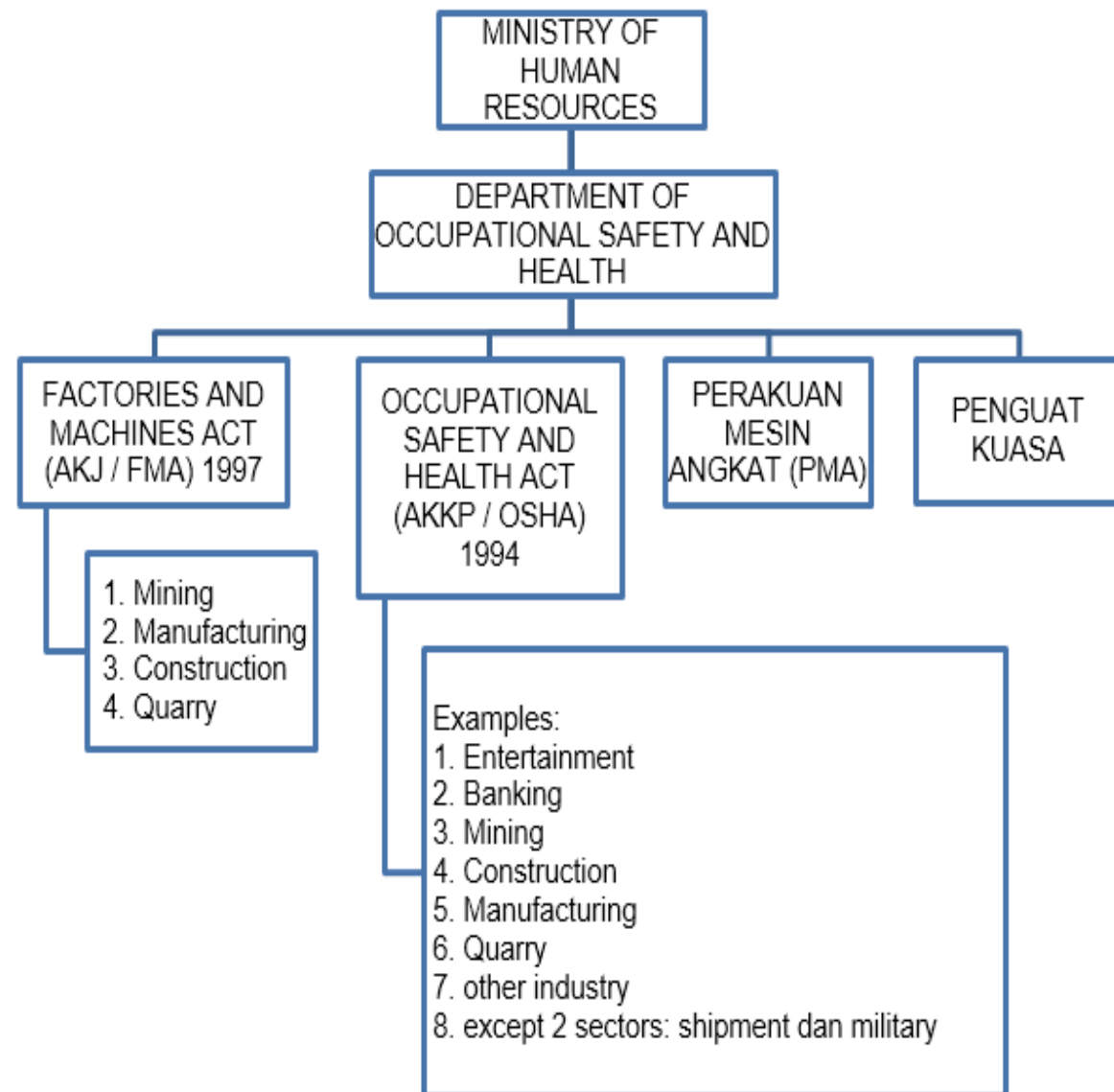
---

## CHAPTER 1 LEGISLATIONS



Enacted to address occupational safety and health issues are the **Occupational Safety and Health Act (OSHA) 1994** and the **Factories and Machinery Act (FMA) 1967**

drawn up by the Ministry under these Acts are enforced by the **Department of Occupational Safety and Health (DOSH), Ministry of Human Resources.**



**Petroleum Act  
(Safety  
Measures)  
1984 (Act 302)**  
aimed at  
ensuring safety  
in the  
transportation,  
storage and  
use of  
petroleum.

The Act contains provisions relating to the transportation of petroleum by road and railway; the transportation of petroleum by water; the transportation of petroleum by air; the transportation of petroleum through a piped system; the storage and handling of petroleum; the use of equipment, gadgets, materials, plants, building equipment, structures and installations; and existing equipment, gadgets, materials, plants, building equipment, structures and installations.

For the transportation of petroleum by road or railway, the owner or operator of the vehicle assigned to carry the petroleum shall take the necessary steps to ensure that the workers handle the petroleum according to the provisions under the Act and Regulations.

When petroleum is transported by water, it should not be loaded or unloaded or removed except at a port or place prescribed by the Minister. The transportation of petroleum by air or through pipelines must be with the prior approval of the Minister.

Furthermore, under the Act, a valid licence for the use of petroleum is required to store or operate any form of petroleum.

There is also a requirement for containers or containers with petroleum to be labelled. The Act also requires residents in nearby areas to give the Minister notice within 24 hours in the case of any accident or loss of life or personal injury arising from a petroleum-related explosion or fire. .

## **Objectives of OSHA (Act 514)**

Part I:

Section 4

Paragraph (a),  
(b), (c) and (d)  
Act 514

- (a) To ensure the safety, health and welfare of employees;
- (b) To protect workers and others from activities that involve risk;
- (c) To promote a safe and healthy workplace environment;
- (d) To provide legislations for occupational safety and health with regulations and an industrial code of practice approved under the provisions of the Act (not limited to acts and regulations).

## Scope of Act 514

Those who are employed:  
In all sectors in Malaysia as follows:

- a) Manufacturing
  - b) Mining and quarrying
  - c) **Construction**
  - d) Agriculture, forestry and fishery
  - e) Utilities: Electricity, gas, water and sanitary services
  - f) Transportation, storage and communication
  - g) Wholesale and retail trades
  - h) Hotels and restaurants
  - i) Finance, insurance, real estate and business services
  - j) Public services and statutory authorities
- Except:** Work on board ships (as stipulated under the Merchant Shipping Ordinance 1952) and the armed forces.

## **General Duties of Employers and Self-Employed Persons (Part IV)\_Summary of general duties of employers:**

- **Section 15. The general duties of employers and self-employed persons to their employees.**
- Adalah menjadi kewajiban majikan dan orang yang bekerja sendiri untuk It is the duty of employers and self-employed persons to ensure the safety, health and welfare of their employees while at work. The general duties of employers are summarized as follows:
- Paragraph (1) and Paragraph (2);
  - The provision of plants and systems of work that are safe
  - The provision of self-protective gear
  - The provision of information, instructions, training and supervision in relation to safety and health
  - The provision of the means to access and egress safely
  - The maintenance of a safe working environment for employees
- .



## **General Duties of Employers and Self-Employed Persons (Part IV)\_Summary of general duties of employers:**

- **Section 16. Duty to formulate a safety and health policy.**
  - It is the duty of the employer to prepare and revise a written statement of his general policy with respect to the safety and health of his employees, and to bring it to the notice of all his employees.
- **Section 17. General duties of employers and self-employed persons to persons other than their employees**
  - It is the duty of the employer and the self-employed person to conduct his undertaking so as to ensure that other persons who are not his employees are not exposed to risks to their safety or health as a consequence of his undertaking.
- **Section 18. Duties of an occupier of a place of work to persons other than his employees**
  - It is the duty of the occupier of non-domestic premises to ensure that the premises, plant or substances used by persons who are not his employees are safe. This duty includes any maintenance or repairs to the place and the access to and egress from that place.
- **Section 19. Penalty for an offence under sections 15 and 16 .** Anyone who contravenes the provisions of sections 15 and 16 shall be guilty of an offence, and shall, on conviction, be liable to: A fine not exceeding RM 50,000.00;Imprisonment for a term not exceeding two years.; Or both.

## **General Duties of Employees (Part VI)**

### **Section 24. General duties of employees at work**

Paragraph (1) sub-paragraphs (a),(b),(c) and (d), and Paragraph (2)

To take care of the safety and health of himself and of other persons.

To cooperate with his employer and other persons in the discharge of the requirements imposed by this Act;

To wear the self-protective gear provided.; To comply with the instructions and measures on occupational safety and health;

A person who contravenes the provisions of this section shall be guilty of an offence and shall, on conviction, be liable to:

A fine not exceeding RM 1,000.00; Imprisonment for a term not exceeding 3 months; Or both.

## General Duties of Employees (Part VI)

**Section 25. Duty not to interfere with or misuse things provided pursuant to certain** A person who intentionally, recklessly or negligently interferes with or misuses anything provided or done in the interests of safety, health and welfare in pursuance of this Act shall be guilty of an offence and shall, on conviction, be liable to:

A fine not exceeding RM 20,000.; Imprisonment for a term not exceeding 2 years; Or both.

The regulations under JKPP 1994 are as follows:

Occupational Safety and Health (Classification, Labelling and Safety Data Sheet of Hazardous Chemicals) Regulations 2013;

Occupational Safety and Health (Notification of Accident, Dangerous Occurrence, Occupational Poisoning and Occupational Disease) Regulations 2004;

Occupational Safety and Health (Use and Standards of Exposure of Chemicals Hazardous to Health) Regulations 2000;

Occupational Safety and Health (Safety and Health Officer) Regulations 1997;

Occupational Safety and Health (Classification, Packaging and Labelling of Hazardous Chemicals) Regulations 1997 (Repealed);

Occupational Safety and Health (Safety and Health Committee) Regulations 1996;

Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996;

Occupational Safety and Health (Employers' Safety and Health General Policy Statements) (Exception) Regulations 1995.

### ORDERS:

Occupational Safety and Health (Safety and Health Officer) Order 1997

Occupational Safety and Health (Prohibition of Use of Substance) Order 1999



## **Factories and Machinery Act (FMA) 1967**

The relevant regulations and orders under the Factories and Machinery Act, 1967 in relation to machinery and the safe construction of buildings are:

1. Factories and Machinery (Exemption of Certificate of Fitness for Hoisting Machine) Order 2015;
2. Factories and Machinery (Building Operations and Works of Engineering Construction) (Safety) Regulations 1986;
3. Factories and Machinery (Notification of Fitness and Inspections) Regulations 1970;
4. Factories and Machinery (Safety, Health and Welfare) Regulations 1970 (Amendment – 1983).

## **Construction Industry Development Board (CIDB) (ACT 520)**

CIDB is a department under the Public Works Ministry. The history of its establishment is as follows:

Tabling of the Construction Industry Development Board Act in Parliament in May 1994.

Gazetted as Act 520 in July 1994.

Came into effect officially on 1 December 1994.

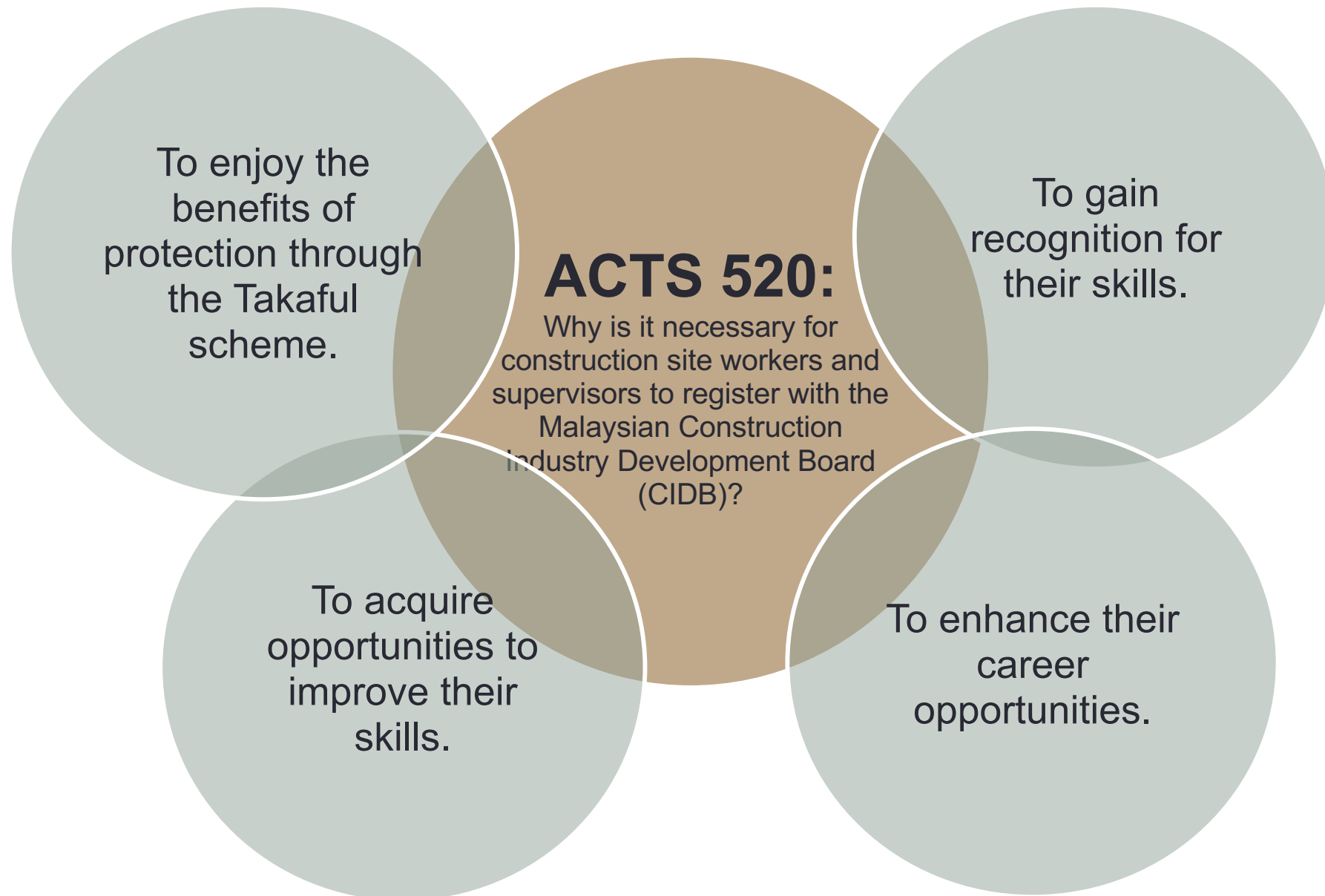
.

## Objectives of Act 520::

1. To register contractors/workers in the construction sector according to their class/skills.
2. To accredit and certify skilled construction workers and construction site supervisors according to the methods and forms specified.
3. To conduct investigations into any offence and inspections.

### Jobs that require skills and certification

- Blaster and painter
- Air-conditioning and mechanical ventilation specialist
  - Drywall installer
  - Ceiling installer
- Petrochemical fitter
- Roof truss installer
- Precast concrete installer
- Formwork system installer
  - Block system installer
    - Bar bender
    - Wireman
    - Bricklayer
  - Plant operator
  - Crane operator
  - Chargeman
  - Cable jointer
- Slinger and rigger
  - Painter
  - Tiler
- Carpenter
- Welder
- Plasterer
- Plumber
- Scaffolder





## **Other Regulations and Code of Practice in relation to Tower Cranes**

Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996

### **PART I**

#### **Regulation 1: Preliminary**

These regulations may be cited as the Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996, and take effect on 1 February 1996.

#### **Regulation 5: Obligations of Manufacturer and Employee**

Setiap pengilang yang menjalankan suatu aktiviti perindustrian perlu-

- a) Every manufacturer who undertakes an industrial activity shall
- b) take immediate action to rectify the situation as soon as he becomes aware of an imminent danger which may affect the safety of persons or the environment; and
- c) establish and maintain a good management system for controlling any major accident, as described in the report made under sub-regulations 14 (1) and regulation 16.

Every employee shall:

- a) cooperate with the manufacturer in complying with the requirements of these Regulations;
- b) act in such manner so as not to endanger himself or to cause or be likely to cause bodily injury to himself or to other persons, or damage to life and property; and
- c) notify the manufacturer as soon as he becomes aware of any potential hazard he considers is capable of generating a major accident, and shall have the right to notify an officer of the potential hazard.

**Other Regulations and Code of Practice in relation to Tower Cranes**  
Occupational Safety and Health (Control of Industrial Major Accident Hazards)  
Regulations 1996

**PART III:**

**Regulation 9: Demonstration of Safe Operation**

A manufacturer who has control of an industrial activity to which this Part applies shall, at any time, at the request of the Director General, provide evidence, including the production of documents, to show that he has:

- a) identified the possible major accident hazards; and
- b) taken adequate steps to –prevent any major accident or minimize its consequences to persons and the environment; and provide persons working on the site with the information, training and equipment necessary to ensure their safety; and
- c) prepared and kept up-to-date an adequate on-site emergency plan detailing how major accidents will be dealt with.

**Other Regulations and Code of Practice in relation to Tower Cranes**  
**Occupational Safety and Health (Control of Industrial Major Accident Hazards)**  
**Regulations 1996**

**PART V**

**Regulation 23: Notification of Major Accident**

Where a major accident occurs on a site, a manufacturer shall notify the nearest Occupational Safety and Health office of the accident by the quickest means available and the manufacturer who makes the notification shall provide:-

- a) the following information relating to the accident as soon as it occurs:
  - i) the circumstances of the accident;
  - ii) the hazardous substances involved;
  - iii) a suitable date for assessing the effects of the accident on persons and the environment; and
  - iv) the emergency measures taken; and
- b) a statement of the steps envisaged to alleviate the medium or long-term effects of the accident (if any), and prevent the recurrence of such an accident.



## **Other Regulations and Code of Practice in relation to Tower Cranes**

Occupational Safety and Health (Control of Industrial Major Accident Hazards) Regulations 1996

### **PART VI**

#### **Regulation 24: Penalty**

- a) A manufacturer who commits an offence against any of the provisions of these Regulations shall, on conviction, be liable to a fine not exceeding fifty thousand ringgit (RM 50,000.00) or to a term of imprisonment not exceeding TWO (2) years or to both.
- b) An employee who commits an offence against any of the provisions of these Regulations shall, on conviction, be liable to a fine not exceeding one thousand ringgit (RM 1000) or to a term of imprisonment not exceeding THREE (3) months or to both.



# COMPETENT PERSON

---

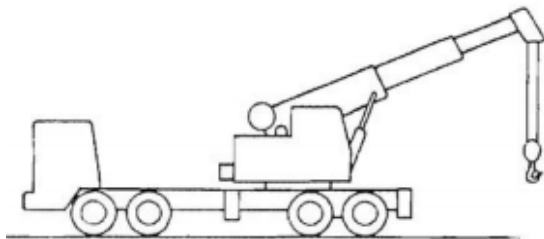
## CHAPTER 2 INTRODUCTION TO CRANES

# Main functions of cranes

- Cranes are included in the load lifting equipment category.
- A crane is a mechanical tool that is used for raising or lowering a load and to move the load horizontally to the required location.
- Its use is also aimed at facilitating and speeding up the construction of tall, huge and wide structures such as buildings and bridges.
- The selection and use of a crane depend on its suitability for the work requirements at a construction site.
- There are also several types of cranes,
  - Mobile cranes
  - Derrick cranes
  - Tower cranes

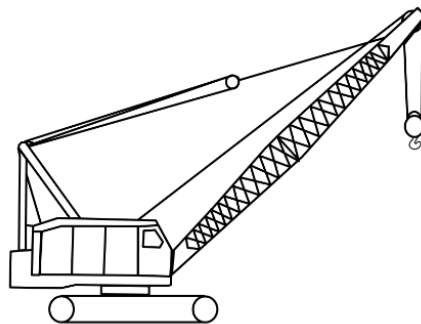
# Mobile crane

- A mobile crane is a type of crane on wheels that is be powered by its own engine and can be driven on the road.
- It is used to raise and lower loads from a moderately high place and is easy to handle for work in a confined space



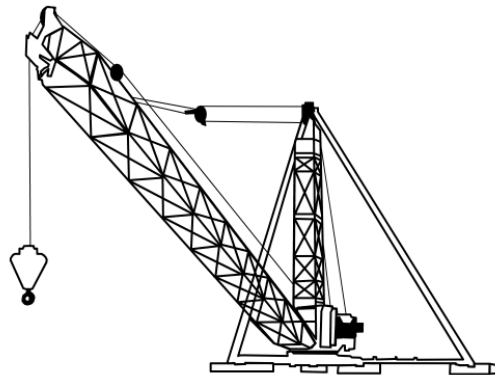
# Crawler crane

- A crawler crane is a type of crane for climbing. It moves by means of tyres or on crawler tracks, and it can be manually driven.
- However, its movements are restricted to the appropriate roads only.
- Crawler cranes are suitable for use on all types of land and earth surfaces.
- This type of crane also has the power to raise and lower loads from a height



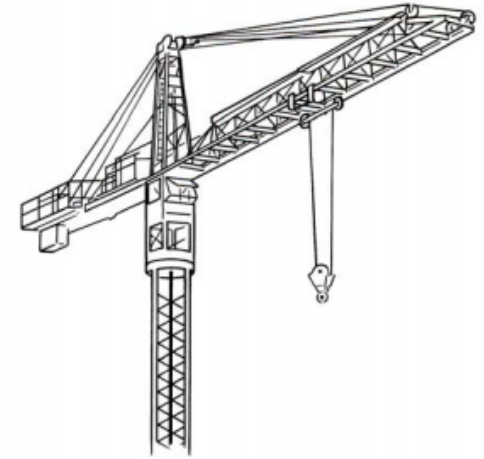
# Derrick Cranes

- A derrick crane is a type of crane that is used on high-rise buildings, where it is placed in a static position on the building structure and cannot be moved
- This type of crane is usually used to lower a tower crane structure that is to be dismantled after having completed works to raise or lower loads.



# Tower cranes

- Tower cranes are designed using high-strength iron shaped into a tower. They are used for industrial works and for the construction of high-rise buildings.
- Tower cranes can raise and lower heavy loads, and are better than other cranes
- They are installed in a static position or move along rails
- Almost the entire tower crane structure is made of solid iron, and it is divided into several parts.
- These parts can be separated and joined back again.
- This technique of joining and separating the crane section by section is used to facilitate the process of installing and dismantling the tower crane.
- It is also meant to facilitate the transportation of the crane from one construction site to another.

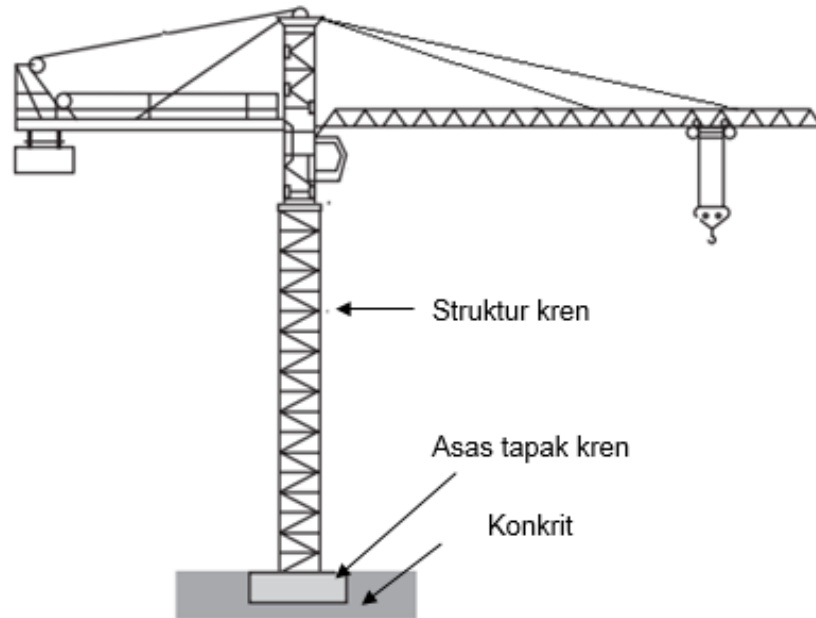


# Types of crane tower

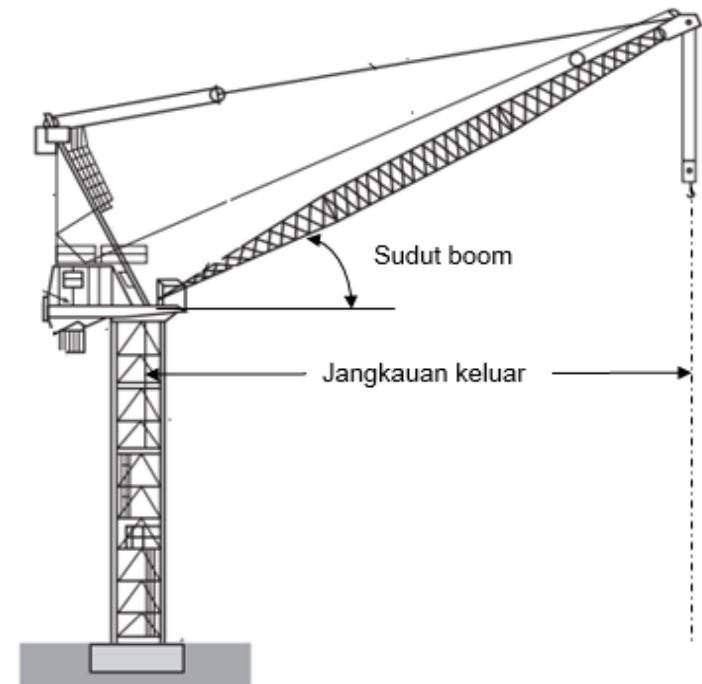
- Tower cranes are one of several types of cranes in the heavy machinery category that are commonly used to raise and move any heavy and massive load from one place to another..
- A tower crane is a rectangular tower fitted with several important components such as bolts, nuts, and pins, and its base is made of cast concrete supported by beams or mounted on rails.
- The slewing platform, hoist, mast and boom are mounted on the base of the tower.
- Before a tower crane is installed, safety inspections should be carried out first, and these must be carefully planned according to the established procedures.
- The installation of the boom and counterweight is a hazardous job, and if it is not carefully planned or studied, it can result in the failed installation of the tower crane.
- These cranes can be divided into several categories depending on their size and manufacturer.

# Types of crane tower

- The popular types used in Malaysia are the **hammerhead**, **hammerhead (flat top)** and **luffing cranes**



*Hammerhead*

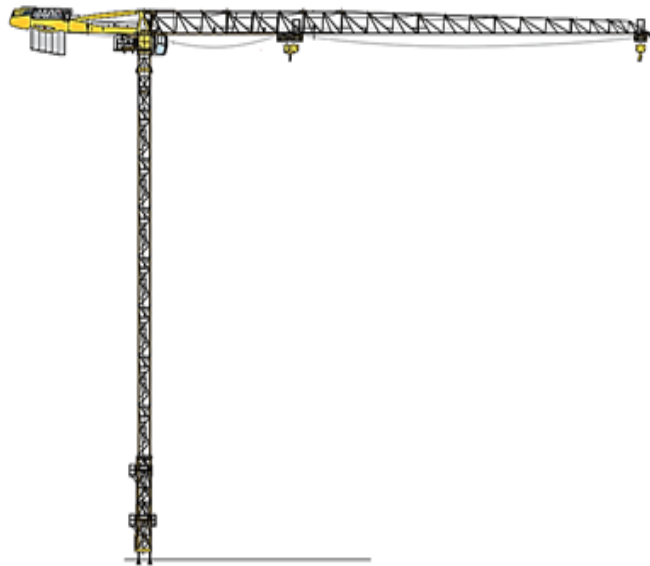


*Luffing*

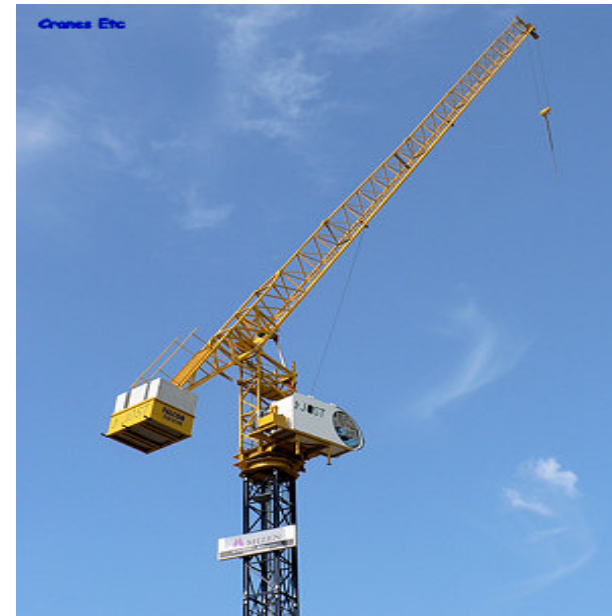


# Types of crane tower

Flat top cranes



*Flat Top  
(Hammerhead)*



*Flat Top (Luffing)*

# Types of crane tower

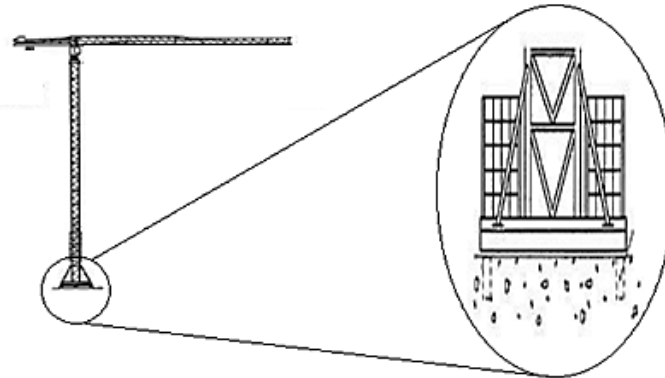


Self erecting crane tower (*self-erecting*)

# Types of Tower crane base

Static Base (Free standing self-supporting static tower crane)

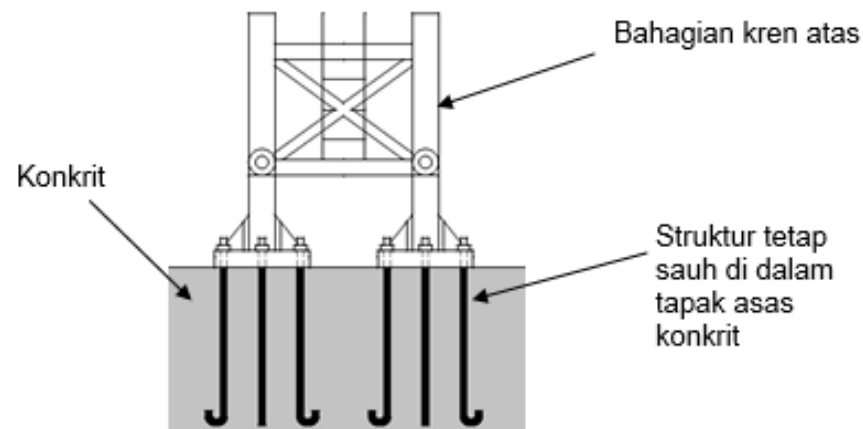
- This type of crane is generally popular and is the tallest among all the other types of cranes.
- It is suitable for installation in open sites, and is usually placed at the front or in any place where there is enough space for the boom to move/rotate
- For the static base category, there are two methods of installation for the tower crane base, namely:



# Types of Tower crane base

## In-situ cast base

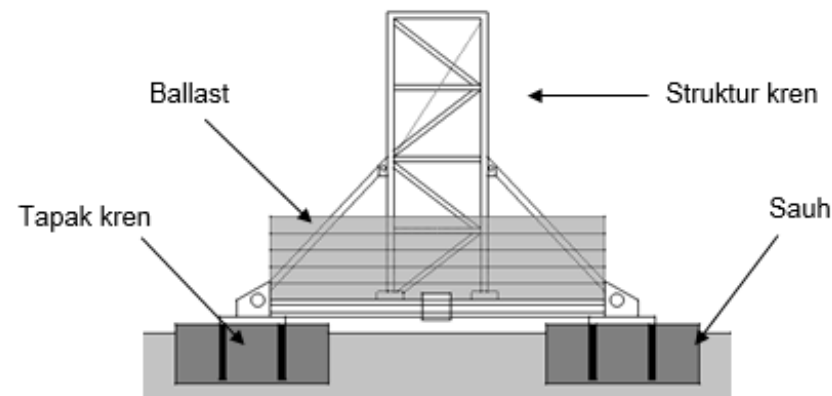
- This type of base requires a special anchor (known as an expandable anchor) to be embedded in a concrete block



# Types of Tower crane base

## Own base

- The base of the crane is constructed by placing ballast at the crane base with the chassis as the weight



# Types of Tower crane base

External supported static tower crane:

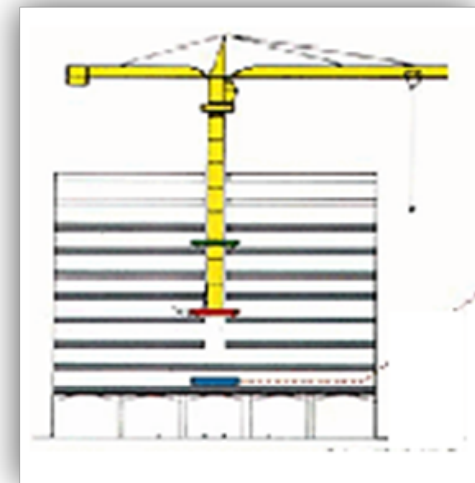
- The base is supported by a construction/building structure joined by a climbing frame.
- The height of the crane can be extended, depending on the height of the building structure, and it should be aligned with the climbing frame



# Types of Tower crane base

## Internal climbing crane

- This type of tower crane installation is usually designed for tall buildings, and it is placed in a location where it can be supported by structures within the building that is under construction. The crane can be adjusted from one level of the building under construction to a higher level.

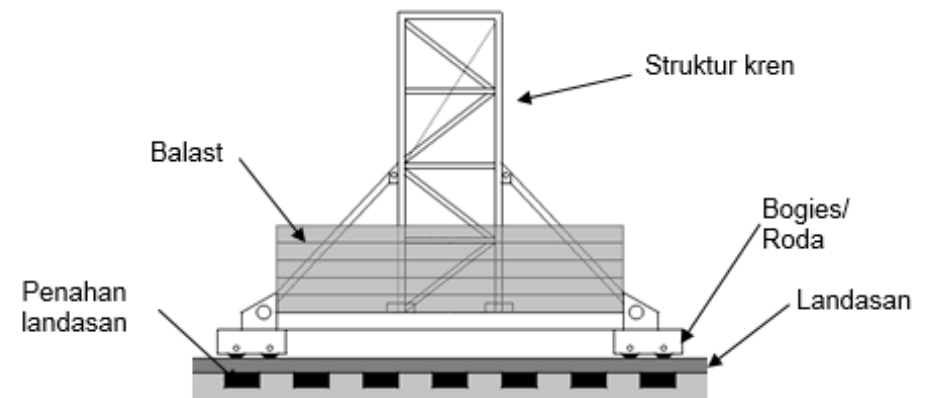
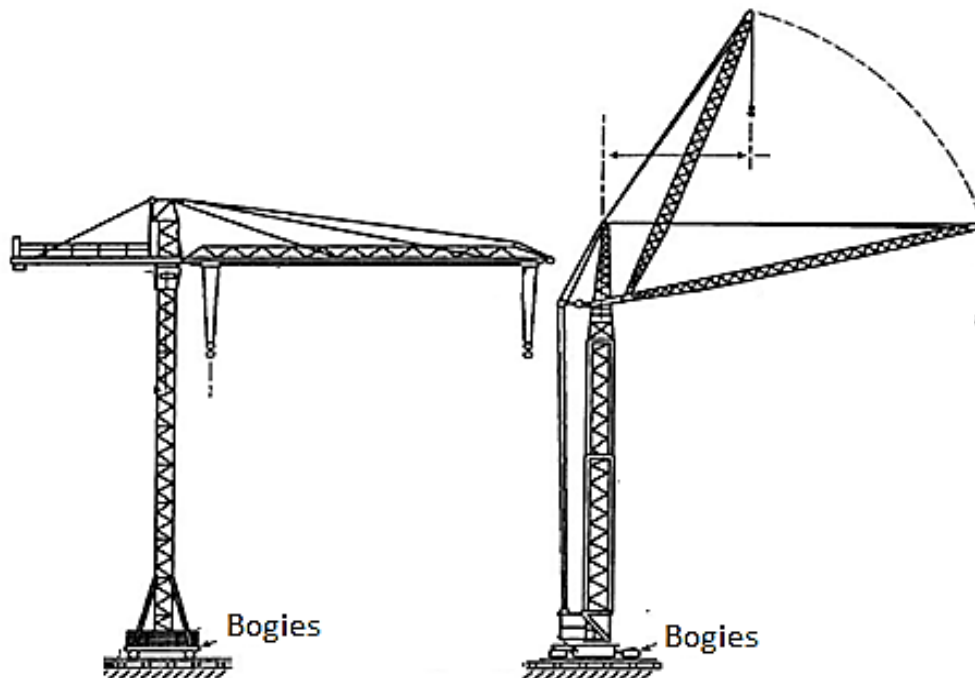




# Types of Tower crane base

## Travelling tower crane

- This type of tower crane moves on heavy-wheeled bogies placed on rails.
- The bogies have no fixed grade but change according to the height of the mast mounted on the tower crane





# Conditions for the selection of tower cranes

## Hammerhead tower crane

- This type of tower crane is suitable for industrial projects that have the following criteria:
  - wide load area or reach
  - higher load to be lifted
- If the area or site meets the above criteria, then the type of tower crane that is suitable for use is the hammerhead.

# Conditions for the selection of tower cranes

## Luffing tower crane

- This type of tower crane is adapted for industrial projects that have the following criteria:
  - limited load area or span
  - Lower load to be lifted compared to hammerhead
- If the area or site meets the above criteria, then the luffing tower crane should be used.

# COMPETENT PERSON

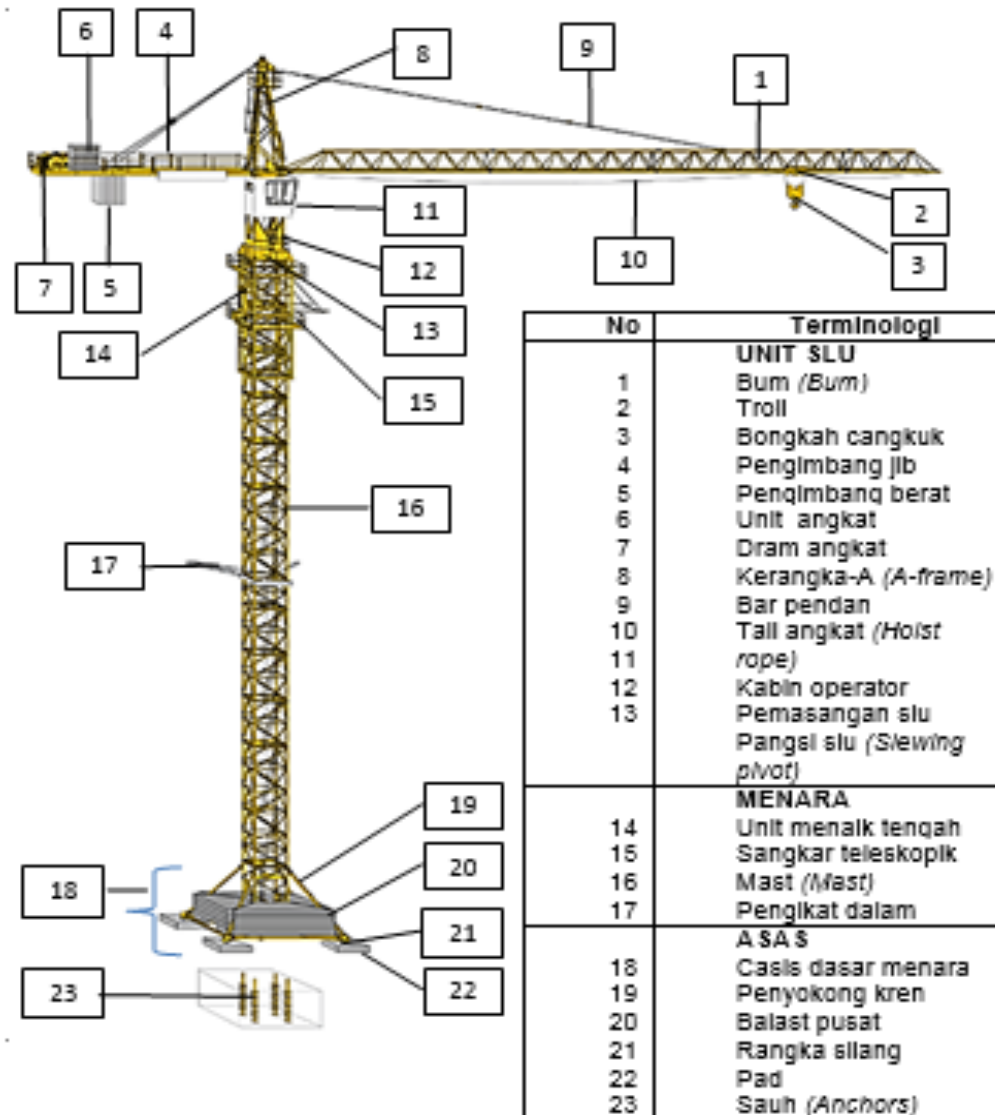
---

## CHAPTER 3

### TOWER CRANE BASIC COMPONENTS

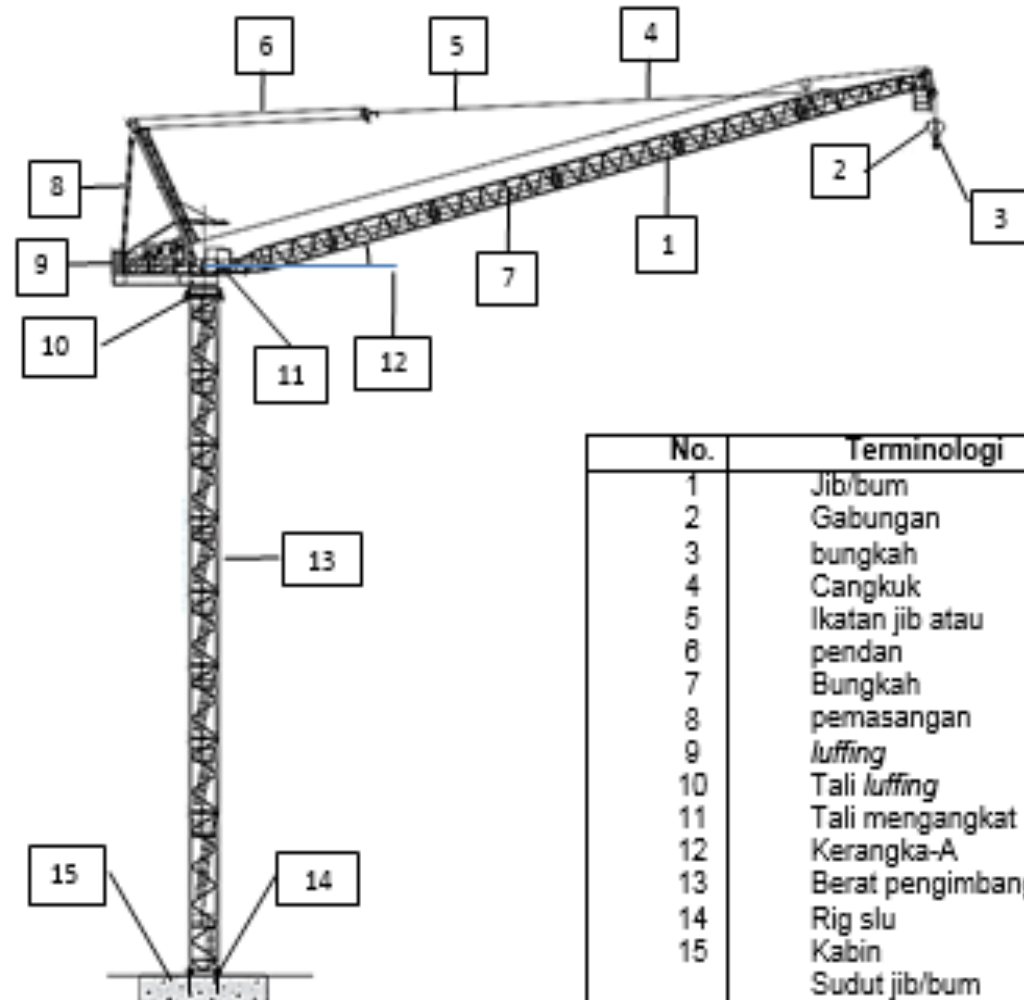
# Terminology and Structure of Tower Crane

Hammerhead tower crane



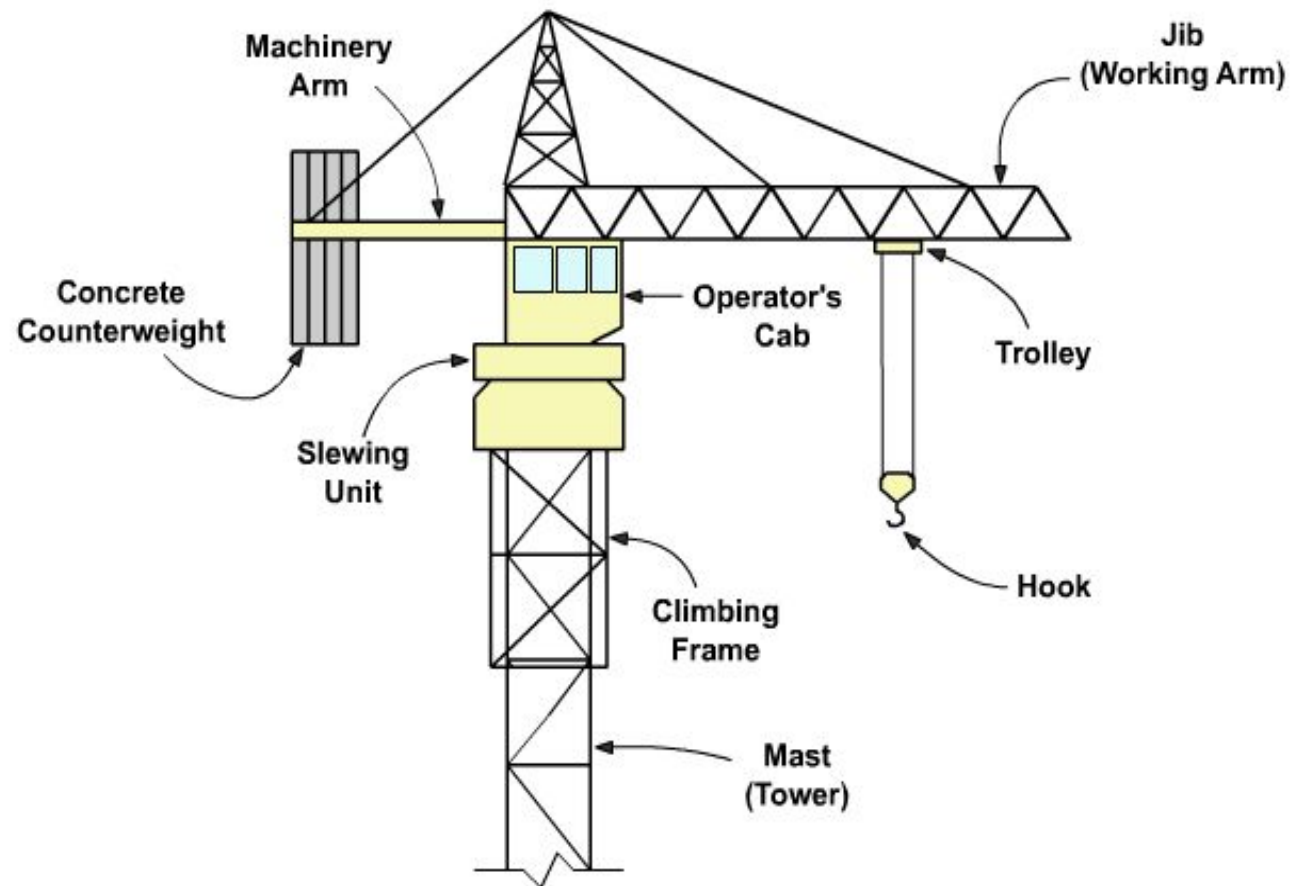
# Terminology and Structure of Tower Crane

*Luffing Tower cranes*



No.	Terminologi
1	Jib/bum
2	Gabungan
3	bungkah
4	Cangkuk
5	Ikatan jib atau pendan
6	pendan
7	Bungkah pemasangan
8	luffing
9	Tali luffing
10	Tali mengangkat
11	Kerangka-A
12	Berat pengimbang
13	Rig slu
14	Kabin
15	Sudut jib/bum
	Menara
	Sauh
	Konkrit

# Tower Crane Basic Components



# Cabin Operator

- Operator cabins for a tower crane are usually in line or under the boom.
- The cabin size space should be comfortable enough to accommodate an operator and the comfort of the cabin should be emphasized to ensure the crane operator is comfortable to carry out the task because the working duration of a crane operator is at least 4 hours straight and the total of maximum working hours is 12 hours.
- This allocated period requires complete cabin fittings for the purpose of comfort and safety such as air conditioning, electrical equipment box, fire extinguisher, computer monitor, weather gauge, and left and right control buttons

# Cabin Operator

Some of the equipment functions in the cabin:

- Computer monitor: Display high information, weight and load position at jib
- Weather gauge: Monitor wind speed and direction, air pressure and temperature.
- Right control button: Lift loads when pulled and lowered loads when rejected
- Left control button: Controls the jib swing when moving left and right and controls the movement of the exit and the trolley from jib.



# Cabin Operator



# Mast Section

- The mast is the most important support for a tower crane.
- It is made of a metal knot that connects all the mast parts.
- Mast has three components, namely base mast, ladder and rear loop



# Slewing Platform

- Slewing platform is a component connected to the highest mast..
- Slewing platform serves as machinery that turns the tower crane and is controlled by using the left control button by the tower crane operator



# Counter Jib

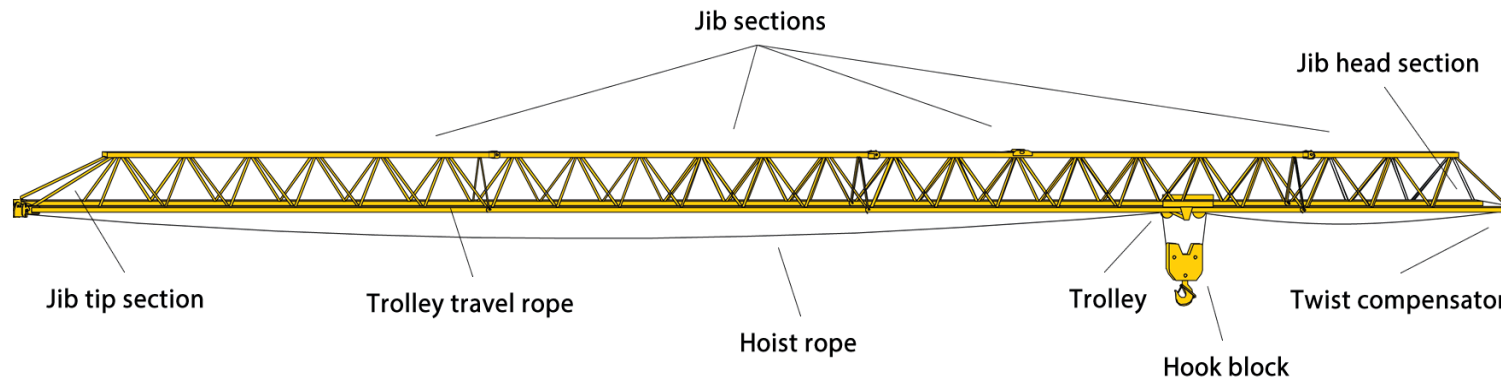
- Counter jib is a short horizontal jib and is in opposite side with boom.
- This section works to accommodate lead weight which is placed based on the length and weight of the boom that will be used for lifting operations.



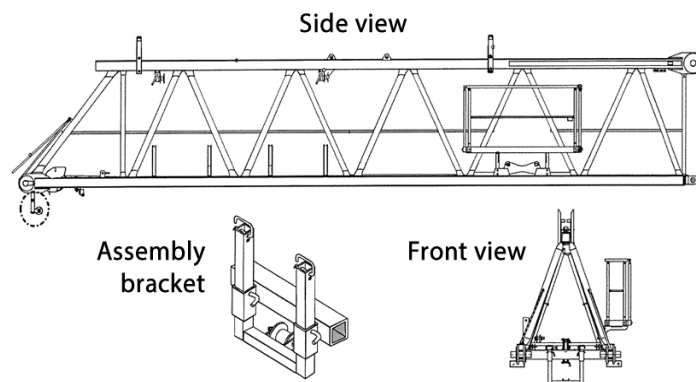
# Boom

- The boom serves as a steering arm and is longer than the counter jib.
- When controlling the hammerhead type of crane, the trolleys are moved in and out to move the load closer or away from the mast.
- If a luffing tower crane is used, the boom is cranked up and down to move the load closer or away from the mast.
- The boom can be divided into parts, the tip, the middle and the start.
- All these parts work to hold lifting cables, trolleys and hooks.

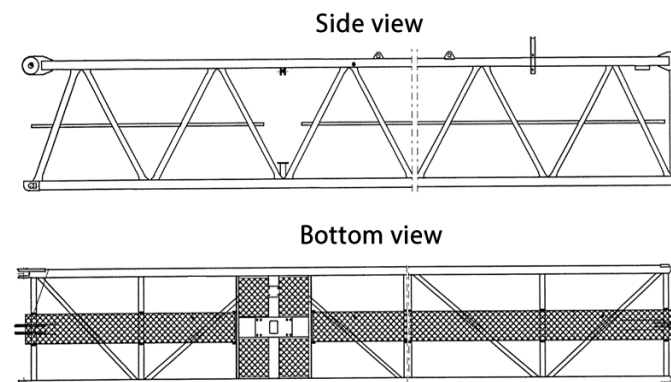
# Boom



## Jib tip section



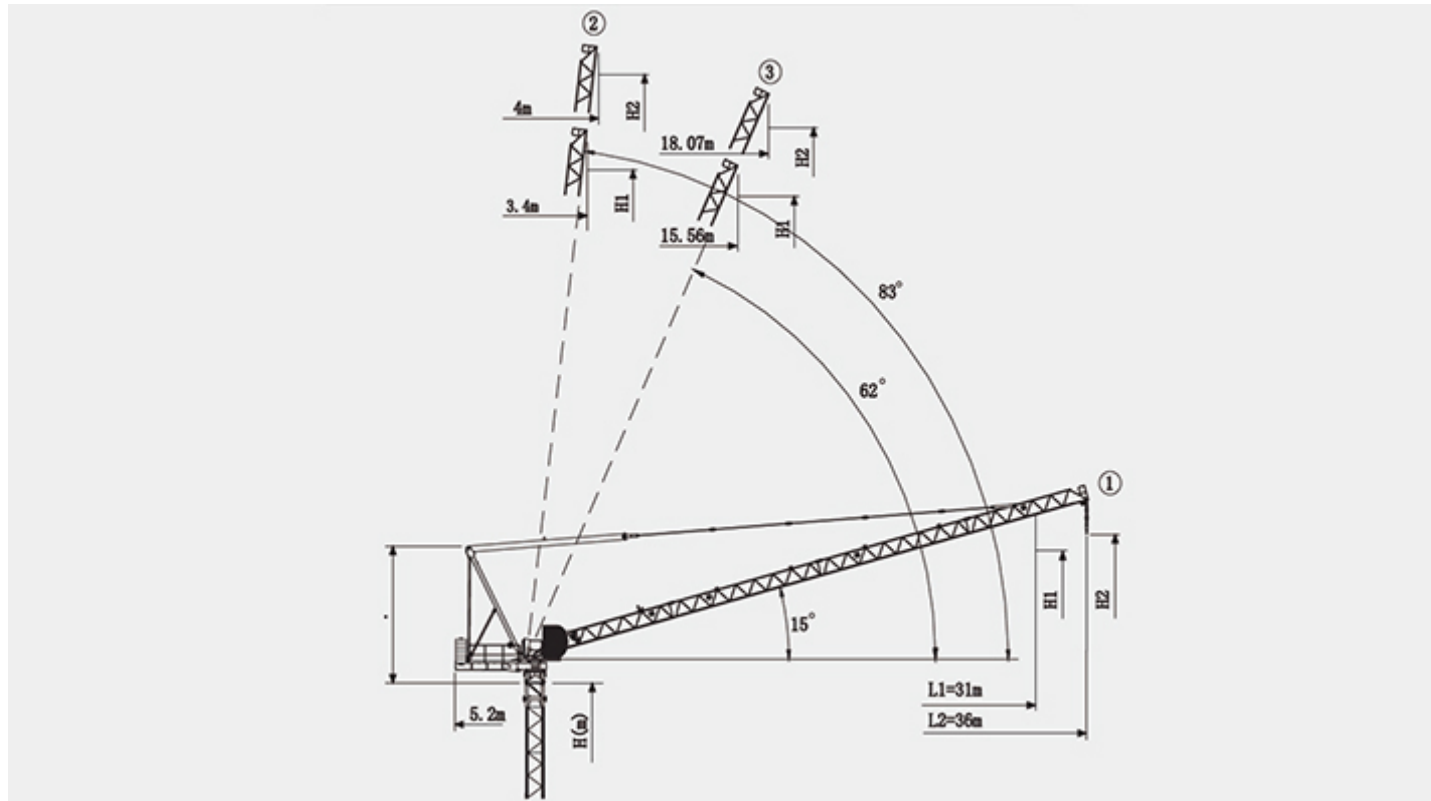
## Intermediate jib section



Boom hammerhead crane parts



# Boom

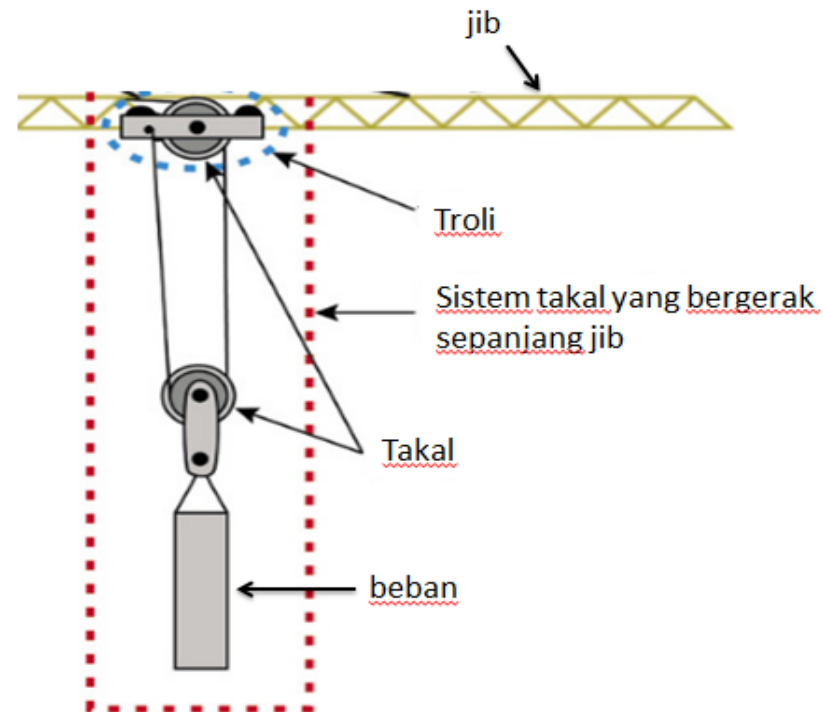


Movement of the luffing tower cranes for different load spacing



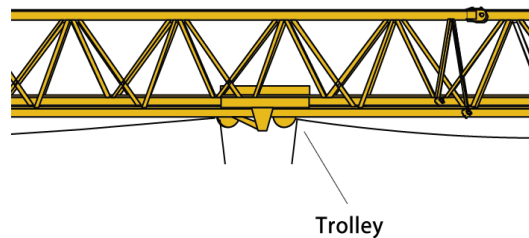
# Pulley

- Pulley is used to support lifting cable movements and changing the power of the cable to facilitate lifting and moving loads.
- The pulleys are placed together with a hook block to connect the hook block to the trolley on the jib.

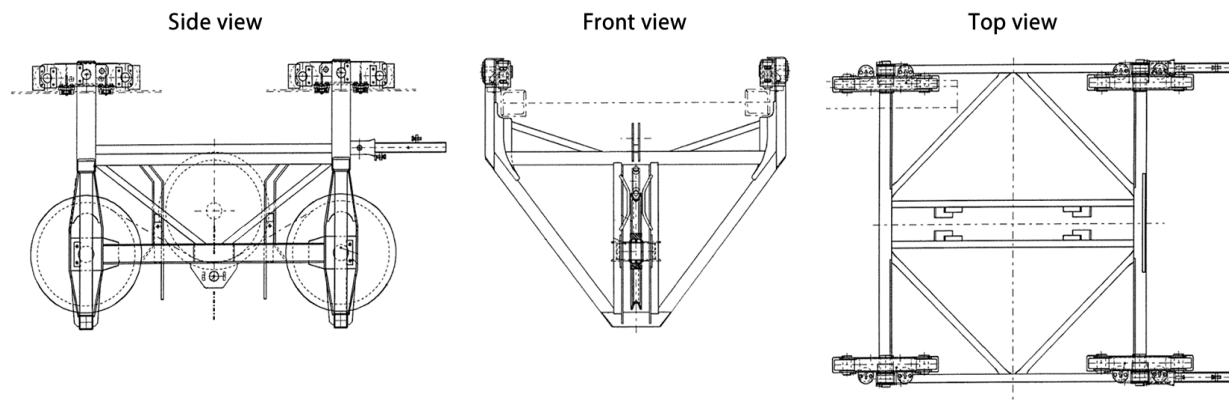


# Trolley

- The trolley is used to move the load closer or away from the mast for the hammerhead tower crane.



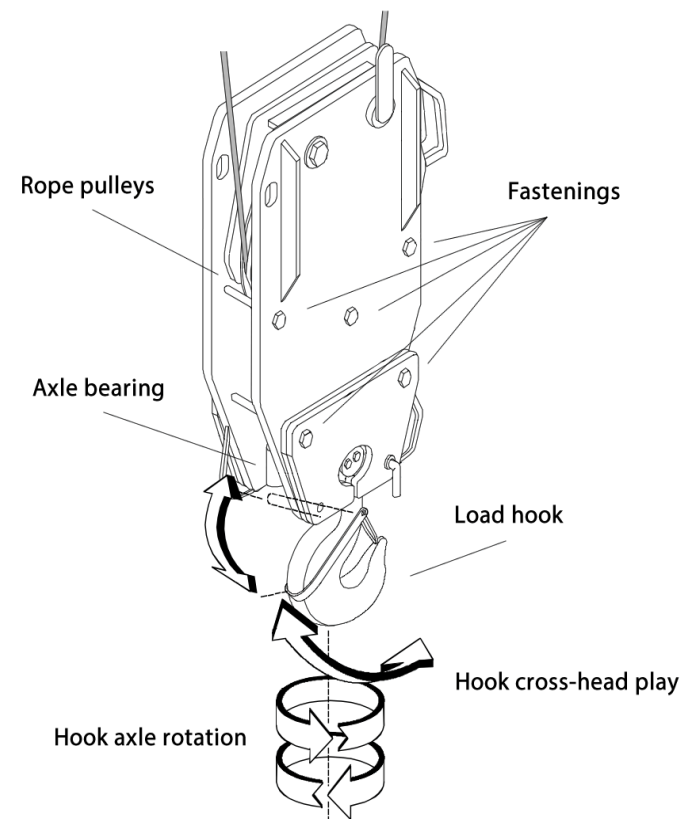
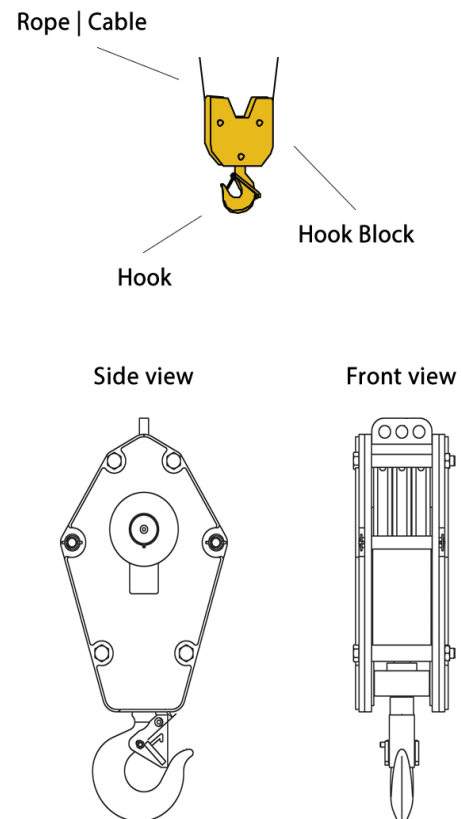
Trolley unit



# Hook Block

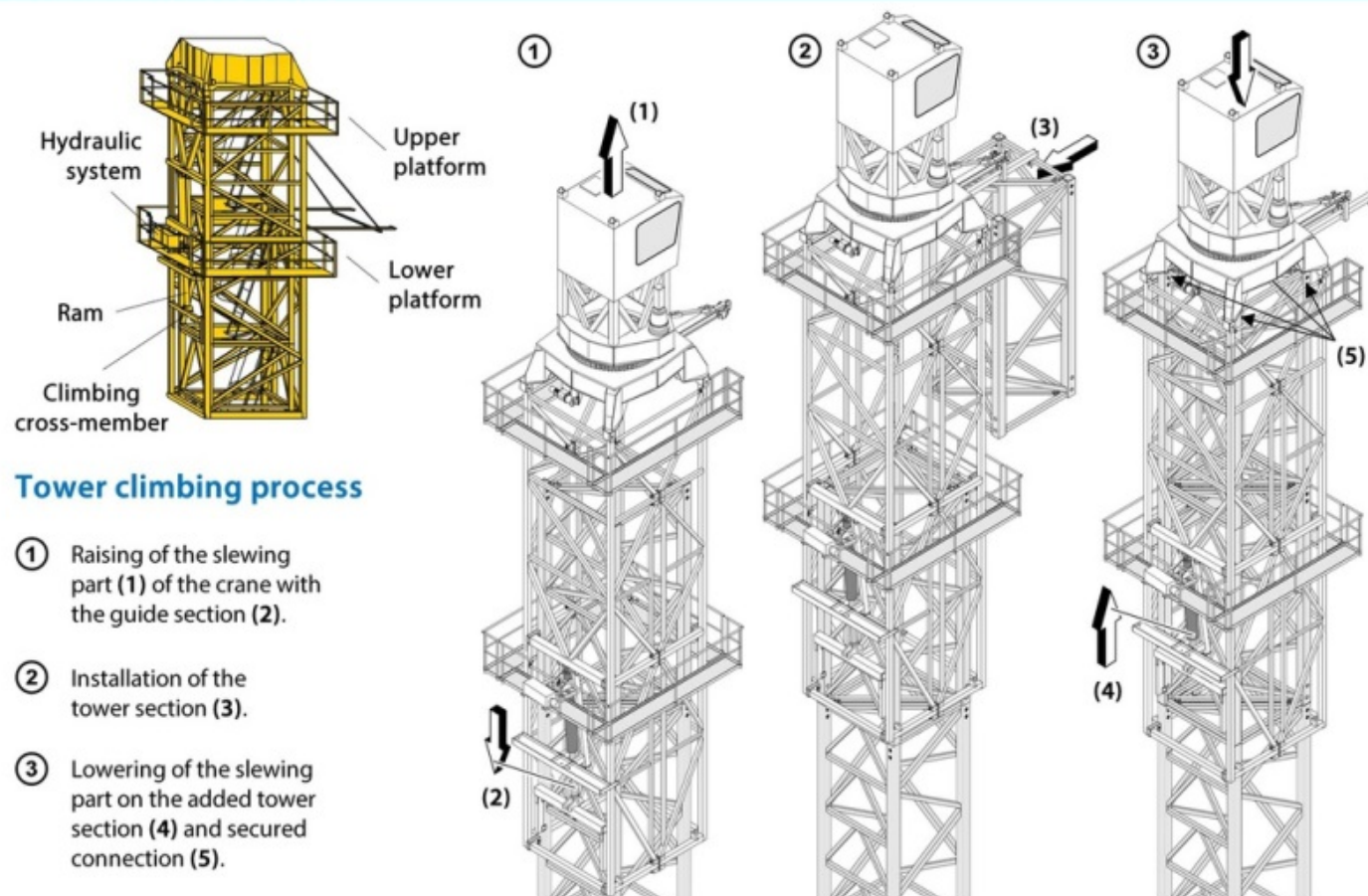
- The hook block is hung on the lifting cord to lift the load.
- The hook block function is to allow the load to be hung on the lifting cables.
- Hooks used for lifting items should be equipped with safety latch.
- The hook should be checked so that it is free of any damage such as wear, rust, cracks or bent.

# Hook Block



# Telescopic Cage

- Telescopic cages are installed for the purpose of the tower crane raising process.
- Before the new mast part is added, the highest mast part of the tower is jacked and reinstalled after the mast is properly inserted



# COMPETENT PERSON

---

## CHAPTER 4

### APPLICATION DOCUMENTS OF INSTALLING AND DISMANTLING CRANE TOWERS



# Document checklist

Before the tower crane is installed, Competent Person must ensure the following documents are provided for the application of installation.

- Application Letter to install a tower crane
- Letter of appointment as a firm of installation
- Letter of approval as an installation, maintenance and dismantling firm
- Competent Person Declaration Letter
- Form JKJ 105 (Factories and Machinery Act)
- Design Approval Letter from JKKP (for new tower cranes)
- Copy of Site Registration letter
- Drawings and Designations of Site Base Structure certified by Professional Engineers
- Declaration Letter of Slew Limiting Switch installation signed by Competent Person
- The plan of the tower crane and the 'Slewing Radius'
- Crossed procedure (if the crane tower crossed)
- Latest Permit of Lifting Machinery (PMA) certificate
- Copy of Application Letter of file and card transfer (if the tower crane is moved from another state)
- Authorization letter from the Local Authority (PBT) if the tower crane operates beyond the site of the site
- Basic image of built site
- Ground Inspection Checklist - Form KPKM 01 and KPKM 02 (Load test)
- Piling Report
- Concrete Cube Test Report
- Certificate of Site Base
- HIRARC
- Standard Operating Procedures (SOPs)
- Technical Specifications of Tower Crane

# Application letter of installing tower crane

- This application letter must be addressed to Department of Occupational Health and Safety (DOSHS) of the state where the tower crane is installed. Application letter must clearly state the address of the built site and the Certificate of Fitness (PMA) number of cranes installed.

# Letter of appointment as an installation firm

- An appointment letter from the main contractor must be addressed Department of Occupational Health and Safety (DOSH) of the state where the tower crane is installed and clearly state the appointment of the competent firm name appointed for the purpose of installing, maintaining and dismantling the tower cranes. If there is more than one crane to be installed, all cranes must be listed with serial number and Certificate of Fitness (PMA) number.

# Letter of approval as an installation, maintenance and dismantling firm

- Competent firms must provide evidence that the companies are registered under the Tower Crane category (EMD01). The Competent Person name must be specified in the letter for each installed tower crane. The approval requirements must also state clearly that the Competitive Firm is responsible for:
  - implement each planned activity according to plan of action plan
  - Inform Department of Occupational Health (DOSH) if there is any change, increase, emptying of officers or changes in organizational structure, existing machinery and premises
  - Supervise Competent Person scope of work to ensure that the work is carried out in accordance with quality plan, inspection and testing procedures, procedures and safe working instructions

# Letter of approval as an installation, maintenance and dismantling firm

- Complete the report for all completed work
- Professional Engineers will verify the strengths and suitability of the site and obtain permission from the state Department of Occupational Health (JKKP) director
- Do not perform unauthorized modification of Department of Occupational Health (DOSH)
- Immediately report any damage to the structure, incident or accident at the installation site to Department of Occupational Health (DOSH)
- Pay attention to the controls and the maintenance records that were specified in the Quality Management System and Occupational Safety and Health Management System and keep it in completely with all the relevant records
- Comply to all additional conditions by Factory and Machinery Inspectors

# Competent Person Declaration Letter

- A Competent Person declaration should include by clearly explaining the activities of installing the tower cranes with the model number, Permit of Lifting Machinery (PMA) number and serial number. A letter of declaration must also indicate clearly the address of the tower crane installation. The letter must be signed by the Competent Person and the project manager. The letter must state the following:

# Competent Person Declaration Letter

- The Competent Person will ensure the safety of the public during the installation, maintenance and dismantling of the tower crane
- The Competent Person must always monitor and keep all work done during the monitoring period and the work is not performed without the presence of Competent Person
- Every machine that will be used to install, upgrade, repair and maintain must have a qualification certificate for use.
- Employees must be skilled and experienced people. All employee details must be included in the attachment.
- Work is carried out by ensuring the safety and health of workers. All requirements such as personal protective equipment must be supplied.
- Work procedures must be approved by professional engineers
- Comply with all official requirements of the Department of Occupational Safety and Health examiner which are issued from time to time.



# Form JKJ 105

- The form must be filled in completely and state the name and address of the main contractor and the address of the construction site. The name of the owner of the tower crane and the company's address must also be included.
- All machinery must comply with the requirements of the Factories and Machinery Act 1967 to qualify for use or installation. Tower Cranes and complete specifications must be specified in this form including the Tower crane model, country made, horsepower, registration reference number, and safe workload to be complied with.

# Design Approval Letter from DOSH

The design approval letter from JKKP must be provided if the tower crane is first installed at the construction site.

# Construction Site Registration Letter

- The registration letter to the main contractor from JKKP included with the following:
  - Construction activities must comply with the Occupational Safety and Health Act 1994 and Factories Act and Machinery 1967
  - Any additional tower cranes installed must be approved and reported to JKKP through the JKJ 105 form.
  - Certificate of Fitness must be obtained before the operation
  - Any accident is compulsory to be reported
  - Any dangerous occurrence involving public property damage and threatening employee safety must be reported.
  - All documents relating to safety at the site of construction should be kept and arranged in order

## **Drawings and Approximate Design of Site Base Structure certified by Professional Engineers.**

Professional engineers must confirm all arrangements and drawings that have been made during the process of re-designing the base structure of the site. All these drawings and calculations must clearly state the following:

- Tower crane model
- the ability to free standing within the correct metre measure based on manufacturer's manual
- The address of the site where the installation is located
- All the important things in the design of the tower crane take off all the forces and certain moments
- Concrete grade
- Water treatment in site environment and barrier fence for safety
- All designs that do not follow the drawings must be reported to the supervisor engineer

Drawings must be complete by specifying the piling layout and accuracy of distance and depth with manufacturer's calculations and manuals.

## **Declaration Letter of Slew Limiting Switch installation signed by Competent Person**

- If the crane is not allowed to rotate 360 degrees, the Slew Limiting Switch must be activated. Restricted rotation degrees should be clearly stated in the certificate letter addressed to DOSH.
- This letter must be accompanied by a plan showing the work radius of the correct scale.
- Each tower crane that needs to be switched on the Slew Limiting Switch must clearly state the serial number of the crane and the model.

# Slewing radius plan

The complete plan of the entire construction site must be enclosed as specified on the certificate of installation of the Slew Limiting Switch. The plan must be signed by a Professional Engineer and has a complete address of the built site. The scale of the drawing should also be precise to ensure the slewing radius of the adapter.

## Crossed procedure (if the crane tower crossed)

If there are two or more tower cranes to be installed, that cause crossing between each other, then the complete procedure and the safety measures taken have to be clearly stated. Maximum distance of intersections must also comply with the designated practice. If this procedure is not complied with, the tower crane is not allowed to operate as a whole and it will not be only a tower crane that has to be stopped its operation.



# Permit of Lifting Machinery (PMA) certificate

- Permit of Lifting Machinery (PMA) certificate of construction site before installation must be included.
- This certificate is for a tower crane which is not used for the first time.
- This certificate clearly states the prior to construction site and the name of the registered contractor.
- The valid date of the certificate is also clearly stated. Inspection date must also be clearly stated.
- This certificate must state the tower crane registration number and model and manufacturer's name.

## Copy of file transfer application letter

If involving installation in a different state, the file transfer application letter to state DOSH must be included. This is to ensure that the crane record is current and the location of its use is registered in the system.

# The base image of the site

- The base image of the site must be included as a proof of compliance with design arrangements that have been certified by a professional engineer. Site bases are not allowed to be closed as long as the inspection is not conducted by DOSH officers.

# Basic site inspection checklist and tower crane test

- The basic site inspection checklist and tower crane test must state the following in accordance with the form KPKM 01 and KPKM 02. All such forms must be signed by the Examining Officer, Competent Person and the construction site builder.

# Basic site inspection checklist and tower crane test

**SENARAI SEMAK PEMERIKSAAN ASAS TAPAK ATAU 'GROUND INSPECTION' KREN MENARA (KPKM 01)**

Nama dan Alamat Pemilik : \_\_\_\_\_

Nama dan Alamat Tempat Kren Dipasang Pemeriksaan dilakukan : \_\_\_\_\_

Firma Pemasang : \_\_\_\_\_

Ruj. Kelulusan Rekabentuk : \_\_\_\_\_

**A : BUTIR-BUTIR MESIN ANGKAT (NO. PENDAFTARAN: \_\_\_\_\_)**

Jenis : _____	Tahun dibina : _____
Model : _____	Kuasa : 60 kw
No. Siri : _____	BKS : 1.3 tan @ 50 meter (2 FALL / 4 FALL)
Pembuat : _____	Kedudukan kren terdahulu : _____

**B : BUTIR-BUTIR PEMERIKSAAN**

PERKARA	BAIK	T/BAIK	CATATAN	PERKARA	BAIK	T/BAIK	CATATAN
1. Asas Tapak *				17. Cabin			
2. Fix Anchor (cast in / reusable)				18. Radius Indicator(H&T)			
3. I Beam				19. Hoisting Winch Unit			
4. J Bolt				20. Hoist Rope			
5. Chassis Frame				21. Hoist Sheave & Pin			
6. Ballast Block				22. Trolley Winch Unit			
7. Mast Element				23. Trolley Rope			
8. Ladder & Platform				24. Luffing Winch Unit			
9. Push bolts & pin				25. Luffing Sheave & Pin			
10. Climbing cage				26. Luffing Rope			
11. Slewing table				27. Cat Head			
12. Counter weight				28. Electrical Panel			
13. Jib				29. Hydraulic Cylinder System			
14. Counter Jib				Others			
15. Hook Block							

Kedudukan kren menara : \_\_\_\_\_

Radius operation dicadangkan & jib length : \_\_\_\_\_ o/s \_\_\_\_\_ meter

Catatan : ( / ) - Satisfactory, (R,A)-Repair, (R,P)-Replace, (N,D,T)-NDT

**C : ASAS TAPAK \***

Surat Akuan daripada Kontraktor Utama / Pengurus Projek / Residents Engineer (Foundation)	ADA / TIADA
Surat Akuan daripada Firma Pemasang ( Fix Anchor / I Beam / J Bolt)	ADA / TIADA
Laporan Test Pile (Jika menggunakan asas pile)	ADA / TIADA / NA
Laporan Ujian Konkrit bersama Photo Penyediaan Asas Tapak	ADA / TIADA / NA

**D : Lain-Lain**

Semua Komponen Asai dipasang	SETUJU / TIDAK
Kebenaran Daripada Jabatan Penerbangan Awam	YA / TIADA
Prosedur kerja selamat kahs bagi operasi jib overlapping	PERLU / TIDAK
Keperluan untuk memasang Anti Collision Sensor / Zoning System	PERLU / TIDAK

**E : Kebenaran Memasang Jentera Dikeluarkan**

SETUJU / TIDAK
----------------

\* Pastikan 'wall ties' dibina mengikut rekabentuk daripada pembuat dan disahkan oleh Jurutera Professional.

Komen : \_\_\_\_\_

Tandatangan Pemeriksa : \_\_\_\_\_ Tandatangan Wakil Tapak & Cop : \_\_\_\_\_ Tandatangan OYB & Co : \_\_\_\_\_

( \_\_\_\_\_ ) ( \_\_\_\_\_ ) ( \_\_\_\_\_ )

Tarikh Ujian : \_\_\_\_\_ Tarikh : \_\_\_\_\_ Tarikh : \_\_\_\_\_

Disemak : Ketua Seksyen Kerja Bina

**SENARAI SEMAK PEMERIKSAAN DAN UJIAN KREN MENARA (PERTAMA / ULANGAN) (KPKM 02)**

Nama dan Alamat Pemilik : \_\_\_\_\_

Nama dan Alamat Ujian Dilakukan : \_\_\_\_\_

Firma Pemasang : \_\_\_\_\_

Ruj. Kelulusan Rekabentuk : \_\_\_\_\_

**A : BUTIR-BUTIR MESIN** No. Pendaftaran: \_\_\_\_\_

Jenis : _____	Tahun dibina : _____
Model : _____	Kuasa : 60 kw
No. Siri : _____	BKS : 1.3 tan @ 50 meter (2 FALL / 4 FALL)
Pembuat : _____	

**B : UJIAN BEBAN LAMPAU**

Beban Ujian : \_\_\_\_\_ kg/tan @ \_\_\_\_\_ meter (2 FALL / 4 FALL)

Keputusan Ujian : \_\_\_\_\_

**C : PERALATAN**

PERKARA	PEMASANGAN			KEADAAN		CATATAN
	NA	ADA	TIADA	BAIK	T/BAIK	
<b>C1 : PEMASANGAN</b>						
1. Struktur Kren (Pemasangan)						*Perlu dipenka terlebih dahulu oleh OYB
a. Mast						
b. Bolt dan Joint						
c. Counterjib						
d. Jib						
e. Trolley						
f. A frame / Cat Head						
g. Hoisting System						
h. Wall ties						
2. Safety Latch (Block)						
3. Wire Rope (Hoisting)						
4. Sling Rope						
5. Load Chart						
6. Fire Extinguisher						
7. Lightning Arrestor						
8. Rest Platform & Ladder						
9. Aviation Light						
<b>C2 : PENGUJIAN</b>						
1. Load Indicator						
2. Radius Indicator						
3. Brake Test (Hoisting)						
4. Luffing Limit Switch						
5. Hoisting Limit Switch						
6. Slewing Limit Switch						
7. L/Switch for trolley In & Out ration						
8. Load Moment Limiter						
9. Overload Limit Switch						
10. Siren						
11. Anti-Collision Sensor						

**D : BUTIR-BUTIR PEMANDU KREN KETIKA PEMERIKSAAN (Salinan Sijil Operator Yang Sah)**

Nama Pemandu : _____	Nama Pemandu : _____
Tamat Tempoh : _____	Tamat Tempoh : _____
No. Sijil JKPP : _____	No. Sijil JKPP : _____

Posidur Kerja Selamat Khas bagi Kren Menara (jib overlapping) : \_\_\_\_\_ ADA / TIADA / NA

Sekiranya TIADA Prosedur Kerja Selamat Khas, kren menara ini tidak dibenarkan untuk beroperasi

\* Pastikan 'wall ties' dibina mengikut rekabentuk daripada pembuat dan disahkan oleh Jurutera Professional.

Komen : \_\_\_\_\_

Tandatangan Pemeriksa : \_\_\_\_\_ Tandatangan Wakil Tapak & Cop : \_\_\_\_\_ Tandatangan OYB & Co : \_\_\_\_\_

( \_\_\_\_\_ ) ( \_\_\_\_\_ ) ( \_\_\_\_\_ )

Tarikh Ujian : \_\_\_\_\_ Tarikh : \_\_\_\_\_ Tarikh : \_\_\_\_\_

Disemak : Ketua Seksyen Kerja Bina

# Site base declaration letter

- If the Tower crane uses a J-bolt type site then a letter of approval is to be obtained by the Competent Person before the site base installation is started. The design is according to specifications and certified by professional engineers. The used J-bolt must comply with the same calculation as the standard set by the manufacturer's manual and use the original material. If permission is not obtained, Competent Person must install the site using the original site provided by the manufacturer.

# HIRARC

- The HIRARC document must be provided by Competent Person before approval of installation is obtained. Further details on HIRARC may be referred in the general safety section. This is to ensure that all risks and hazards are accounted for when installing, raising, dismantling and maintaining the tower cranes. Some of the things are taken into account but not limited to the following:
  - Conduct risk assessment on site construction
  - Working safety in high places
  - Using effective engineering control methods
  - Use of personal protective equipment
  - Records and storage are well organized



# HIRARC

- The following must be taken into account in assessing the risk of installing, raising and overhauling the tower cranes:
  - Weather and wind
  - Traffic
  - Loading and unloading of goods
  - Fall from height
  - Object fall
  - Ease of access to the tower crane
  - Hand tools
  - Other personnel involved around the build site
  - Communication

## Standard Operating Procedures (SOPs)

- A standard operating procedure to install and dismantle the tower crane must be provided by Competent Person . The item must include the procedure of installing and dismantling the tower cranes in the correct manner according to manufacturer's manual, safety measures, and employees involved in the whole operation of the installation, assembly and dismantling.

## Standard Operating Procedures (SOPs)

- Examples of SOP procedures for assembling or dismantling hammerhead cranes:
  - Site base inspection is carried out with professional engineers and according to specification
  - inspect the structure and components of the tower cranes including pins, pulley, bolts and nuts, hook block and electrical systems
  - using moving cranes with the appropriate capacity of component loads and towed crane structures
  - Base mast must be used based on manufacturer's manual and suitable for maximum crane height whether free standing or wall-tie
  - Install the slewing platform on the mast
  - Assemble the operator cabins
  - Assemble framework-A
  - Assemble counter jib and switchboard
  - Assemble and inserting lead weight based on manufacturer's manual and correct sequence
  - Connect the connection rod between the counter jib and the framework-A
  - Assembly connection rods and booms on the ground before being raised
  - Assemble trolleys and wire rope

# Standard Operating Procedures (SOPs)

- Examples of SOPs regarding public safety
  - Only Competent Person can assemble and dismantle the tower cranes
  - Safety protective equipment must be used at all times and supplied by the employer
  - Briefings on safety are to be held to all members every time before starting the process of assemble or dismantling
  - All areas involving the assembling or dismantling process must be marked with safety tape etc. and monitored by a Station House Officer (SHO)
  - Moving cranes are fully functioning
  - No other worker aside from the assembling or dismantling team along in the building or under the tower crane
  - The moving crane has the capacity to hold the heaviest load of the tower crane to be installed or dismantled
  - all the small equipment that were brought up must be firmly tied and held by the assembling team to avoid falling objects

# Standard Operating Procedures (SOPs)

- Complete lifting team must consist of:
  - Competent Person
  - Technical Manager
  - Lifting Supervisor
  - Crane Operator
  - Technician
  - Senior Rigger
  - Rigger
  - Signalman
  - Welder
  - Wireman

# Technical specifications of the tower crane

- Technical specifications of cranes must be included when applying for the crane installation. This general specification is available in the manufacturer's manual. The specifications include height of the cranes, the length of the counter jib and boom, distance of hook block and load chart.

# COMPETENT PERSON

---

## CHAPTER 5

### PROCESS OF BUILDING CRANE TOWERS SITE BASE



# Basic ground evaluation for tower cranes site

- Assessment of ground strength can be different from visually examined ground surface and geotechnical survey.
- Therefore, it is important that the evaluation to be made by person with sufficient knowledge and experience to know the necessary needs and assessments.
- Ground failures can be the cause of minor incidents and dangerous events at construction sites, and can cause serious injury and death.

# Basic ground evaluation for tower cranes site

The hazard of ground conditions may be due to:

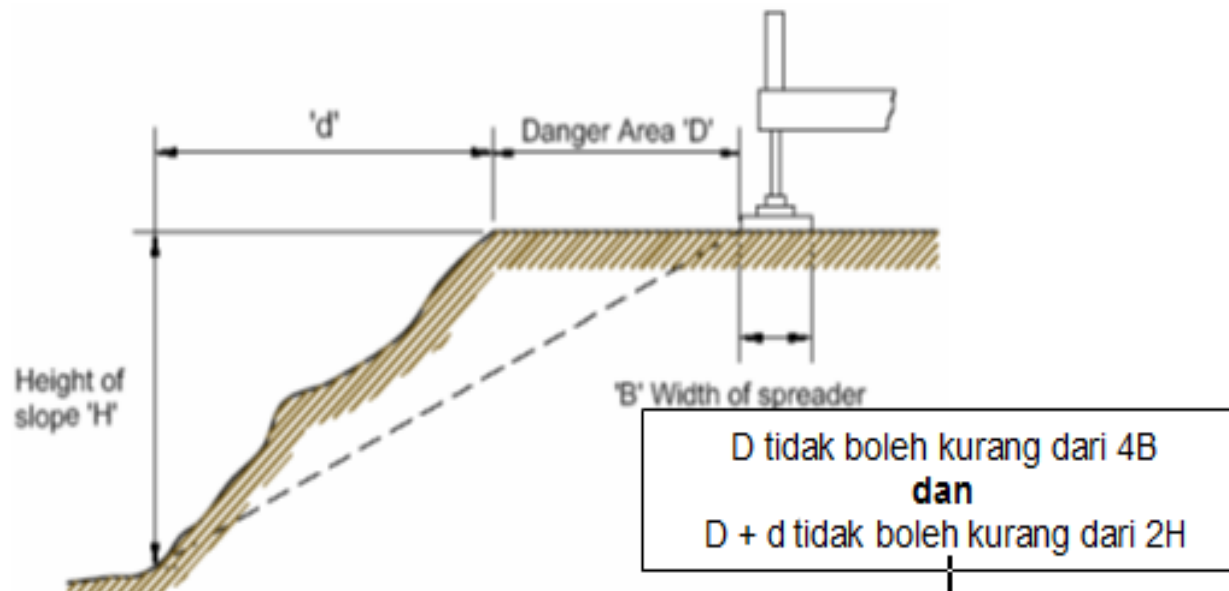
- Uncompacted fill
  - Soil or other material may be buried without compacting. The ground cracks along the area are an indication that the ground state is not solid and can cause accidents



# Basic ground evaluation for tower cranes site

The position is close to the excavation area.

- The crane / structure should not be placed near the edge of the ditch and other excavations as it may collapse without warning.
- If the machinery needs to be used near the slope or excavation, with outriggers or wheels in a "danger area", engineering evaluations by authoritative geotechnical engineers need to be made. The location and the safe distance for placement of machinery



# Basic ground evaluation for tower cranes site

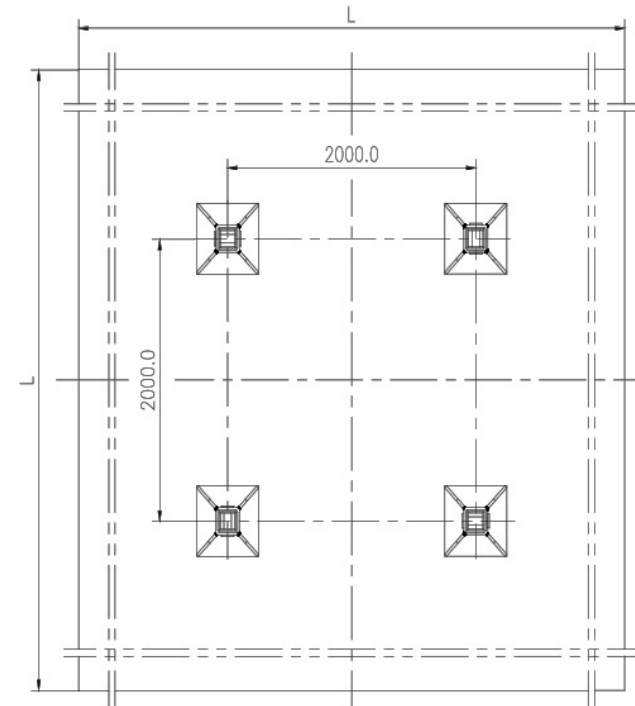
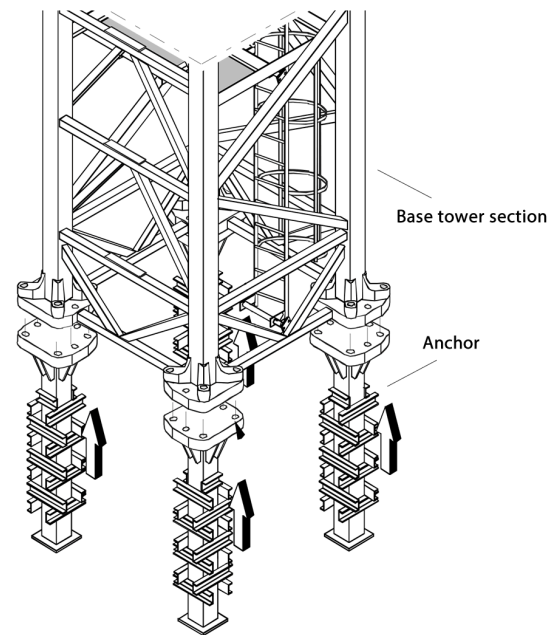
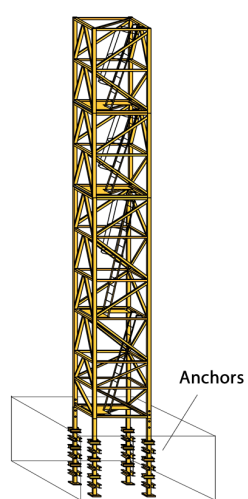
## Weather

- Heavy or prolonged rains can also alter the ground conditions and cause outriggers or tires to sink
- If it is suspected that the support ground becomes soft, periodic checks should be made. Periodic checks should be performed when the ground freeze / harden because of its appearance it is stronger but rather weak.

# Types of sites base

The site base of the tower cranes is provided by installing fixed anchor on concrete. There are two types of anchors used in the tower cranes that are permanent anchor and variable anchor.

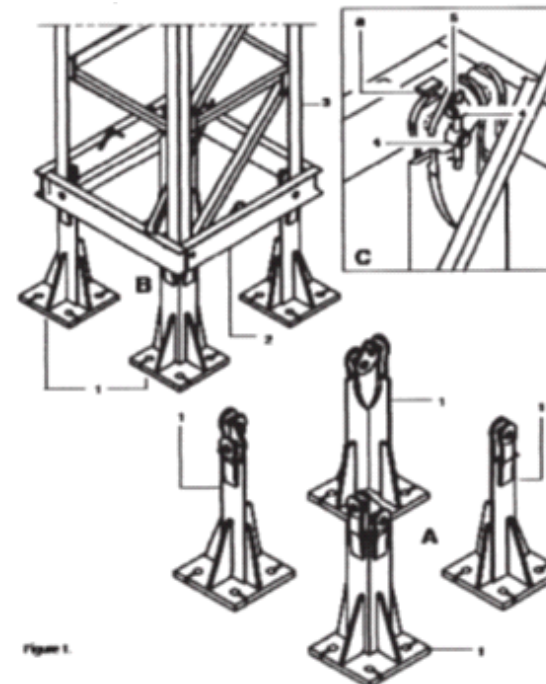
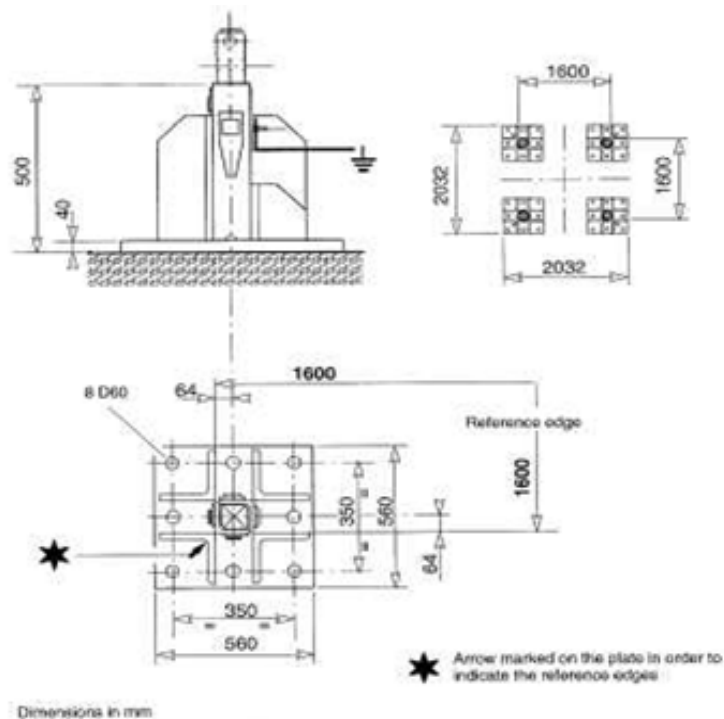
# Types of sites base



Fixed anchor installation plan

# Types of sites base

In the process of assembling a concrete bonded concrete mount, all binds shall be in the symmetry position of the concrete where the concrete block axis forms the square according to the designated pile size



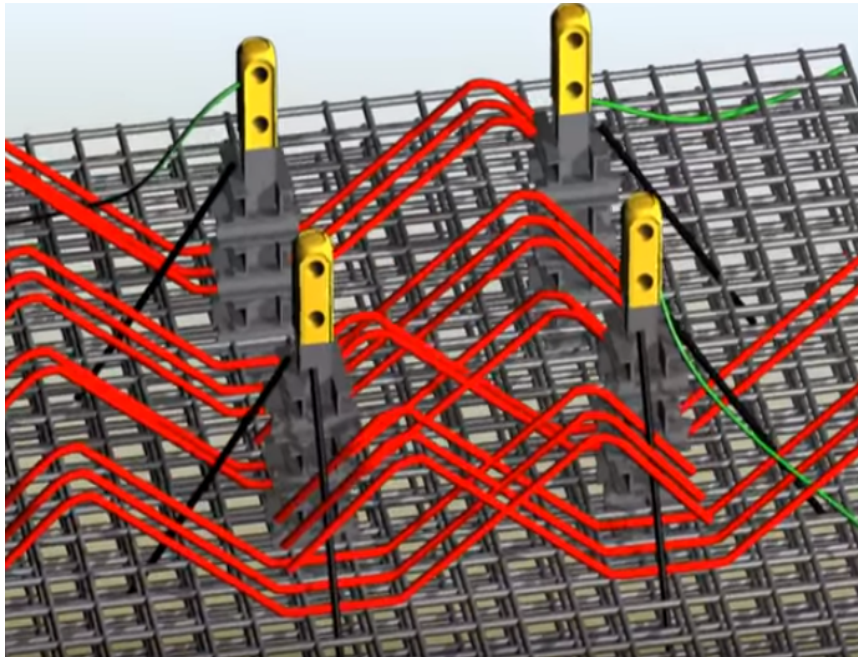
Variable anchor installation plan



# Types of sites base

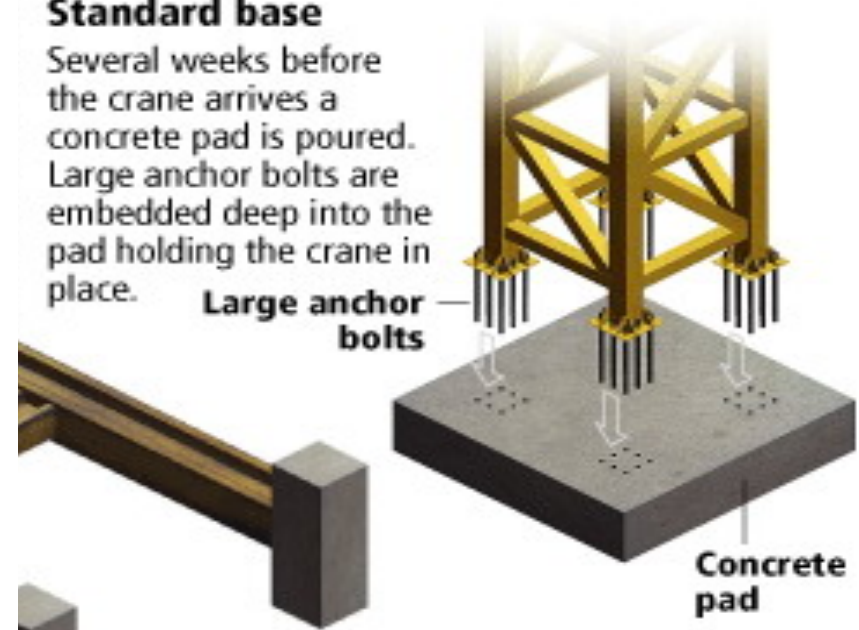
- In the construction of a base site, a high strength bolt is also indispensable to increase the bond strength of the base mast. In choosing a good anchor, a metal grade rating needs to be done. Aside from that, installation steps should also be taken into account to ensure that the anchor used is stronger. Common plates require at least 16 bolts. Specs of bolts used must be the same as specified by the manufacturer.

# Types of sites base



## Standard base

Several weeks before the crane arrives a concrete pad is poured. Large anchor bolts are embedded deep into the pad holding the crane in place.



construction of site bases

# COMPETENT PERSON

---

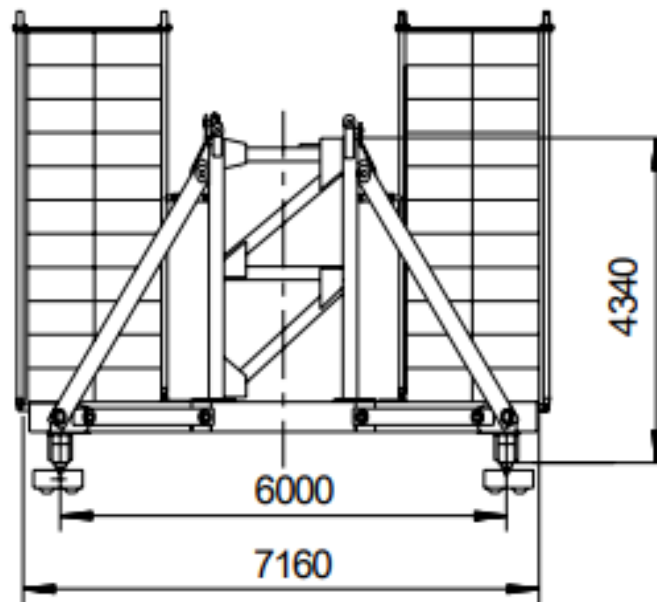
## CHAPTER 6

### THE PROCESS OF INSTALLING TOWER CRANES

# Mast Parts

## Basic mast

- The basic mast length is longer than the rest of the mast. This mast portion is placed on the site base of a tower crane



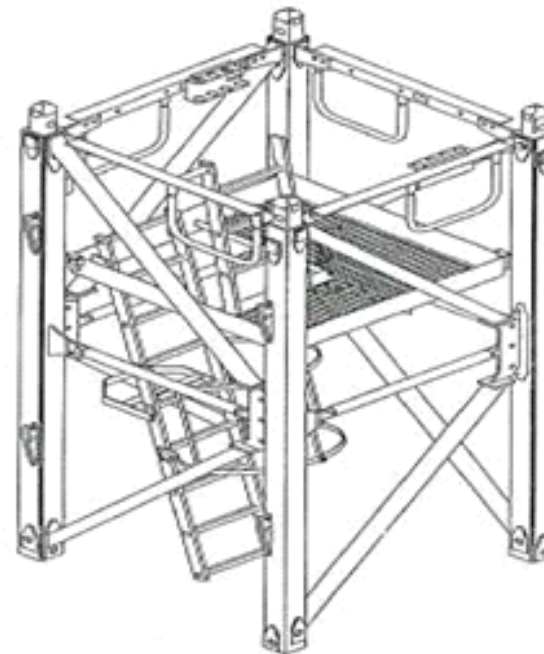
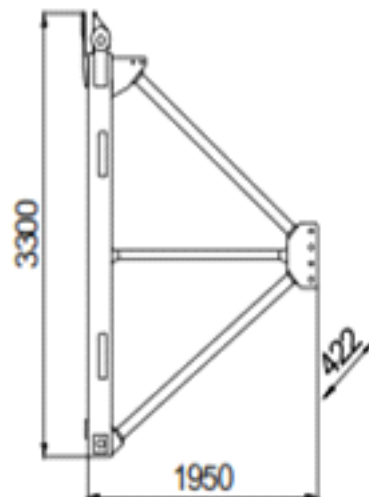
Basic mast part

# Mast Parts

## Mast Parts

The middle part of the mast has a length of about 3 m high and is connected with anchor connector, resting platform, short staircase, long staircase and stair support

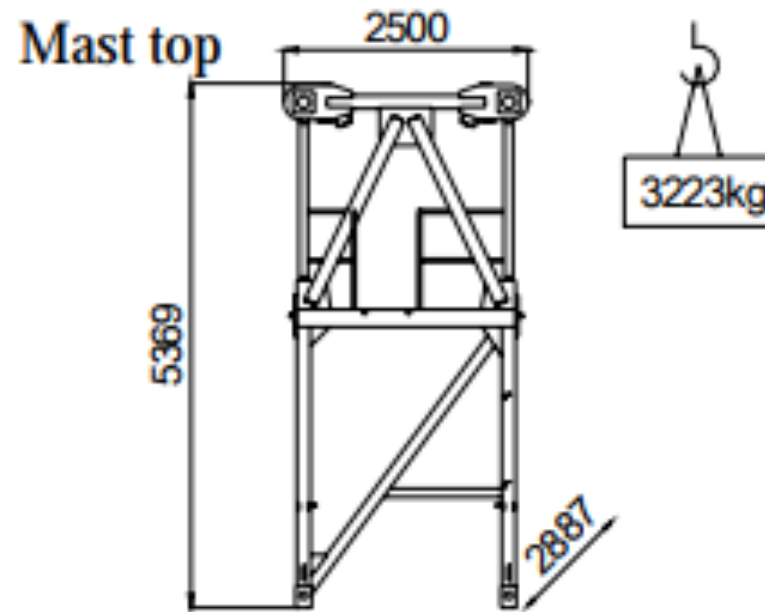
Mast section



Mast parts

# Mast Parts

The highest mast is connected to the slewing platform



# Preparation of parts of the tower

## Installation of slewing platform

The top of the mast will be joined with a slew table, slew tables are lifted using a moving crane and positioned accurately above the mast .



slewing platform



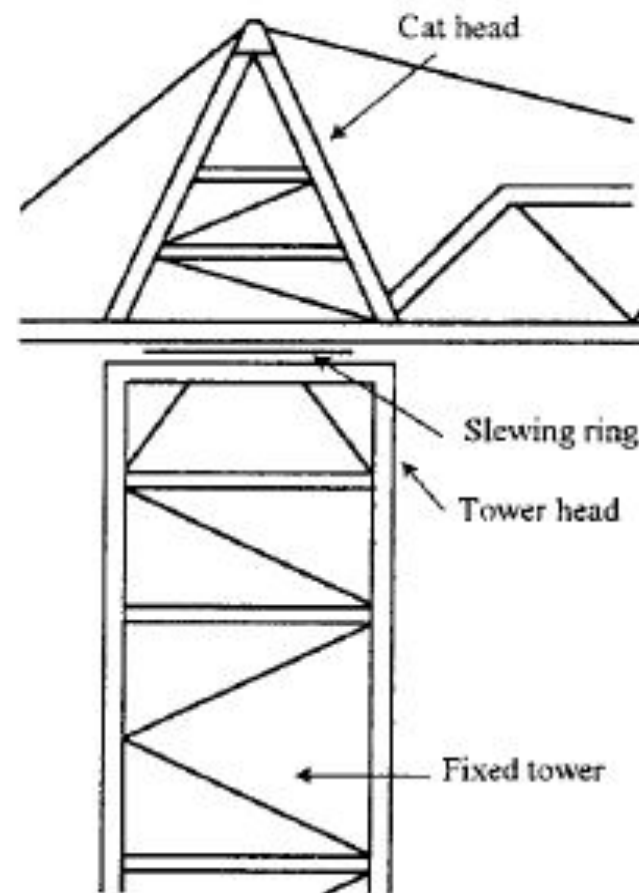
# Preparation of parts of the tower

## Installation of A-frame

- In merging and installing the A-frame, the listing is done by placing the A-frame in the vertical position. The position of the A-frame is arranged at the top of the tower pole under slewing platform. Before the raising process starts, the slewing platform is first installed on the tower pole in the correct position using the bolt

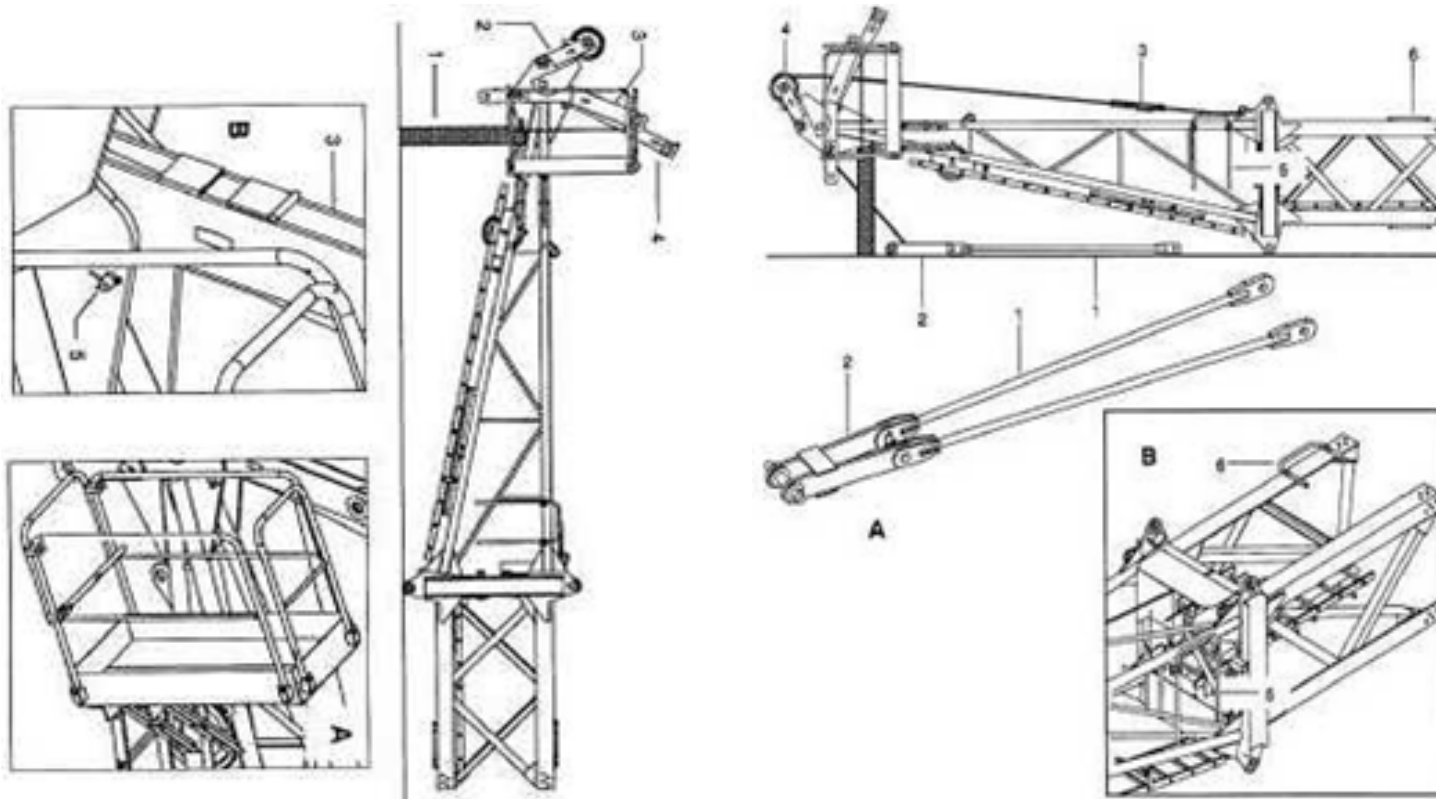
# Preparation of parts of the tower

## Installation of A-frame



# Preparation of parts of the tower

## Installation of A-frame

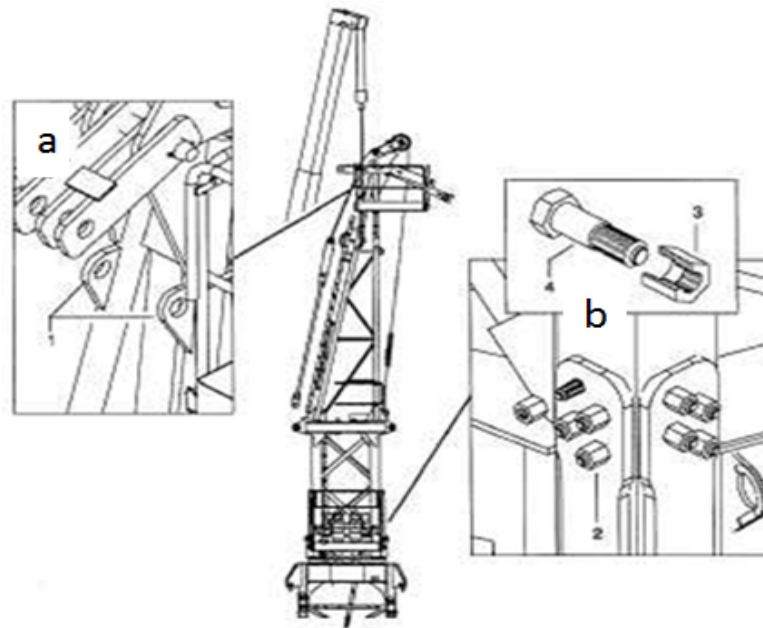


The A-frame preparation steps

# Preparation of parts of the tower

## Installation of A-frame

- The Installation of the A-frame is made by lifting the A-frame using the moving crane to the top of the tower and connecting the A-frame on the slewing platform by using bolts



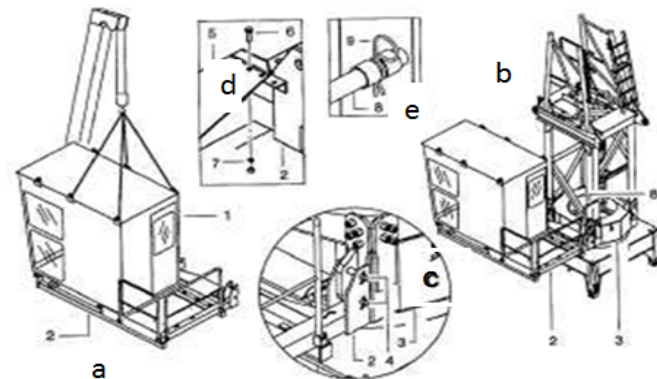
Installation of frame A (a) tied rod (b) bolt connection to the pole

# Preparation of parts of the tower

- **Cabin Installation**

- Cabin installation steps are:

- The cabin is lifted using a moving crane and is rotated to the right position (a)
- The cabin is placed on the platform (b)
- Interconnecting pin between cabin and platform mounted (c) and tightened (e)
- The pedestal is connected to the crane platform (d)
- Move the grab rails and lock the track position using the safety pin

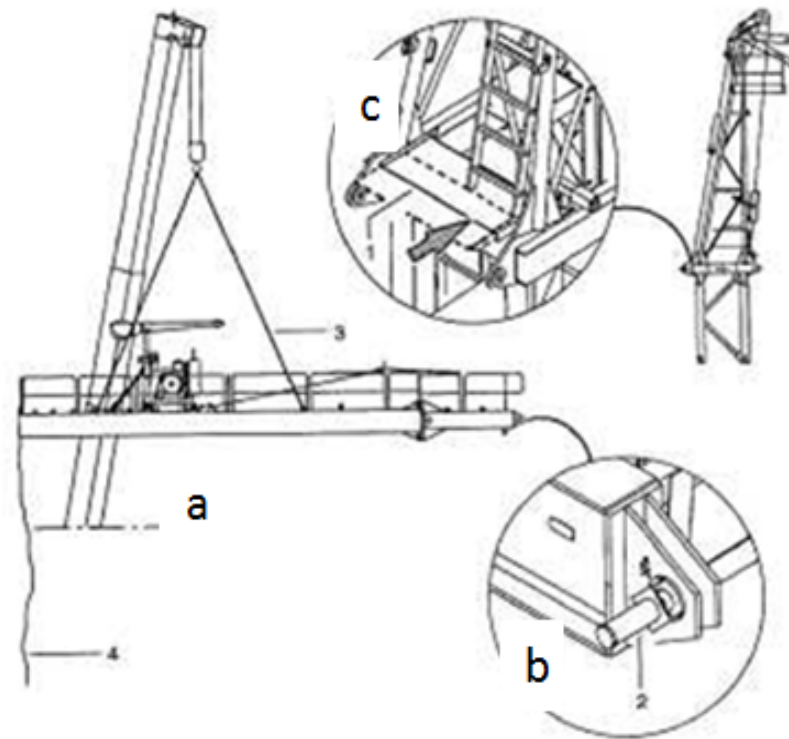


# Preparation of parts of the tower

## Installing counter jib

- The counter jib that holds the counterweight should be mounted to the correct position before lifting. Counter jib is lifted using a moving crane and is connected to the slewing platform. Connection is tightened so jib does not slide when lifted.
- If installing without using a second crane aid, the installer cable should be properly rolled and the locking tool is used with caution. Counter Jib is connected to the A-frame and the bolt connection is tightened. All pins, bolts and nuts shall be inspected from time to time.

# Preparation of parts of the tower



Lifting and mounting counter jib

# Preparation of parts of the tower

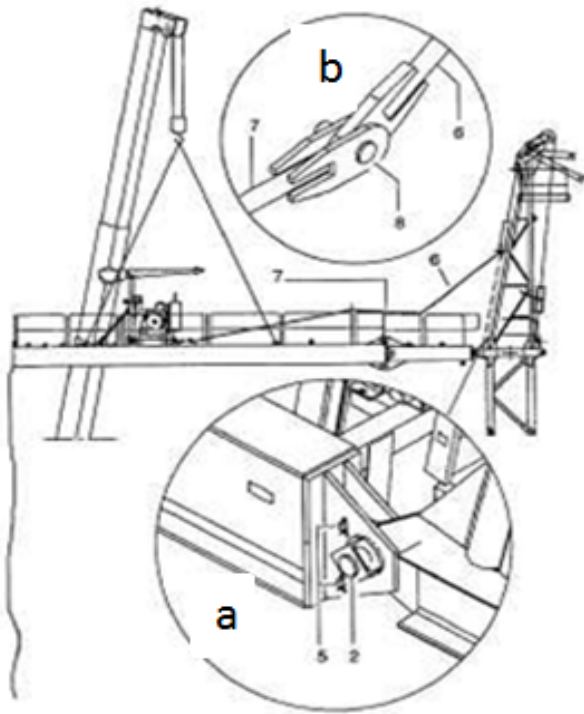
## Connecting Rod

- The connecting rod works to connect the jib to the A-frame. This component requires periodic checks to prevent bending from occurring. Once the counter jib is connected to the tower crane, the connecting rod is connected to the A-frame using the appropriate bolts.

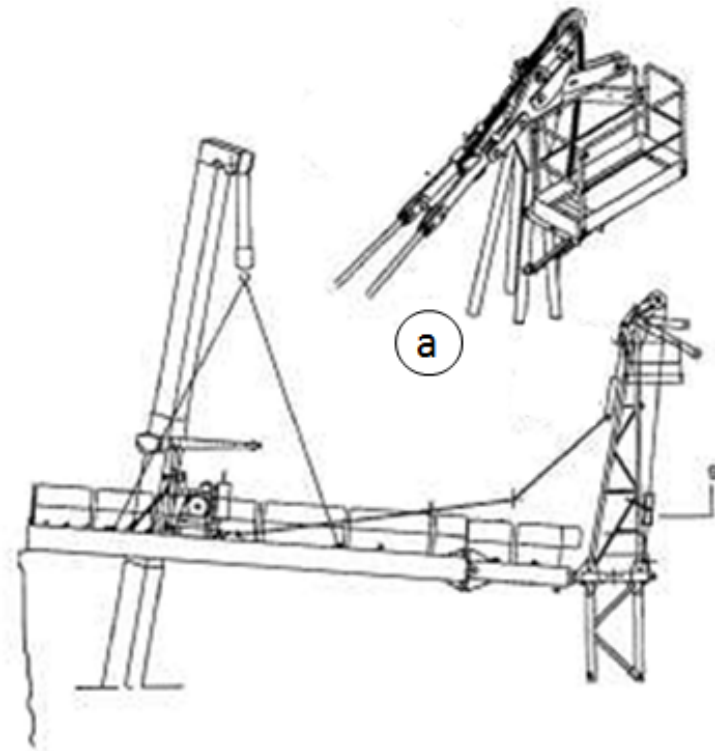


# Preparation of parts of the tower

## Connecting Rod



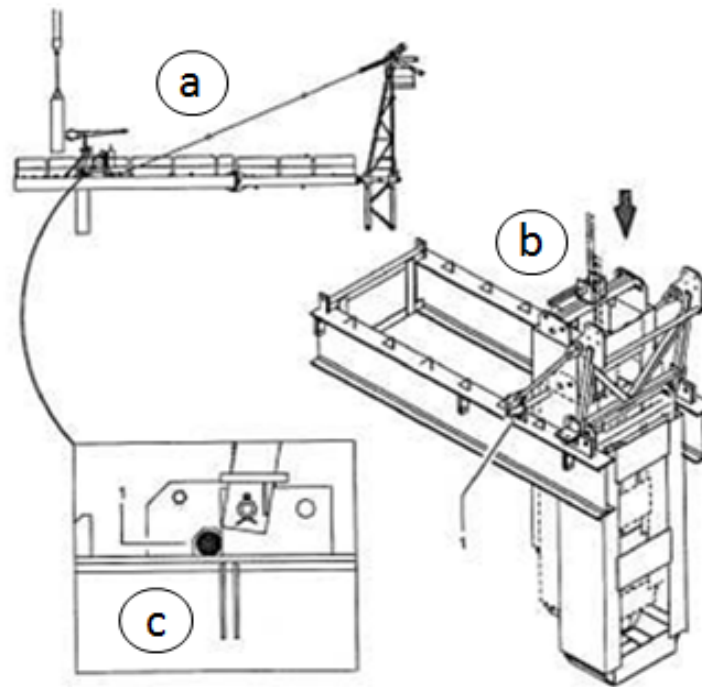
Tying the connecting rod



Example of a counter jib and A-frame connection using a connecting rod

# Preparation of parts of the tower

- **Installing the counterweight**
- Jib connected to the A-frame and is connected using bol before the counterweight is composed on jib.



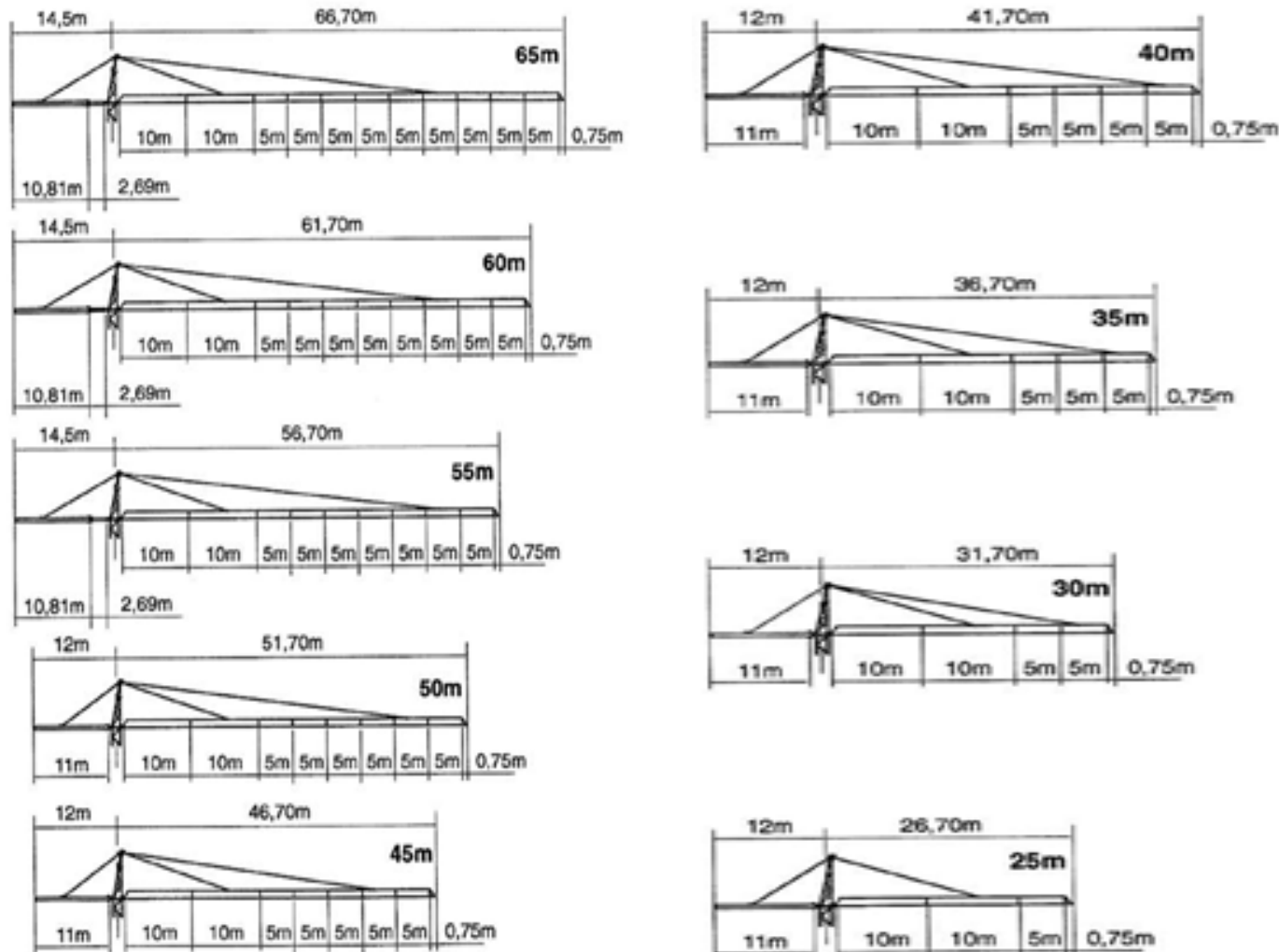
Installing counterweight

# Preparation of parts of the tower

## Identification and installation of boom

- Boom is identified from the diameter of the tower crane rotation required by the built site. Figure shows the rotation diameter standard that corresponds to the jib length.

## Identification and installation of boom



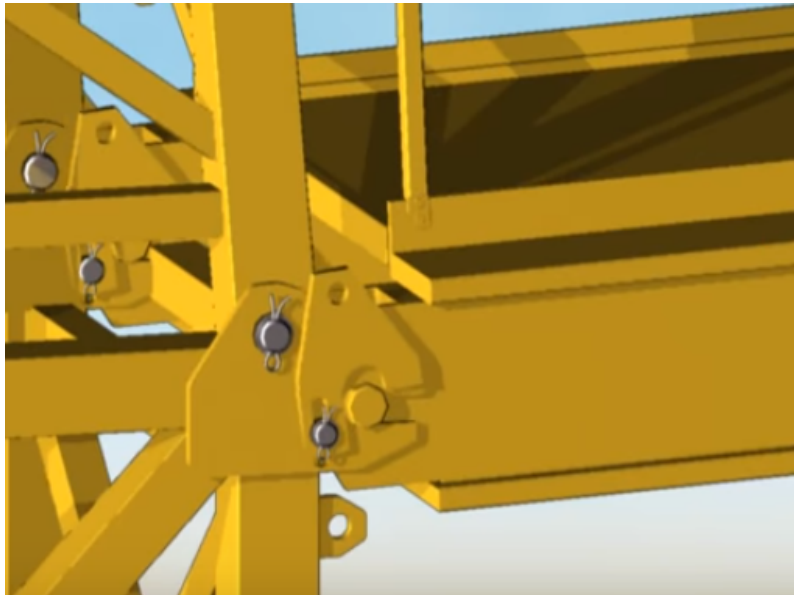
# Preparation of parts of the tower

## Installing the boom

- A connecting rod should be connected to the boom before lifting; while another part of the connecting rod is connected to the A-frame. The trolley also needs to be installed on the boom before lifting.
- The boom needs to be lifted slightly using the lifting cord on the moving crane before the trolley is mounted on the boom. The position of the trolley on the boom should be maintained to ensure that the boom is in balance when it is lifted on the tower. The main functions of trolley and other tools such as limiting switches and wiring need to be checked before the boom is raised.
- The boom should be lifted horizontally to the mast. The booms are mounted on the slewing platform using before both connecting rods are installed.

# Preparation of parts of the tower

## Installing the boom



(a)



(b)

(a) The pin is used to connect the boom with the slewing platform (b) The boom and A-frame connector rod are mounted using the pin

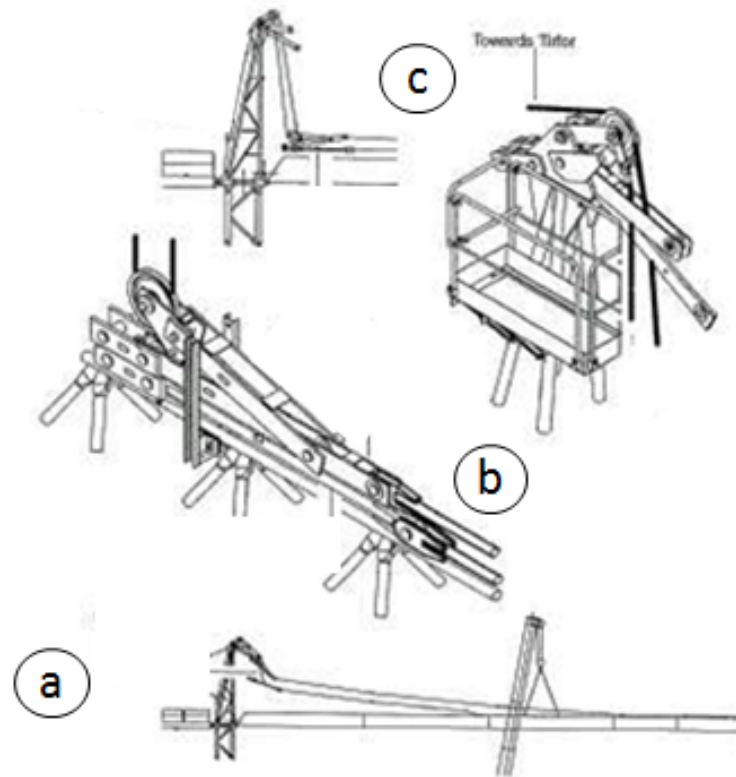
# Preparation of parts of the tower

## **Tie the connecting rod to the A-frame**

- The connecting rod is connected to the frame before the jib is raised and at the same time another connector rod is tied to the A-frame.
- After the jib is lifted and connected to the slewing platform, The connecting rod on the A-frame and the boom is then connected

# Preparation of parts of the tower

**Tie the connecting rod to the A-frame**



Steps of connecting boom and A-frame



# Preparation of parts of the tower

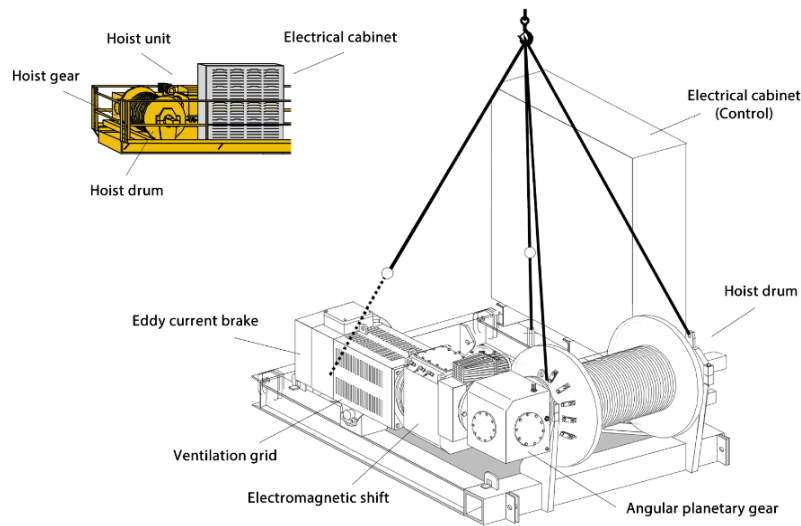
## Installation of the drum on the counter jib

There are two methods of installation of the drum and wire rope on the crane:

- Ready to roll wire rope on the drum
  - Wire rope rolled in drum is prepared before being raised to the counter jib using the mobile crane.
  - Wire rope is connected to the trolley and pulley in the boom area and is connected directly to the hook to lift the load

# Preparation of parts of the tower

## Installation of the drum on the counter jib



Some examples of diagrams that showed rolled drums rope and are on the counter jib

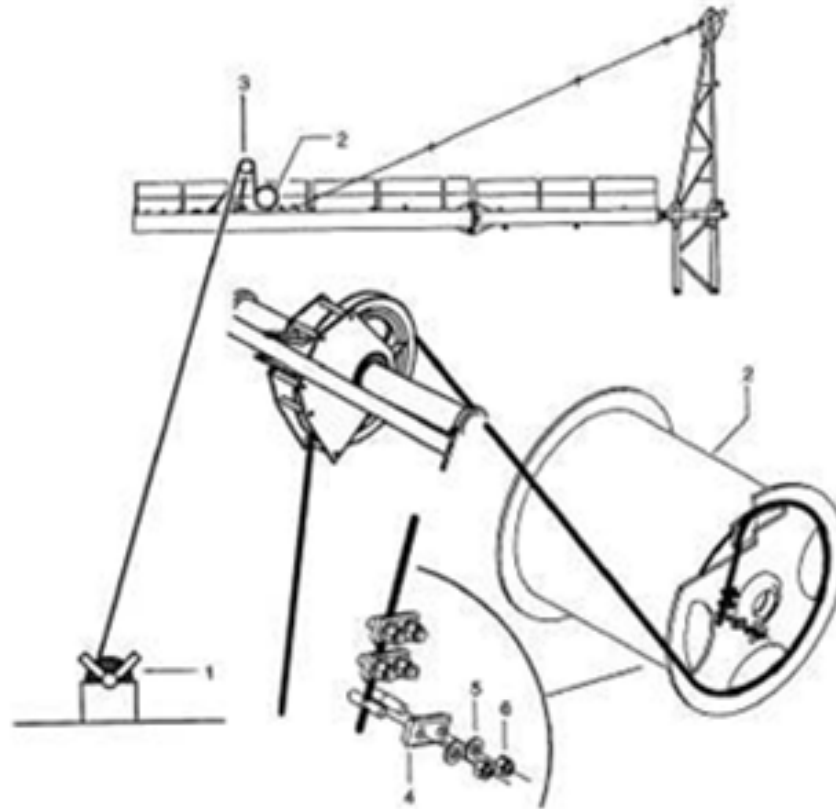
# Preparation of parts of the tower

## Installation of the drum on the counter jib

- Wire rope rolls from below
  - When rolling the cable, the motor gear can be changed according to the speed of the cable to be rolled. When changing the motor gear, the hook block should be placed on the ground to prevent the load from falling.

# Preparation of parts of the tower

## Installation of the drum on the counter jib



Flow of rolling the lifting cable on the motor

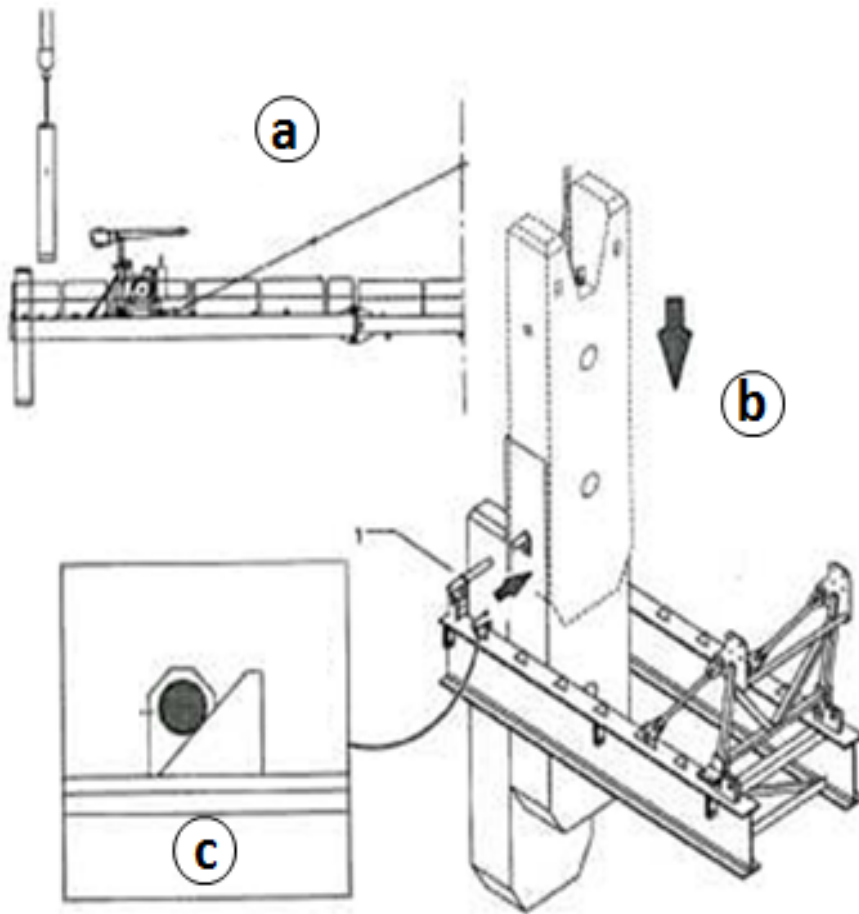
# Preparation of parts of the tower

## Installing the counterweight

- Counterweight made of concrete is a balancer used as ballast that was placed on the counter jib part of the tower crane counter
- Counterweight can also be used as a weighted ballast on own base of the tower crane and the one that is rail mounted.
- Ballast cannot be cracked either during transmission, before installation or during installation.

# Preparation of parts of the tower

- Installing the counterweight



Ballast installation on the counter jib:

- a) Ballast was raised one by one using another crane beginning with the farthest ballast from the mast;
- b) Ballast is inserted into the space reserved on the counter jib;
- c) Ballast lock pin

# Preparation of parts of the tower

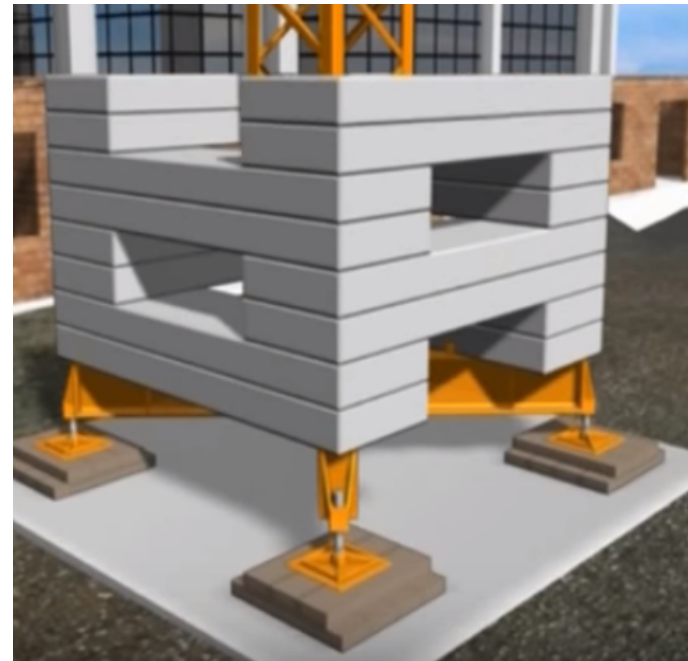
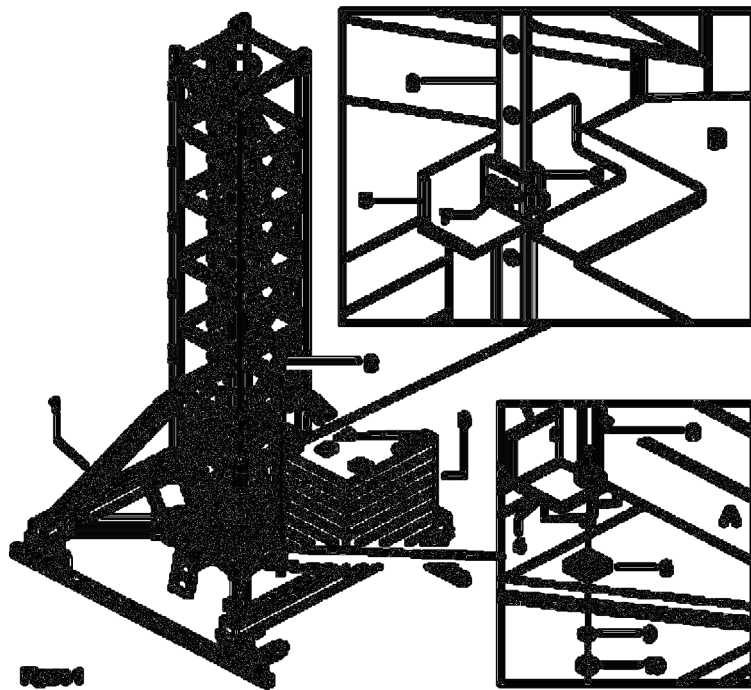
## Installing the counterweight

The ballast installation steps at the crane base are:

- The number of ballasts to be used is determined from the height of the tower crane (see manual)
- Ballast is placed on the frame of the tower crane (locked in both the top and bottom of the ballast).
- The ballast weight is determined by the size and density of the concrete (commonly used concrete density is 2400 kg / m<sup>3</sup>).

# Preparation of parts of the tower

## Installing the counterweight



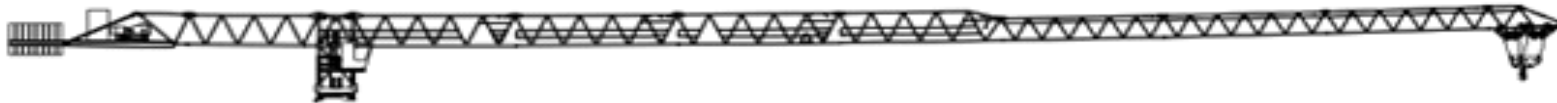
Ballast installation on the tower crane site base with own base type



# Preparation of parts of the tower

## Installation of ultimate counterweight

- The amount and grade of counterweight attached to the counter jib depends on the length of the boom and the counter jib.



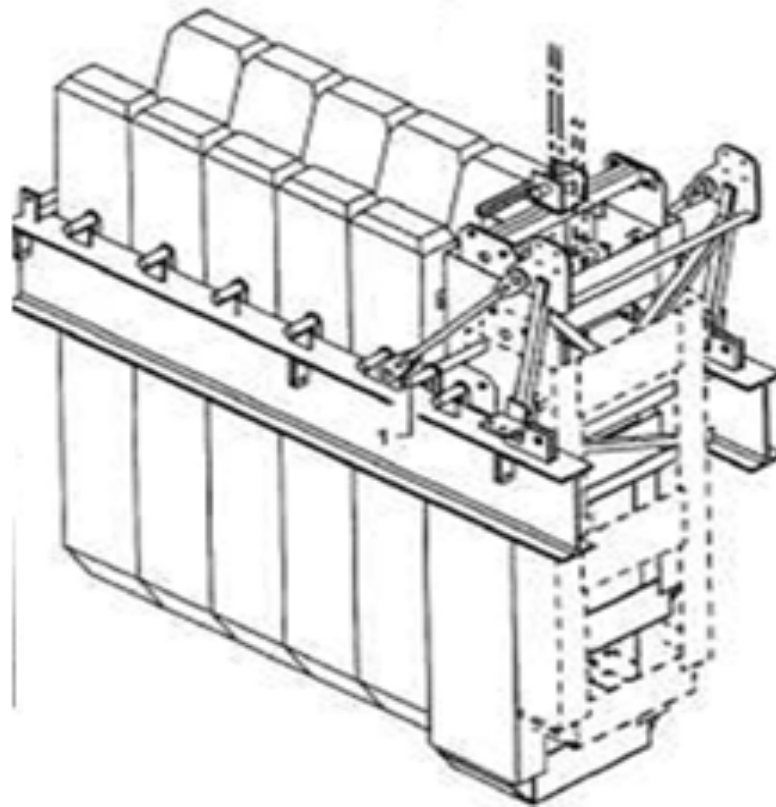
Length of jib		30	35	40	44	50	54	60	64	70	74
Length of counter jib		16.2	16.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2	20.2
During working and telescoping	Blocks	2A+C	2A+B+C	3A+C	3A+B	4A+C	4A+C	5A	5A+C	5A+B+C	6A
	Weight (kg)	9000	11000	13000	14000	17000	17000	20000	21000	23000	24000

Block type	Density (t/m <sup>3</sup> )	Weight (kg)	Tolerance
A	2.4	4000	±1%
B	2.4	2000	±2%
C	2.4	1000	±2%

Standards for boom lengths and counter jib

# Preparation of parts of the tower

## Installation of ultimate counterweight



Ballast arrangement on the counter jib

# Introduction to the merging of bolt / pin

- During the merging process, the quality and condition of bolts and pins should be checked to ensure that the bolts and pins to be used have high pre-tension strength. The pre-tension strength is a bolt connection consisting of bolt, nut, and bush made of high quality and strong materials. All bolt connections must be monitored, inspected and fixed from time to time. This is because this connection can be used when the crane is used. Failure to do this may result in accidents and damages. Bolts, pins, nuts and bush must comply with established standards.

# COMPETENT PERSON

---

## CHAPTER 7 SAFETY TOOLS

# Lightning Arrester

- The tower crane needs to be protected from lightning rays before being operated. For tower cranes that use the track, at least one track jib should be connected to the electric power of each connection and make sure it works.

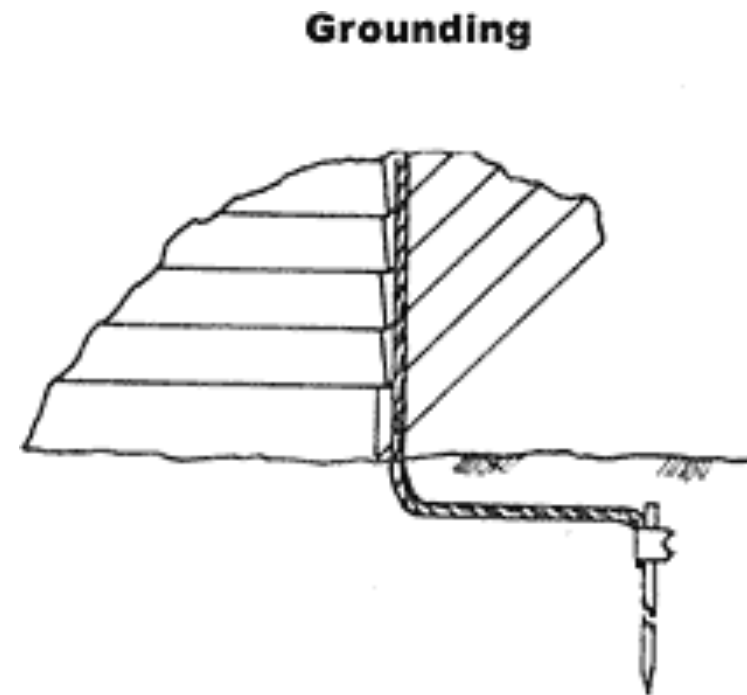
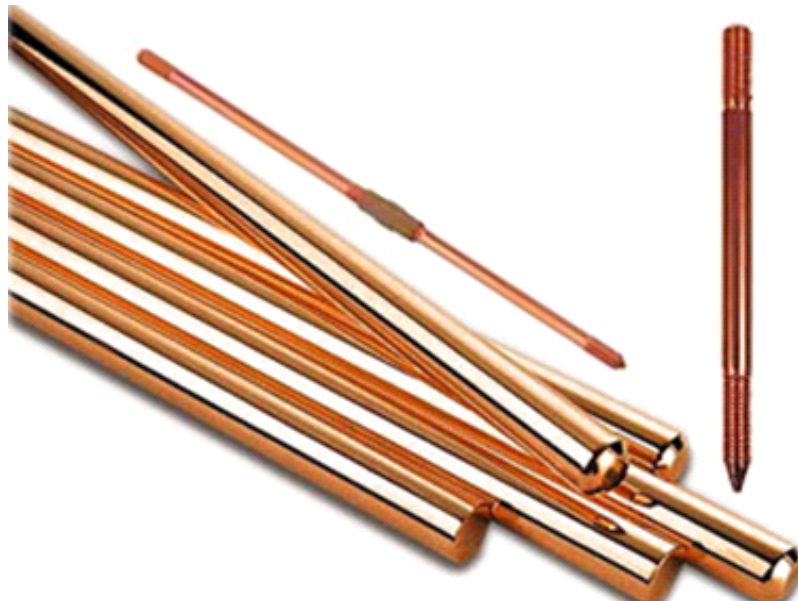


The tower crane mounted with a lightning arrester

# Copper Ground Rod

Copper grounding rods are the finest and most cost-effective ground rods for structural grounding and lightning protection. The grounding rods are suitable for use in high corrosion resistance and long-term use. It is made of solid copper and is formed into a radius for connectivity. It is suitable for use in shallow soils or ground areas with high voltage electrical equipment.

# Copper Ground Rod



The grounding rod made of copper



# Aviation light

The aviation light works to generate aircraft warnings. It is mounted on a tower crane such as the upper part of the A-frame, the end of the boom and also the tip of the counter jib.



Aviation light positions on the tower cranes



# Fire extinguisher

Fire extinguisher is a protective device used to eradicate and control small fires if it occurs and is used in emergency situations. It should be placed in the operator's cabin and the expiry date of its use should be checked.



fire extinguisher

# Limiting Switch

## Slewing Limiting Switch

- Slew limiting switch acts as a limitation of rotating movement of the tower cranes to the degree of permissible movement only. At a narrow construction site especially in the city this limiting switch is used to ensure the safety of the off-site area around it in the safe state so that the crane boom does not go out of the allowed area.

# Limiting Switch

## **Luffing Limiting Switch**

- The luffing limiting switch serves to limiting the control of luffing tower crane boom movement

## **Trolley Limiting Switch**

- The pulley limiting switch works to control load weight and pulley control. This control system is controlled by the same limiting switch.

# Limiting Switch

## **Load limiting switch**

A load limiting switch is an essential component of a tower crane. This switch works to limiting the tower crane load to avoid accidents. This switch automatically stops the crane if the load is above the allowed load weight.

.

# Limiting Switch

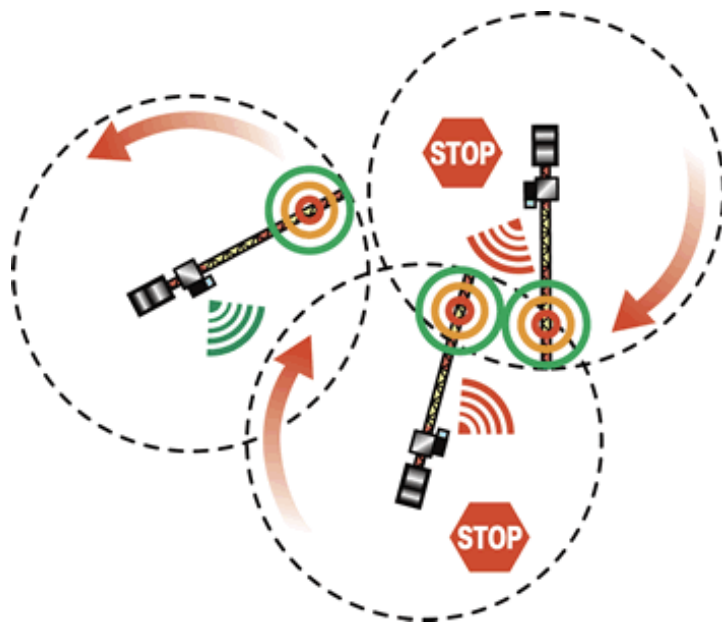
The limiting switch attached to the A-frame tower crane



# Anti-collisions system

- To avoid collisions between tower cranes, each tower crane can be equipped with an anti-collisions tool. The system works to measure the position and speed of the lifting load, calculating the risk of collision depends on the ability of the tower crane brake. Additionally, this system warns operators about the risks that will take place and perform automated braking systems as soon as risk of clash is identified.

# Anti-collisions system



Anti-collisions system

# COMPETENT PERSON

---

CHAPTER 8

CRANES INSPECTION AND MAINTENANCE



# Periodic Inspection and Maintenance

Project managers need to ensure periodic inspection and maintenance must be done by Competent person based on manuals from crane manufacturers. Periodic inspection and maintenance are as follows:

- all functions and speed controls, smooth operation and crane movement limiting;
- all emergency and safety switches, including indicator and load limiting devices;
- lubrication of all moving parts
- inspection of filter components and hydraulic fluid levels;
- visual inspection and evaluation of crane structures and other critical components such as brakes, gear, pins, wire rope, locking devices and so on;
- warning signs and controls;
- wear on wheels and rails (rail mounting crane type); and
- other things mentioned by the crane manufacturer.

All replaced crane components need to meet the minimum specification or the same as the specifications of the crane components. Inspection reports should be provided upon completion of the inspection.

# Annual Inspection

The project manager should ensure that the annual inspection is done by Competent person as it is part of the requirement during the registration of the tower crane. The annual inspection should involve all components or parts specified by the crane manufacturer. This includes parts / items that are relevant during periodic inspection and maintenance. An annual check involves a review of:

- All parts / matters relevant to the current inspection and testing prior to installation of the crane
- Function and calibration of all indicator and load limiting devices
- Visual inspection in detail (examples such as pin or bolt inspection whether wear, corrosive, cracked or loose)

The inspection report shall be provided by Competent person upon completion of the inspection and subsequently submitted to the project manager for review.

# 10 Year Inspection

The project manager also needs to ensure a major inspection for every 10 years from the date the crane is registered or the tower crane started operating. This examination should be performed by Competent person . This 10-year inspection involves inspections of structures and mechanical components that are more comprehensive than annual surveys. Although cranes do not operate continuously for 10 years, the crane structure and components may experience deterioration of performance depending on the way and the storage environment.

The 10 year inspection involves all structures, components, control devices and crane safety. This inspection involves the following:

- Structure, mechanical and electrical components, instrumentation, control devices and cranes handling
- Non-destructive tests based on relevant standards
- Controls and emergency switch
- Brake system
- Component safety / crane parts that have been through the repair and replacement process
- Complete safety instructions and manuals

# 10 Year Inspection

Some parts of the crane or tool that need to be checked during the 10-year inspection are as follows:

Slewing ring	Mast
Hydraulic motor	A-frame
Hydraulic pump	Pins and moving parts (e.g. boom heel pins, ram pins)
Block valve	Static pin
Lifting drum and luff	Steel wire rope
Brake System	Electrical system
Wire rope pulley	Control system
Luffing hydraulic cylinder	Electric motor
Main gear and drive shaft	Hook trolley
Jib/Boom	Hook block

# 10 Year Inspection

Some components or parts require non-destructive tests during the 10-year inspection

Component tested	Non-destructive testing details	The frequency / timing of the non-destructive test
The chord rod thickness on jib / boom	Material thickness test	10 years
Slewing ring	Crack detection test	10 years
Luffing hydraulic steel nuts	Crack detection test	10 years
Luffing hydraulic cylinder and ram (end and cover rods)	Crack detection test	10 years
Welding on jib connector	Crack detection test	10 years
A-Frame (all welded parts)	Crack detection test	10 years
Hook	Crack detection test	10 years
Welding on hook blocks and trolleys	Crack detection test	10 years

# Examples of tower crane maintenance checklist form

## SAMPLE CHECKLIST FOR TOWER CRANE

This checklist provides an overview of the basic requirements to be checked which would help to ensure that a tower crane is safe for use. Tower crane users should consult manufacturers, suppliers and owners to check on minimum requirements and address any concerns before using the equipment. These items in this checklist are non-exhaustive and users are recommended to make the necessary modification and customisation to suit your work processes and conditions at the workplace.

S/N	Items		Remarks
<b>A. Tower Crane Approved For Use</b>			
1.	The Tower Crane is of type-approved by MOM	<input type="checkbox"/> Yes <input type="checkbox"/> No	
2.	The Tower Crane has a valid Lifting Machine (LM) certificate (issued less than 12 months ago).	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>B. General Requirements</b>			
3.	The Tower Crane is provided with markings of the Safe Working Load, Tower Crane serial number and LM number.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
4.	Proper and safe access and egress (with proper foot and hand holds/ supports) are provided to the crane operator.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
5.	A load capacity chart is displayed in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
6.	Operator crane cabin is provided with a locking mechanism so as to prevent unauthorised entry.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
7.	A safety bar is fitted across the operator's cabin window where there is likelihood of the operator falling through it.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
8.	An approved fire extinguisher is provided in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
9.	An Operation and Maintenance log book is available in the operator cabin.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
10.	A Manufacturer Operating Manual and Maintenance Manual are made available.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
11.	Crane hook is provided with a safety catch to prevent displacement of the sling or load from the hook.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
12.	Wire ropes are well lubricated and that there are no visible defects such as broken wires, kinks, excess wear, crushing etc.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
<b>C. Safety and Operational Devices</b>			
13.	A load radius indicator with warning alarm is installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
14.	A Jib angle indicator is provided (for Luffing Jib Tower Crane)	<input type="checkbox"/> Yes <input type="checkbox"/> No	
15.	An emergency stop button, which will terminate the operation of the crane engine, is installed in the operator cabin and correctly identified.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

# COMPETENT PERSON

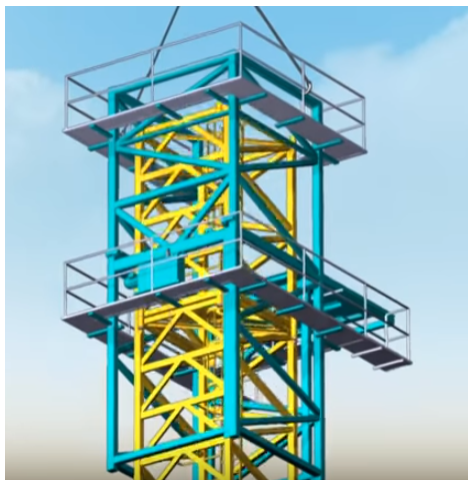
---

CHAPTER 9

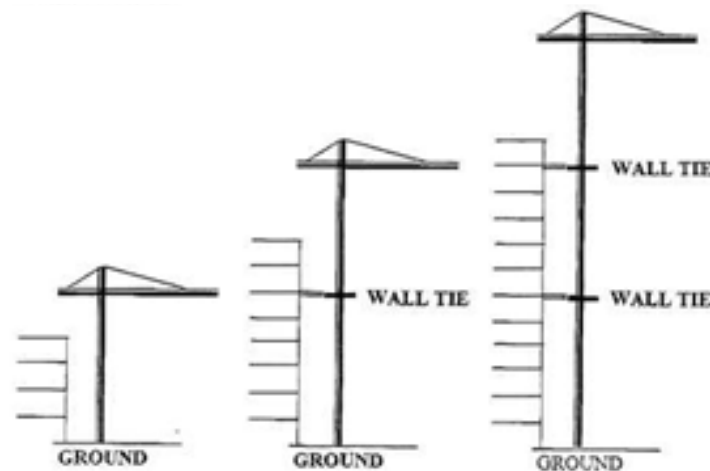
TOWER CRANES CLIMBING PROCESS

# Telescopic Method

The telescopic method is an external climbing method used to increase the mast portion of the tower crane. A hydraulic cylinder is used to reduce or increase the altitude of the tower using a telescopic cage. The telescopic cage becomes intermediary to connect the new mast portion to be added to the existing mast section during the climbing process



telescopic cage

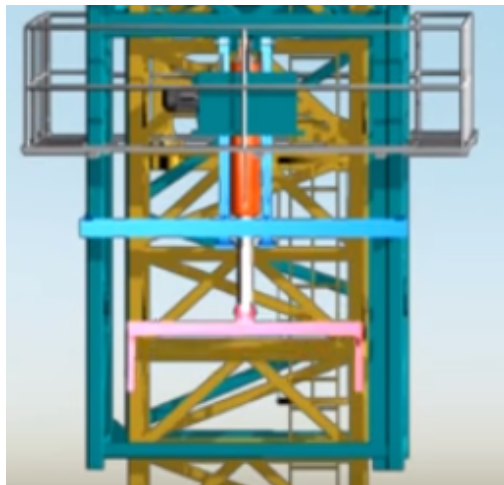


schematic representation of telescopic method / external climbing method

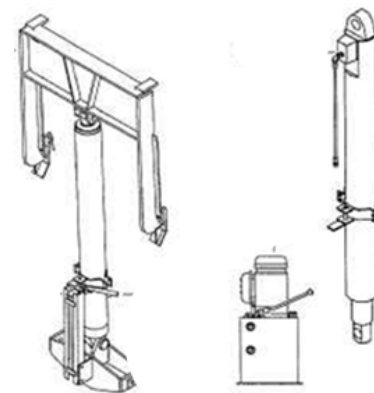


# Telescopic Cage

Climbing equipment using telescopic cages for a tower crane should be checked and connected according to manufacturer's instructions. The main parts of the telescopic cage



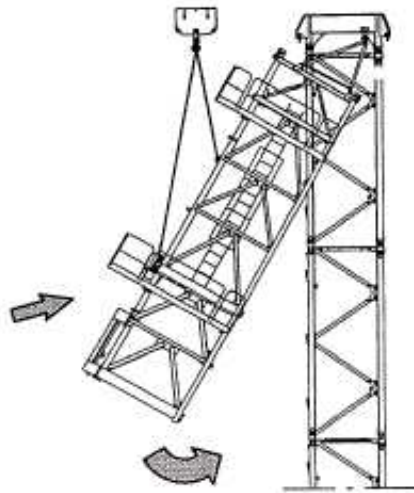
Telescopic cage installed to the mast



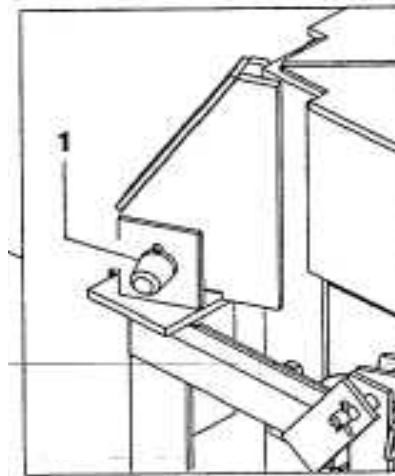
Hydraulic system: 1. *Equipped Telescoping Yoke*, 2. *Hydraulic Cylinder*, 3. *Hydraulic Unit*, 4. *Cylinder Support Beam*, 5. *Cylinder Stop*, 6. *Lever*

# Installing Telescopic Cage

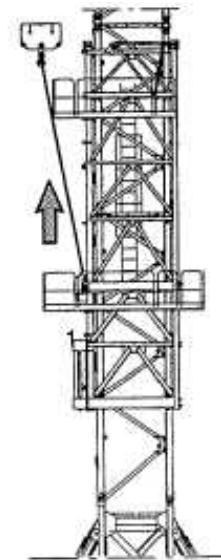
During the installation of the telescopic cage on the crane, the open cage part is swivelled into the mast. The top of the cage inserted first on the mast before the bottom of the cage assembly process is done.



Telescopic cage lifted and inserted into mast



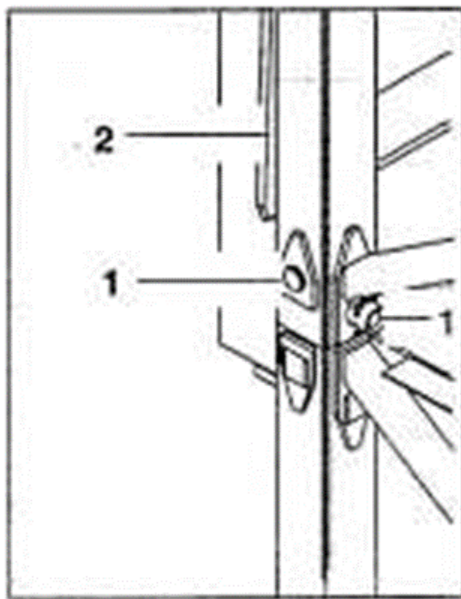
the top of the telescopic cage is locked first



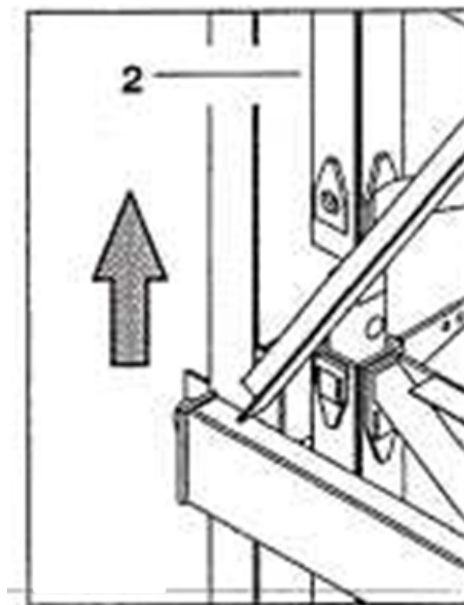
telescopic cage to be mounted on the mast

# Insert the mast part

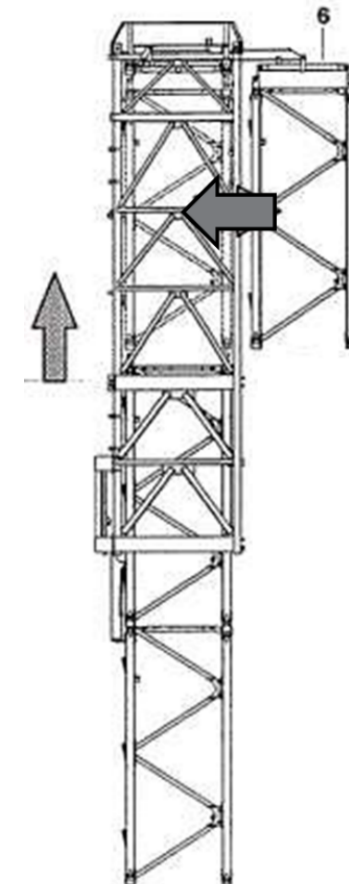
During the rising operation, the Competent Person for the crane installation should be on the platform, handling the hydraulic system, control the mast to stabilize so it will ease the installation process.



The pin is removed from the mast

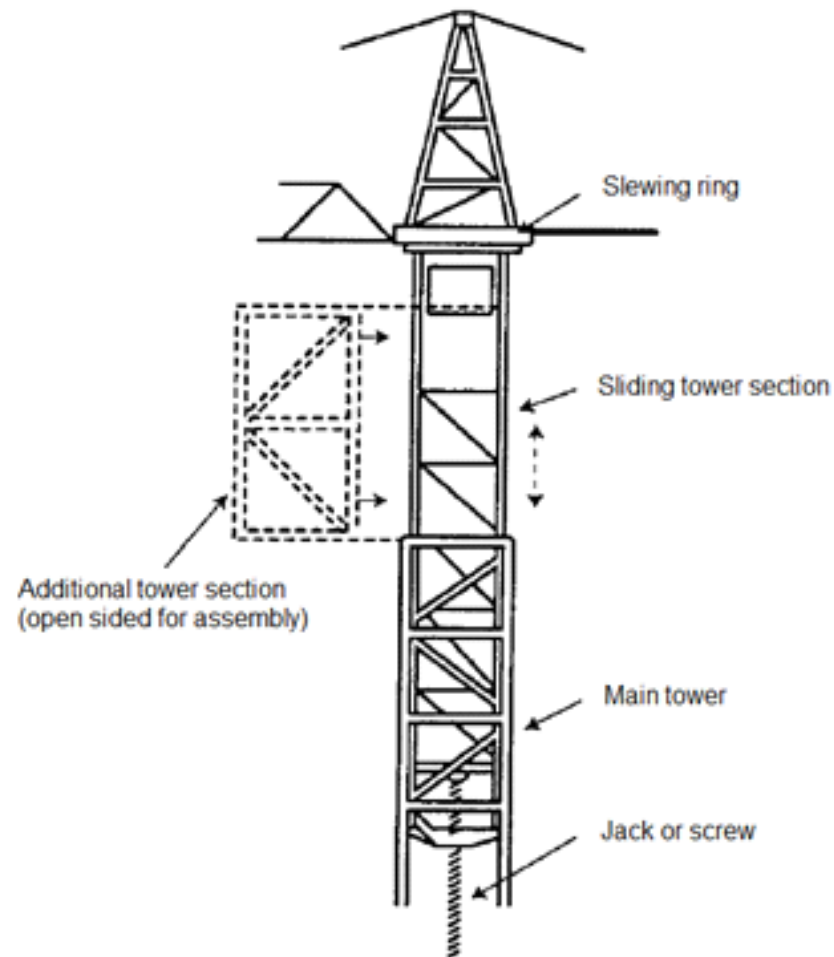


The mast is raised using a hydraulic pump



The mast is inserted into the tower crane

# Insert the mast part



Crane towers climbing equipment during the crane lifting progress (*Code of Practice for Safe Use of Tower Cranes, Occupational Safety and Health Branch, Labour Department, Hong Kong, 2011*)

# Climbing Collars

Collar climbing is a collar that binds the tower crane to the building and it is very necessary for the construction of tall buildings.

The tower is assembled according to the structure of the tall buildings and the tower structure is erected so as to reach the height of the building to be built.

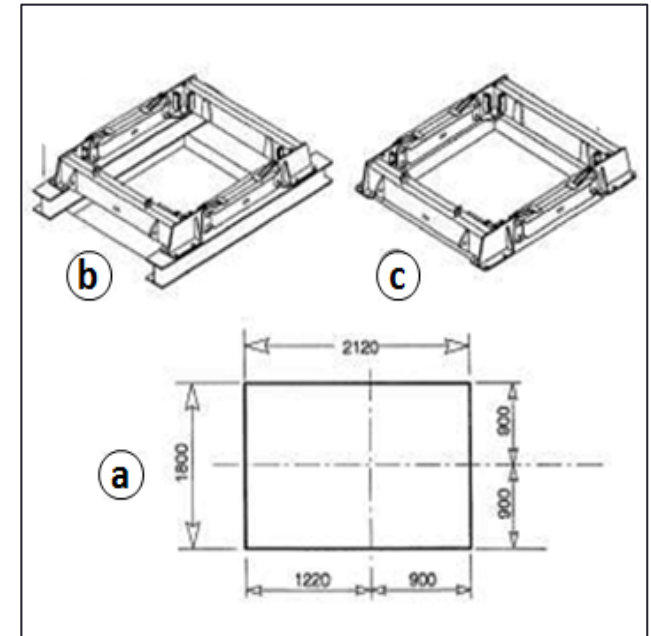
Collars are installed depending on the height of the building. The collar is connected to the mast floor around the tower crane to move the load to the building.

The decision to install the tower cranes must be done with caution and collar should be designed according to the suitability of the building structure.

# Climbing Collars

## Installing Climbing Collars

- The connection between the tower crane and the connection structure includes three strut connection pins.
- The strut is connected to the collar surround the tower pole.
- The strut will connect the tower crane parts to the cross-section building.
- The strut end is connected to the lug connected to the support structure.
- When planning a vertical position for ties, it should be noted that the collar position can only be installed in some places and allowed by the manufacturer

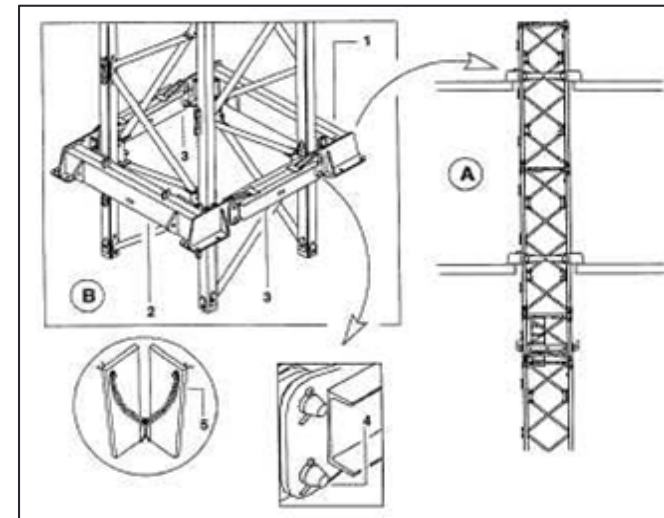


The collar width and collar mounted on the support beam

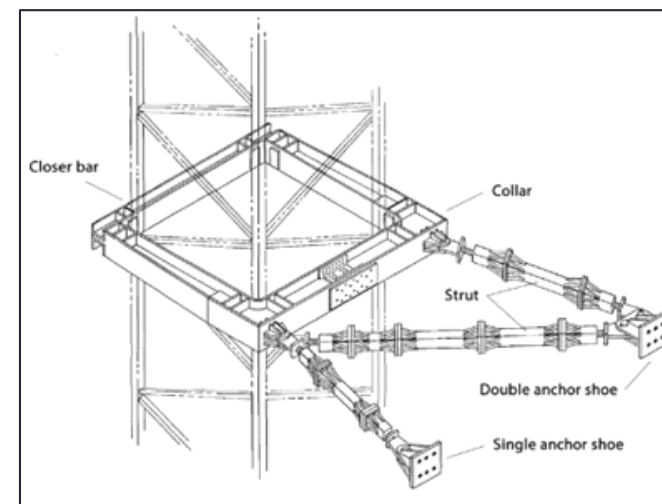
# Connecting the Rising Collars

The mast and building parts need to be connected using the collar. The height between the base of the crane site to the wall-tie or between the wall-tie to the wall-tie should be in accordance with the manufacturer of tower cranes. Inspection of the tower crane should be made a month before the climbing process is made and the condition of the collar and slab should be investigated by the project engineer.

The rising collars on the pole tower connected to the building using three wall-ties for each collar. Two struts are connected to double anchor shoes and one strut is connected to a single anchor shoe



Steps of installing collar to the mast

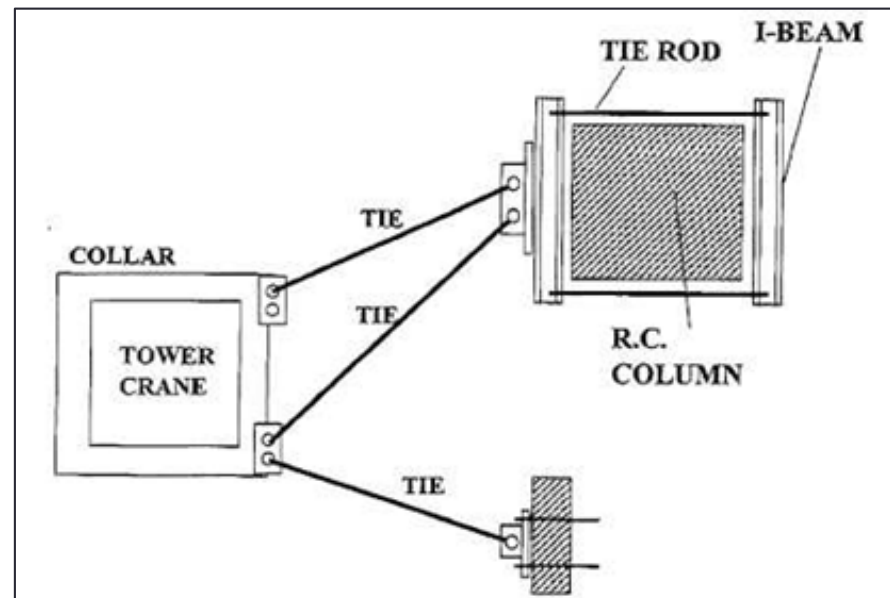


Binding rising collars method



# Specialized rising collar design

mast collar extension with reinforced concrete (RC, column) building and binders are used. This design is used if the bind is to be performed on the RC pole because the punch on this pole should be avoided.



Specialized Design



# Internal Climbing Method

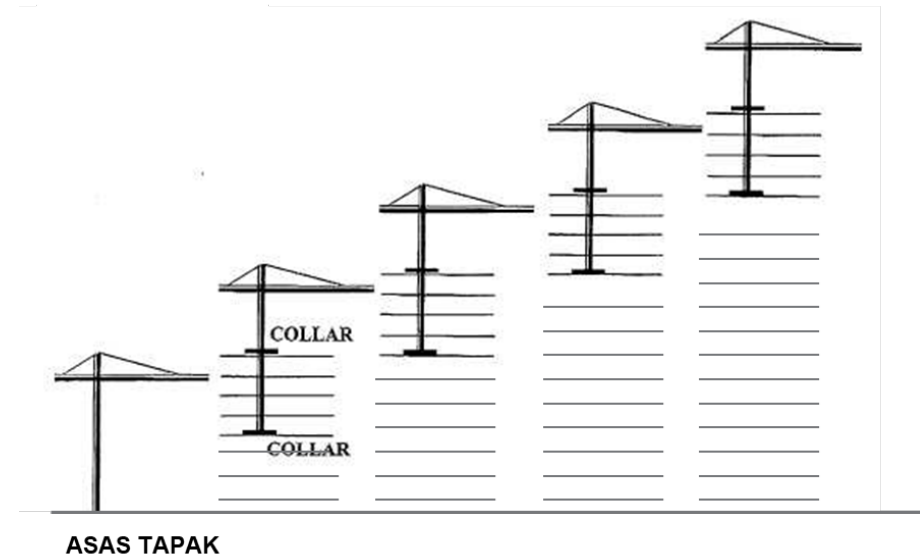
Internal climbing method is used to elevate the crane inside the building in contrast to the external climbing.

This method does not require the addition of a mast to the pole of the tower.

This method is used by raising the entire tower crane to the higher building level by moving the collar as the base of the tower crane .

Change of collar transfer shall be in accordance with the tower crane manual.

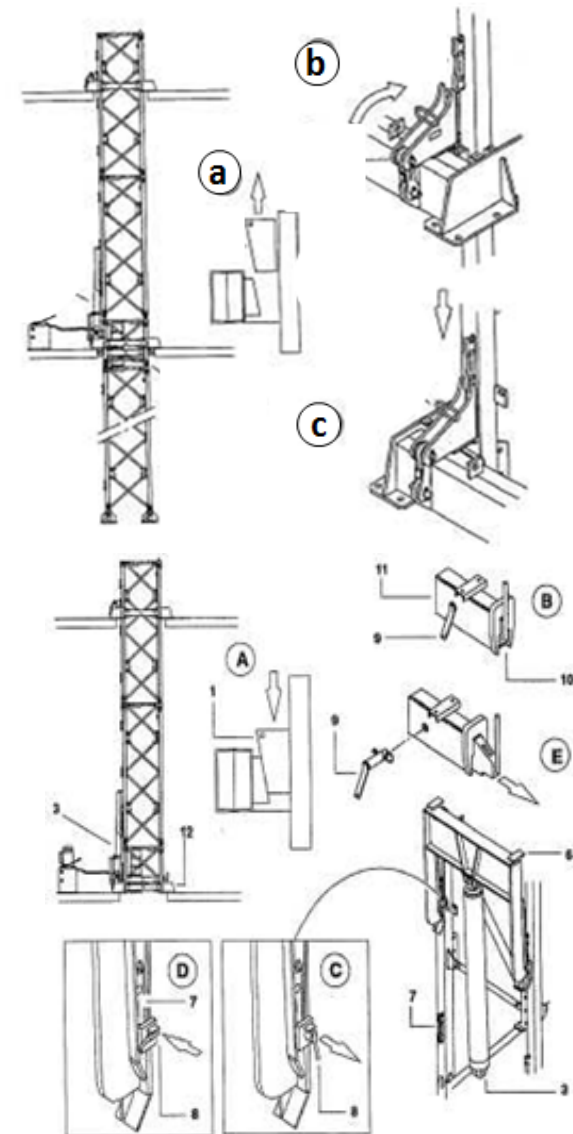
Rising collar is bind up by ensuring the centre of the tower crane gravity is on the axis. To ensure that stability of the tower crane boom trolley is positioned at the most stable position.



# Internal Climbing Method

## Internal climbing method: The first telescopic sequence

- In the process of climbing, there are two internal climbing collars that are at a distance determined by the tower crane manual to ensure the crane is always in stable condition.
- Once the two collars are bind to the wall of the elevator core then the crane is separated from the base.
- The internal climbing part of the collar works to support the overall weight of the tower when the crane is being triggered up and then the crane site will stand on the bottom of the collar.
- During offset operation, the boom is not allowed to rotate and move, while the lifting cord also cannot be rolled. The first internal climbing sequence method



The first telescope sequence meth

# Internal Climbing Method

## The second telescope sequence

- If cranes need to be lifted again after the first sequence elevation due to the rise of the building level, the second sequence should be done.
  - This sequence involves three collars to ensure the stability of the tower crane when triggered.
  - The third collars are mounted first at the top level based on the setting of the tower crane manual before the first collars (which is made as the first sequence site base) is opened.
  - The tower crane is then triggered until the height of the second collar and will be the new tower crane site base.
  - This opened collar can be used as a binding collar for the next sequence.
- Steps to climb the second sequence

# COMPETENT PERSON

---

## **CHAPTER 10** **DISMANTLING TOWER CRANES** **PROCESS**

# Early Preparations and Dismantling Steps

**Before the dismantling process started, several steps need to be followed:**

- The tower crane components and parts should be checked including pins, bolts, hooks, trolleys and electrical systems.
- Hooks, trolleys and cables need to be rolled.
- Electrical power connections should be disconnected from the main

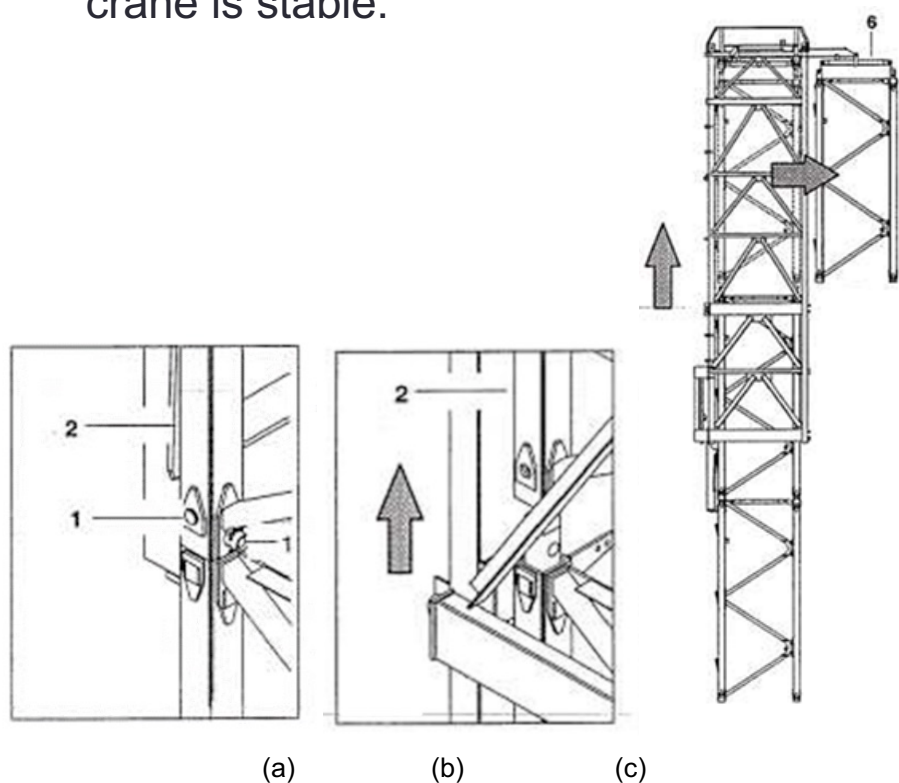
**Steps of dismantling the tower crane outside the building are as follows:**

- The tower crane needs to be lowered so that the height can be reached by the mobile crane. The mast part should be lowered one by one by using telescopic cage to the appropriate height.
- Dismantling the lifting cables and connecting wires
- Boom is dismantled by lifting and lowering it using a mobile crane.
- The counter load needs to be moved according to the steps outlined by the manufacturer.
- The counter jib shall be dismantled after all counter loads are removed
- Dismantling A-frame
- Dismantling Slewing Platform
- The mast part is lowered one by one using a mobile crane

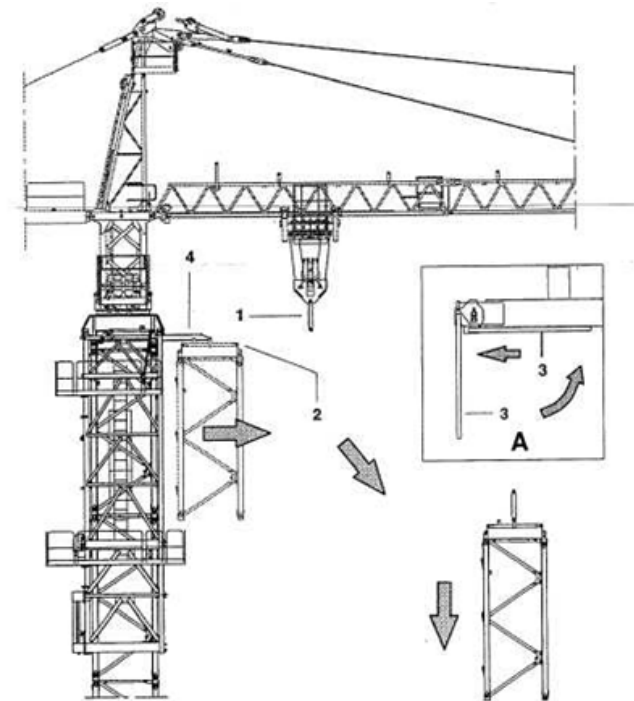
# Dismantling Tower Crane

- **Lower the mast**

- The first step of dismantling is to reduce the height of the tower crane by removing the mast part one by one until its height can be reached by the mobile crane.
- The mast part is lowered by hoisting the tower crane which is being triggered using a telescopic cage, therefore the force should be balanced to ensure that the tower crane is stable.



Kaedah mengeluarkan bahagian mast

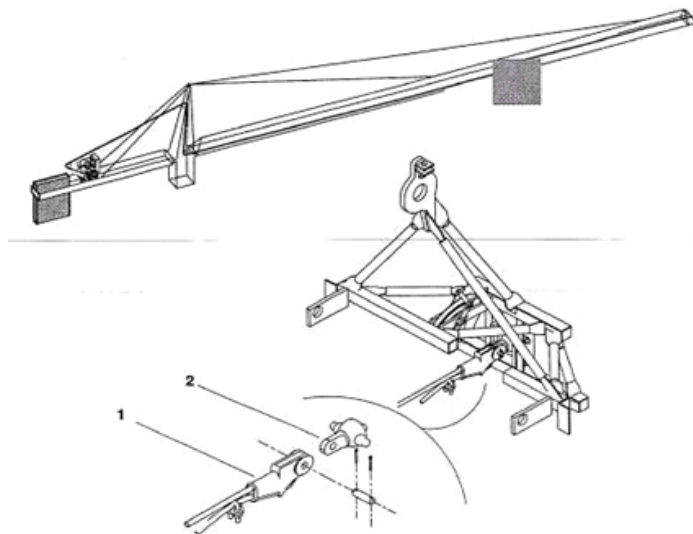


Kaedah menurunkan bahagian mast

# Dismantling Tower Crane

## Dismantling the lifting cables and wires

- Upon reaching the appropriate height, cables and hooks should be removed prior to lowering parts of the tower crane component.
- The hook is lowered to the basement and the pin connecting between the lifting cable and the hook is disassembled.
- The cables are dismantled and rolled down or rolled wires first before being lowered using a moving crane.

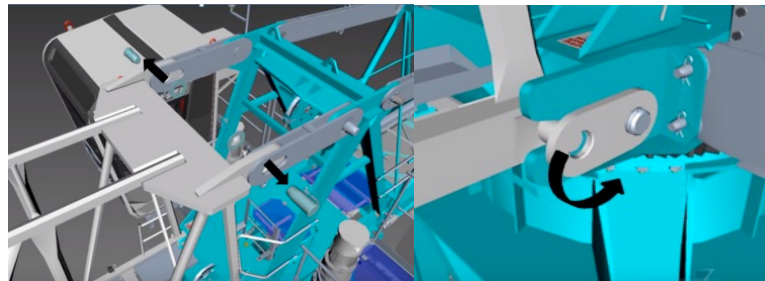


Dismantle the lifting cables and connecting wires

# Dismantling Tower Crane

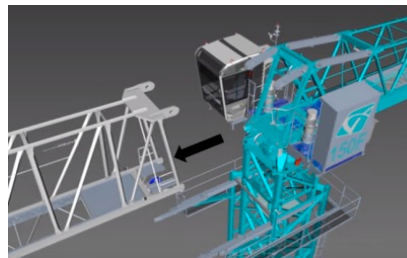
## Dismantling the Boom

- The tower crane boom needs to be lifted slightly using the mobile crane before the pin that connect the connector rod of the boom and the A-frame are opened.
- Then the pin connecting the boom with the slewing platform is opened. The balance of the boom should always be ascertained when lifted by the mobile crane and assisted with the tag line so as not to spin.



(a)

(b)



(c)

(a) Dis and reassembly boom and reassembly tower after A disassembly (b) Dis



# Dismantling Tower Crane

## Dismantling counter loads and counter jib

- Crane loads are removed from the counter jib and lowered on the ground using the mobile crane.
- If there are multiple sets of weights, the lowest weighing load shall be issued first.  
Method of dismantling the counter load.



Kaedah merombak beban timbal

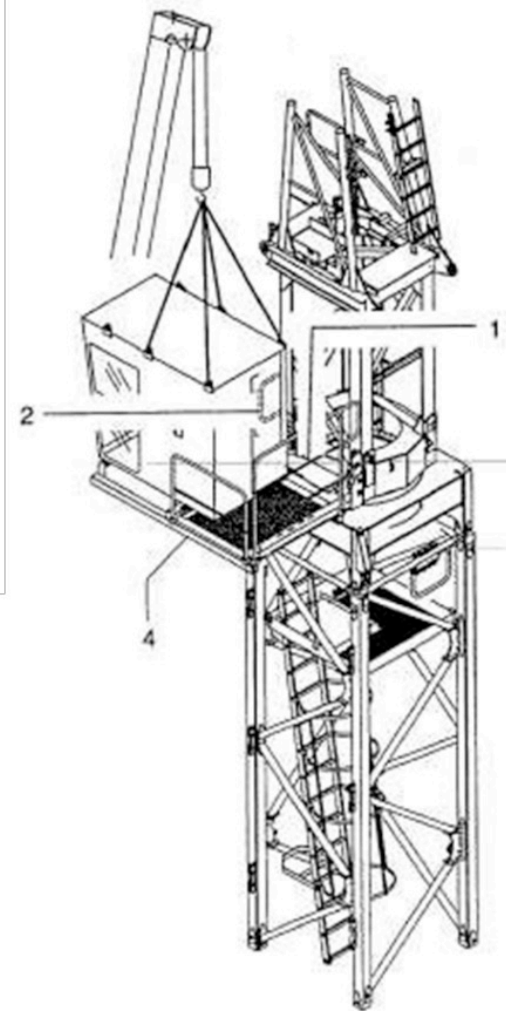


Menurunkan jib pengimbang

# Dismantling Tower Crane

## Dismantling the cabin

- Cabin connections need to be removed before they are dropped using mobile cranes.

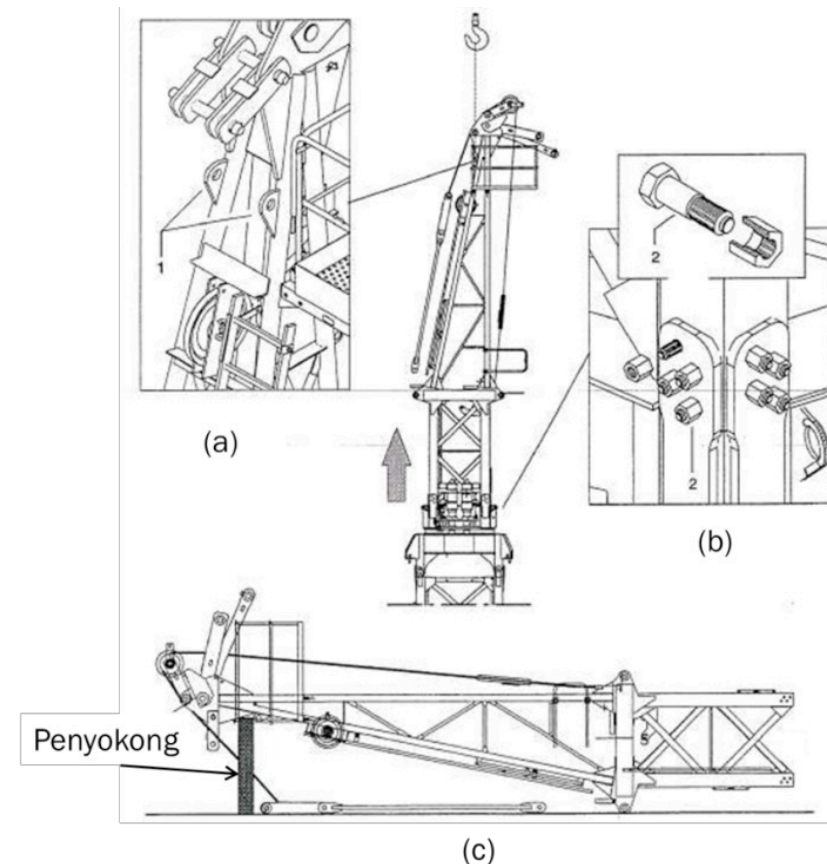


Merombak kabin

# Dismantling Tower Crane

## Dismantling the A-frame

- The A-line dismantling step also requires the help of a mobile crane by connecting the hoisting rope to the A-frame.
- All bolt connections should be unlatched first before the A-frame is lifted from slewing platform.
- A-frame should be placed on the ground with the help of supporter so that it is in a horizontal position.

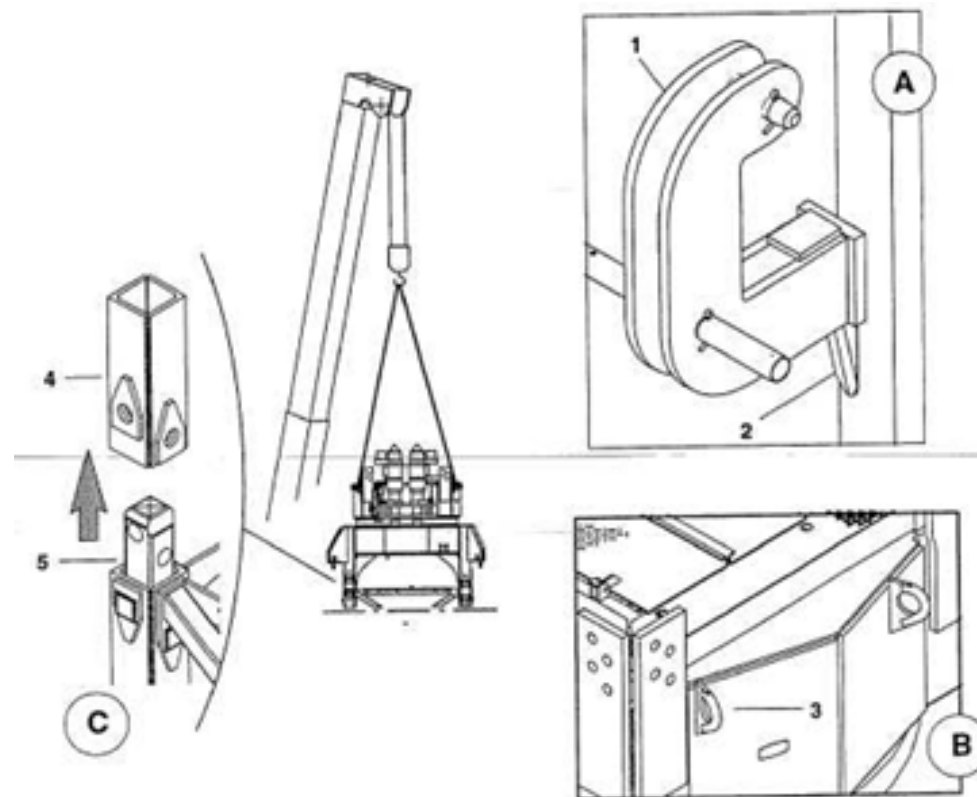


Kaedah merombak kerangka-A: (a) tali pengangkat kren bergerak disambungkan ke bahagian kerangka-A; (b) bol penyambung kerangka-A dan pelantar slu dibuka; (c) kerangka-A diletakkan secara mendatar

# Dismantling Tower Crane

## Dismantling the slewing platform

- Slewing platforms should be tied to the moving crane before the bolt between the mast and the slewing platform is unlatched.

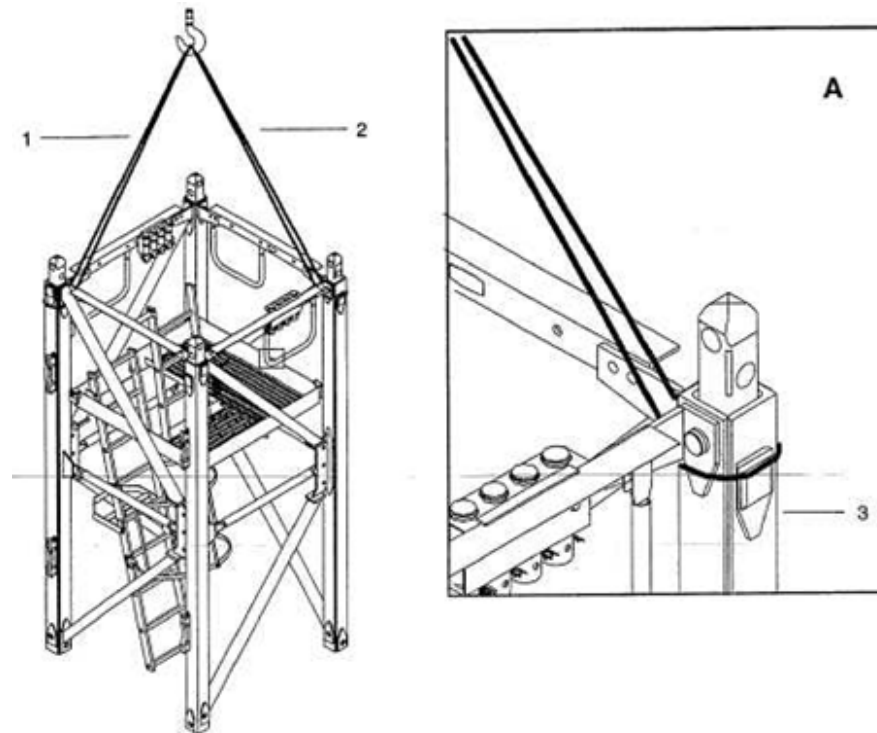


Kaedah merombak pelantar slu

# Dismantling Tower Crane

## Lower the Mast

- The mast part is lowered one by one and the mast must be tied to the mobile crane before the pin is removed.
- The lifting rope should be tied at least two corners of the mast before lifting using a mobile crane hook



Kaedah mengikat tali mengangkat pada bahagian *mast* semasa rombakan

# The use of Derrick cranes

- This crane is specially designed for assembly and dismantling for all internal climbing type of tower cranes.
- It is installed on the roof of the building directly as it has no mast side. It is safe and suitable for the purpose of dismantling.
- If the derrick crane is used to dismantle the tower crane, the derrick crane owner should ensure that critical parts inspection is conducted by a competent inspector.



Derrick crane for tower crane dismantling work



# Safety measures of dismantling tower cranes

- The space restriction by the crane structure itself, and other buildings that complicate the dismantling process.
- Choosing cranes such as type, size and crane position is determined at the start of the project.
- Equipment used to lower the crane structure is strong and sufficient.
- All lifting equipment, such as gears, need to be tested, scrutinized and checked by Competent Person.
- The dismantled and lowered crane parts are safely placed on hooks or lifting devices before the bolt or pin lock is unlatched.
- It is recommended that the bolts used between the gear rings on slew and the top of the tower ring are deemed defective when the crane is transferred to another construction site and should be disposed of.
- Slew should be checked to see cracks on welding surface and flat surface when replaced and transferred to another construction site.

# COMPETENT PERSON

---

## CHAPTER 11 PERSONAL PROTECTIVE EQUIPMENT



# Introduction

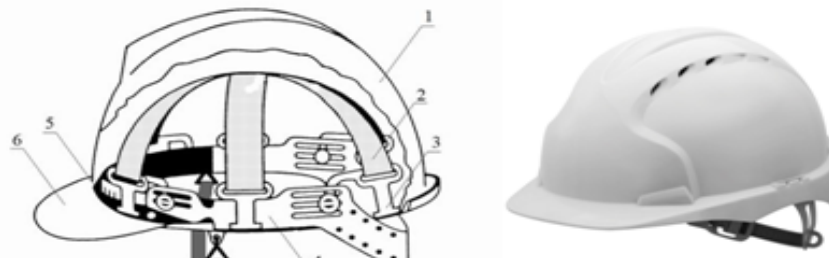
Personal protective equipment (PPE) means all equipment intended for use or to be held by persons at the workplace, and that protects them against risks to their health and safety. PPE is also related to any additional gear or accessories designed to meet those objectives. PPE must be worn when carrying out work at construction sites

# Types of Personal Protective Equipment

## a) Safety helmet

A safety helmet is one of the most commonly used PPE . The safety helmet serves to protect the head of the user against:

- The impact from a falling object by rebounding and deflecting the force
- Impact from the side and behind
- Fire, splashes from molten metal, high temperatures and electric shock (depending on the standard of the hard helmet chosen. However, standard hard helmets cannot function to protect the wearer against electric shock). A complete safety helmet must come with a shell, harness and headband.



Safety helmet for the construction industry; 1 – shell, 2 – harness, 3 – harness adjuster, 4 – headband, 5 – sweatband, 6 – peak, 7 – chin strap

# Types of Personal Protective Equipment

## b) Safety shoes

The risk factors that should be identified are:

- Based on the characteristics of the workplace
  - a) heavy items that can fall onto or injure the feet,
  - b) type, concentration and physical properties of chemicals (acids, alkalis, solvents, etc.),
  - c) ambient temperature and humidity..
- Based on the condition of the worker:
  - a) working in a standing position
  - b) activities involving constant movement
  - c) climbing up ladders
  - d) moving on smooth surfaces
  - e) awkward working posture
  - f) working in an open space
  - g) working in a confined space (depending on the temperature)



# Types of Personal Protective Equipment

## c) Gloves

The following factors must be taken into consideration in the selection of gloves:

- a) The material being handled
- b) The risk of danger to the hands
- c) The type and period of contact
- d) The size of the hand and the comfort of the wearer
- e) The type of task





# Types of Personal Protective Equipment

## d) Reflective vests

- Reflective vests should be worn in dim workplaces so that the wearer can be easily seen
- The colour of the vest must be in contrast to the work environment so that the personnel will be clearly visible
- The selection of the appropriate vest should be determined through discussions with the employer.
- The vests should carry a valid label by the manufacturer, and be recognized by the authorities.



# Types of Personal Protective Equipment

## d) Safety glasses

a) Safety glasses, face shields, and welding helmets are used to protect the eyes and face. This type of protection needs to be worn when power tools are being used or to prevent liquid from splashing onto the eyes or face. Glasses are the most widely used eye protection equipment.

b) There are three types of eye protection devices, namely, a face shield, safety glasses, and goggles. The face shield provides the best protection against droplets and splashes of hazardous substances.



Rajah a menunjukkan cermin mata keselamatan dan gogal.



Rajah b menunjukkan tiga jenis alat pelindungan mata iaitu pelindung muka, cermin mata keselamatan dan gogal.

# Types of Personal Protective Equipment

## e) Ear protection devices

Earplugs and ear muffs are ear protection devices that are used to protect the hearing of the wearer.

Ear muffs are more comfortable and effective in reducing noise, while earplugs are more effective in terms of their use, although some workers find them uncomfortable.

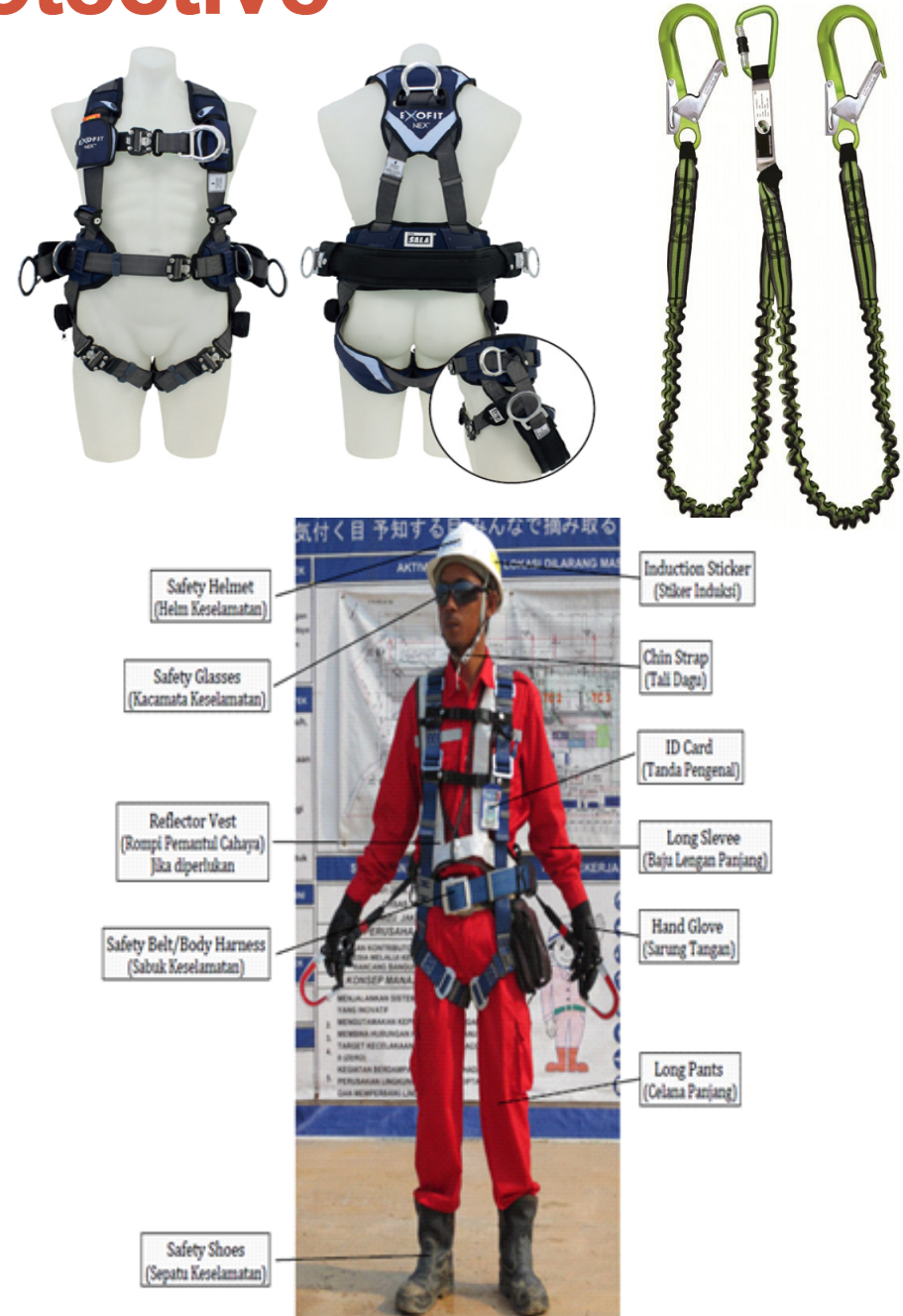




# Types of Personal Protective Equipment

## f) Safety harness

A safety harness is a protective equipment that is designed to protect a person who is performing a climbing activity or is coming down from a height. The harness connects a moving object to a stationary object, and it is usually designed with a rope and cable, together with a lock that can be easily opened.





# COMPETENT PERSON

---

## CHAPTER 12 GENERAL SAFETY

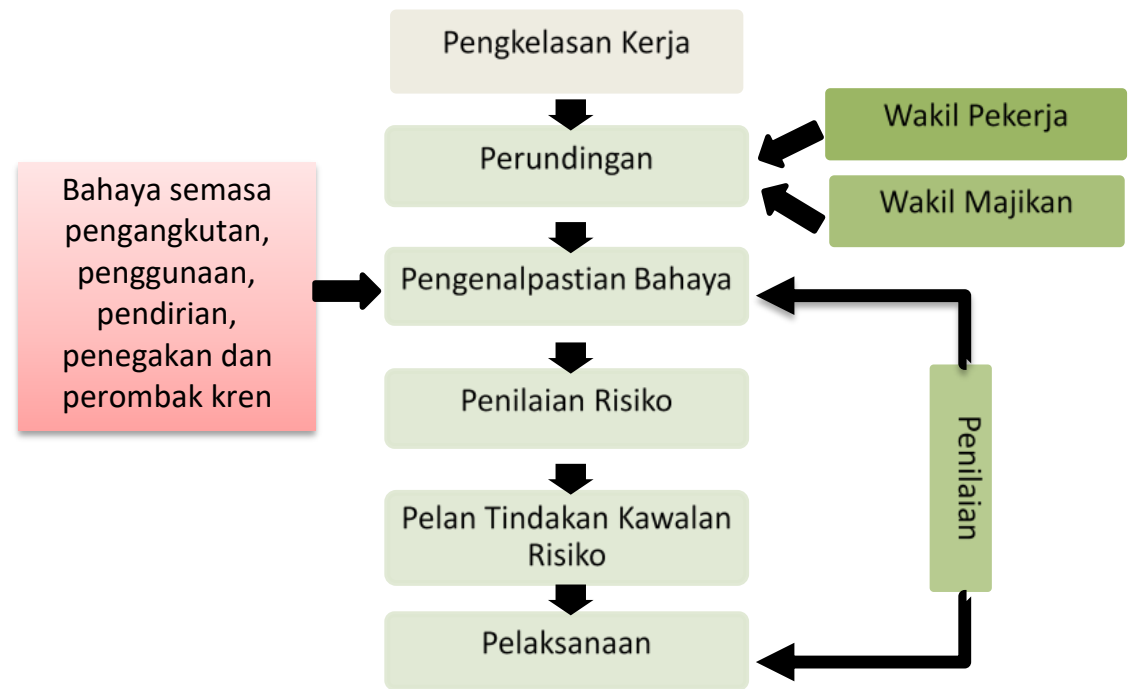
# Risk management of the tower crane operation

- **Step 1 - Hazard Identification.** The responsible party must identify potential dangers or hazards in relation to use and tower crane operations such as tower crane sites, tower crane and personal equipment involved in lifting operations;

## Step 2 – Risk Assessment.

Assessments are made based on the bad potential otherwise the dangers that may result from the use and operation of the tower cranes. Associated engineering expertise is required when making this assessment;

**Step 3 - Risk Control.** The proper control must be identified and implemented so that the predicted risk can be prevented. Risk controls include setting the appropriate place, the radius of the tower crane operation, crane operator and other qualified personnel.



## Carta alir bagi proses HIRARC

# Hazards Identification

- Employers must identify and assess the risk in reference to provisions in MS1803: 2008 and MS ISO 12100, pertaining to the necessary risk assessment to mitigate or eliminate risks associated with hazardous elements.
- List of hazards, hazards and dangerous occurrences associated with tower crane operations refers to MS1803: 2008 and EN 1050: 1996:
  - Mechanical hazards are caused by machine parts or work sheets, e.g. shape or lack of mechanical strength;
  - Electrical hazards
  - Hazards produced by the sound;
  - Hazards generated by materials and materials processed or used by machinery:
  - The hazards generated by the abandonment of ergonomic principles in the design of the machinery:
  - Unexpected start of operation / operation, over operation / speed (or system does not work or anything similar to it) are caused by:
    - Power failure
    - Control circuit failure
    - Break-up during operation
    - The object or liquid falls
    - Loss of stability / over turn on the machinery
    - Slipping, trapped and fallen people (related to machinery).

# Risk Assessment

**1. Cranes use: Risk identification and evaluation at crane use rates involves the following factors:**

- The lifting person
- The stability of the crane
- Failure of lifting equipment
- Condition of the weather
- Exceeds the allowed capacity
- Binding and lifting instructions
- Inspection and maintenance of cranes
- The efficiency of the crane operator and the person involved
- Failure of electrical and mechanical systems
- Unauthorized entrance or exit

**2. Installation, erection and dismantling of cranes: Identification and assessment on the enforcement stage, erection and crane dismantling involve the following factors:**

- Delivery cranes to site
- Traffic management
- Lifting cranes or cranes components from lorries
- The usage of mobile cranes
- Condition of the ground
- Condition of the weather
- Public passage
- Lifting across people or other structures
- Stability and load forces
- Permit for crane erection
- Site base design and support strength
- Efficiency, training and supervision
- Falls from high altitude
- Use of personal protective equipment
- Materials from high altitude
- Entrance facilities

# Risk Assessment

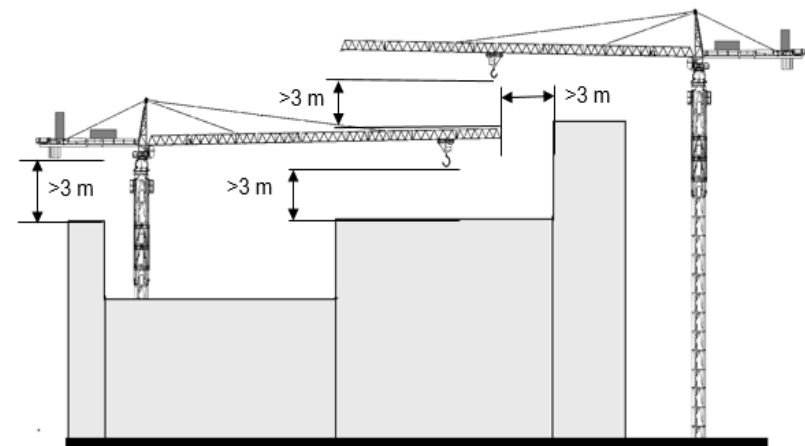
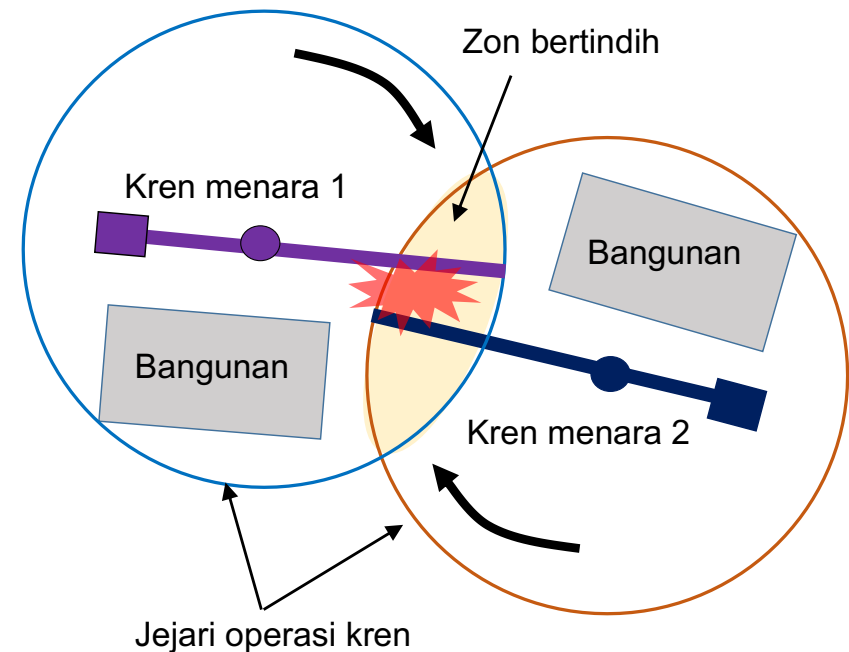
- Other risks that may cause injury to people involved with the tower crane operation or person around the crane are:
  - Crane crashed;
  - Structural failure or crane component;
  - Collision of cranes or loads with other structures
  - Falling from altitude (from buildings, cranes and others);
  - Fall objects
  - Electric shock
- The tower crane may or may fall when the crane instability occurs due to overload and is influenced by several other factors including:
  - The use of incorrect crane weighing weight
  - Installation of wrong crane support arm;
  - Bolt flash on incorrect crane structure (mast or boom);
  - Incorrect crane site base design

# Risk Assessment

## The Risk of Crashing Between Cranes

In order to reduce the risk of injury from collisions between cranes and other structures, the Competent Person should ensure:

- Placement of cranes and spaces between tower cranes that may collide with other structures should be planned in advance to ensure cranes are in place (Figure 12.3)
- The Competent Person should plan a safe working method during placement and crane operation
- Persons involved in crane operations and other structures should be provided with adequate training to ensure that the procedures are properly implemented
- The communication method between the crane operator and the load fastener or signaller is aligned and understood accurately.



# Risk Assessment

## Operation near Pole and Electric Cable

When cranes are to be used in an electrical line environment on the following precautions should be noted by designated person, crane operator and others working with the crane, namely:

- Each crane has different operating characteristics in determining the safe operating distance from the electrical conductor, if the active power line seek advice from electrical utilities party such as Tenaga Nasional Berhad (TNB) before the commencement of work
- Any crane operation should be supervised by a Competent Person
- Make sure the load and crane do not approach the nearest power line
- Crane operator or anyone at risk should be advised to take appropriate action in the event of contact with electrical conductor
- The crane cannot be used to remove the material from the power line or enter the power line danger zone, unless approved by electrical utility company engineers or TNB
- If the electricity line is to be disconnected, have the discussions with the online controllers as early as possible before the work is done.

Range of voltage and distance range when doing work near the electric current:

- 0 - 33,000 voltage (distance 3.0 m)
- 33,000 - 132,000 voltage (distance 6.0 m)
- Over 132,000 voltages (refer to electrical utility company)

If a person or something comes in contact with the electric line above, the following must be done:

- If it is touched / close to the wires broken, move and stay away as soon as possible until the line is confirmed safe
- Always think that the electricity line is active, though it does not trigger a spark, or if it looks like no current
- It needs to remember that, even if the electricity line is off, it can switch on either automatically after a while or after a few minutes or hours if the online owner does not realize that the line has been damaged.
- Need to remember that if the active wire touches the surrounding area (the ground) it may become active. Keep the safe distance from the wire or anything that can touch it
- If necessary, call emergency services from responsible parties such as TNB.

# Risk Control

## Occupational Safety and Health Guidelines in the Construction (Management) Industry 2017 which provides the principles for risk control.

- Avoid risk
- Assessing the inevitable risks
- Reducing the existing risks
- Customizing work for individuals, such as workplace designs, selection of work equipment, selection of working method, production and others
- Adapt to technological advances in machinery or systems
- Develop an overall risk prevention policy covering technology, work organization, working conditions, social relationships and the influence of factors related to the work environment
- Give priority to collective protection measures from individual protection measures
- Giving appropriate and easy-to-understand instructions to employees
- Device inspection and safety movement limitation, lifting equipment, and critical components such as jib, pulley, wire rope and others should be monitored and evaluated periodically, for example monthly, quarterly or annually
- Safety checks on employee health should be monitored and evaluated periodically, for example monthly, quarterly or annual
- Employers must ensure that every employee involved in the lifting operation has undergone a safety training course and related techniques (signals, bonds etc.) and pass the exam
- Ensure clear and easy-to-understand communications between crane controller, signaller or load fastener such as using walkie-talkie or phone or hand gesture
- the responsibility of each employee must be explained and set as the person who manages the lifting operation, a maintenance person, a security supervisor, or other employee in connection with the use and operation of the crane.



# Risk Planning and Coordination of Tower Crane Use

Effective planning will help identify ways to protect those who:

- Assembling, erecting, directing the work and dismantling the tower crane
- Directly involved in lifting operations such as crane controllers
- In an area adjacent to a tower crane, including public places
- Regarding the use of electricity, ensure the supply and electrical equipment are installed and used in a safe manner especially for those who work near the power supply
- Determine the crane requirements, including loading and access space for lifting, at the stage of project preparation;
- Reducing the number of tower cranes at the project site to reduce the possibility of collisions between cranes and other objects
- Ensuring that every tower crane can be installed at an acceptable distance from other tower cranes and concrete placement booms
- Ensuring the crane machine platform remains at a safe distance above the building

# Safe Design and Registration of Tower Cranes

## Stability of the Tower Crane

- The stability of a tower crane must take the following factors into account : -
  - Moment stabilization using load chart and suitable counterweight
  - Reversal of moment caused by excessive load
  - Site base designed for the installation of a crane
  - Design, number and location of connection
  - Wind condition
- All tower crane designs must be approved by JKKP. The design of the tower crane and any part of it shall be in accordance with specifications specified in MS 1803: 2008-Cranes-Safety-Tower Cranes standards.

# Safety measures during cranes installation and dismantling

- Safety Measures during Installation (Luffing)
- some security measures in installing luffing cranes need to be emphasized such as:

<ol style="list-style-type: none"> <li>1. Submit a checklist and other relevant documents to DOSH to obtain approval if using the used tower crane.</li> <li>2. Invite JKKP to come to monitor the site of the tower crane site and inspect all components of the crane that will be used before the install process is started.</li> <li>3. Project engineers should examine the base site of the tower cranes to ensure that tower crane sites are built according to the specifications of professional engineers and manufacturers prior to installation of concrete.</li> <li>4. Inspect all state of the structure, pin, pulley, bolt, moving components and electrical systems.</li> <li>5. Ensuring the process of installing tower cranes is made according to manufacturer's instructions.</li> <li>6. Checking all components of the mast pole is vertical when the installation starts.</li> </ol>	<ol style="list-style-type: none"> <li>7. Assemble the supporting cage along with a complete hydraulic system before it is mounted on a tower crane pole.</li> <li>8. Install power system on machine deck.</li> <li>9. Connecting the hydraulic system and electrical system properly.</li> <li>10. For the main boom assembly, bind the lifting cord on the ground and slowly lift with good stability and connect to the top of the tower crane.</li> <li>11. To install the luffing cord, connect the luffing cord to the luffing pulley and lock the thimble at the top of the tower crane.</li> <li>12. Tense the luffing cable and remove the cable that lifts the boom slowly.</li> <li>13. Correct the balancer and tighten the balancing position</li> <li>14. Connect the lifter cables through all the pulleys and lock using anti-twist hoisting thimbles</li> <li>15. Install all security switches and test all switch functions</li> <li>16. Test the crane at no load conditions</li> <li>17. Determine the maximum switch size, momentum and speed limiter at state with load.</li> <li>18. Invite JKKP to make final inspection and load test.</li> </ol>
--	--

# Safety measures during cranes installation and dismantling

- **Safety Measures during Installation (Hammerhead)**

- some security measures in installing hammerhead cranes need to be emphasized such as:

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Request monitoring from project engineers to ensure the base of the tower crane site is built to the specification of professional engineers and manufacturers.</li> <li>2. Examine the conditions of tower crane structure, pins, pulleys, bolts, moving parts and electrical systems.</li> <li>3. Ensure that the process of installing the tower cranes is made according to the manufacturer's instructions.</li> <li>4. Checking all components of the mast pole is vertical when the installation starts.</li> <li>5. Assemble the cage along with a complete hydraulic system before it is mounted on a tower crane pole.</li> <li>6. Ensure that slew base is installed along with operator cabins, catwalk platform and handrails before being lifted.</li> </ol> | <ol style="list-style-type: none"> <li>7. Assemble the counter jib on the ground before it is lifted.</li> <li>8. Installing the balancer at the counter jib according to the specifications specified.</li> <li>9. For the main boom assembly, bind the lifting cable on the ground along with the binder rod, the pulley section and the load indicator board. Then, lift the main boom slowly with good stability and connect it to the top of the tower crane.</li> <li>10. Adjust the balancer and tighten the balancing position</li> <li>11. Connect the lifter cables through all the pulleys and lock using anti-twist hoisting thimbles</li> <li>12. Test the crane at no load conditions</li> </ol> |
|--|--|

# Safety measures during cranes installation and dismantling

- **Safety Measures during Installation (Derrick)**
- several safety precautions need to be emphasized:

- |  |  |
|--|--|
| 1. Inspect derrick cranes with professional engineers whether the load distribution can be on roof slab beams. | 5. Connects all electrical connections and derrick crane commissions.                              |
| 2. Collect all required documents to be sent to JKKP for approval.   | 6. Run an in-house load test.  |
| 3. Using building elevator space and labour energy to lift up derrick cranes on the roof of the building       | 7. Invites JKKP for final inspection and load test.  |
| 4. Use a stiff leg crane to install a derrick crane onto the slab.   | 8. Derrick cranes can only be operated by qualified and capable operators.                         |
|  | 9. Create safe lifting methods with security officers before actual lifting works are carried out. |

# Safety measures during cranes installation and dismantling

Security measures during dismantling (luffing)

several safety precautions need to be emphasized:

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Send all relevant documents and construction site sketches to JKPP for approval of the dismantling of the tower crane.</li> <li>2. Check PMA and tower crane serial number before being dismantled</li> <li>3. Examine the checklist for maintenance of the last month's crane conditions before dismantling.</li> <li>4. Check all brake systems, cabling systems and trolleys.</li> <li>5. Inspect any obstacles in the construction site area to facilitate the process of dismantling.</li> <li>6. Disconnect the roll limiting switch</li> <li>7. Disconnect the cable and rewind the cable on the hoisting drum.</li> <li>8. Disconnect the cable on the pulley and rewind the cable on the hoisting drum.</li> <li>9. Lock the trolley part to dismantle the main jib.</li> <li>10. Disconnect all crane main power connections.</li> </ol> | <ol style="list-style-type: none"> <li>11. Disconnect all control cables and limit switches.</li> <li>12. Move half of the balancer to balance the tower crane and dismantle the main jib along with the binding pole and trolleys.</li> <li>13. Transfer all balances from the counter jib</li> <li>14. Dismantling counter jib</li> <li>15. Dismantle and lower the cathead (A-frame)</li> <li>16. Dismantle the slewing platform</li> <li>17. Dismantle the entire mast part and site.</li> <li>18. Using suitable mobile cranes depends on the height and width of the site during the dismantling.</li> </ol> |
|--|--|

# Safety measures during cranes installation and dismantling

Security measures during dismantling (hammerhead)

In the process of dismantling a hammerhead type crane, several safety precautions need to be emphasized:

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Send all relevant documents and construction site sketches to JKKP for approval of the dismantling of the tower crane.</li> <li>2. Check PMA and tower crane serial number before being dismantled</li> <li>3. Examine the checklist for maintenance of the last month's crane conditions before dismantling.</li> <li>4. Check all brake systems, cabling systems and trolleys.</li> <li>5. Inspect any obstacles in the construction site area to facilitate the process of dismantling.</li> <li>6. Disconnect the roll limiting switch</li> <li>7. Disconnect the cable and rewind the cable on the hoisting drum.</li> <li>8. Disconnect the cable on the pulley and rewind the cable on the hoisting drum.</li> </ol> | <ol style="list-style-type: none"> <li>9. Lock the trolley part to dismantle the main jib.</li> <li>10. Disconnect all crane main power connections.</li> <li>11. Disconnect all control cables and limit switches.</li> <li>12. Move half of the balancer to balance the tower crane and dismantle the main jib along with the binding pole and trolleys.</li> <li>13. Transfer all balances from the counter jib</li> <li>14. Dismantling counter jib</li> <li>15. Dismantle and lower the cathead (A-frame)</li> <li>16. Dismantle the slewing platform</li> <li>17. Dismantle the entire mast part and site.</li> <li>18. Using suitable mobile cranes depends on the height and width of the site during the dismantling.</li> </ol> |
|---|---|

# Safety measures during cranes installation and dismantling

Safety measures during the process of erecting the tower pole

- |  |  |
|--|--|
| <ol style="list-style-type: none"><li>1. Check the last month's maintenance checklist of the tower crane before the erecting process is carried out.</li><li>2. Request a project engineer's view to ensure the column / collar is in a strong state and capable of supporting the torque and bending of the tower crane.</li><li>3. Install the binder collar set on the mast, wall tie beam and check the horizontal position.</li><li>4. Checking hydraulic jacking up system.</li><li>5. Arrange the mast parts and mount the platform at the mast according to specifications when they are above the ground before jacking up.</li></ol> | <ol style="list-style-type: none"><li>6. Extend the length of the main power cable if required.</li><li>7. Checking roll system, trolley cable, brake system and end bulldog clip for climbing purposes.</li><li>8. Check all roll restraint switches.</li><li>9. Using concrete blocks to balance the tower crane during the jacking-up process is made.</li><li>10. Jacking up the towers at appropriate altitudes.</li><li>11. Tighten all bolt / pin and nut connections.</li><li>12. Resets the roll restriction after the process of jacking up.</li><li>13. Test tower crane with load.</li></ol> |
|--|--|



# Responsibilities of Tower Crane Management at the Site of Construction

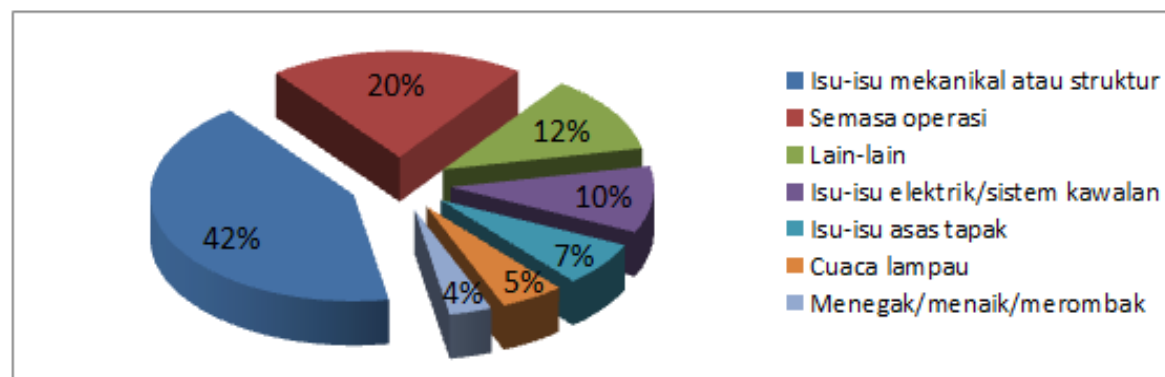
- Those responsible for tower crane management at the site must ensure that:
  - The tower crane is vertical and dismantled by a Competent Person who has training and experience. Companies should provide written procedures for each type of tower crane and this procedure should refer to the manufacturer's instructions.
  - A thorough examination of the crane should be carried out after enforcement by a Competent Person.
  - Only competent person can handle cranes.
  - Pre-use checks are performed by the crane operator at the beginning of each shift to ensure that the crane does not suffer any damage or failure and is safe to use.
  - Internal checks are carried out by crane operators, usually on a weekly basis, and records of these checks are kept.
  - Lifting operations need to be properly designed and supervised accordingly.

# Safety Factors and Failure of Tower Cranes at Construction Sites

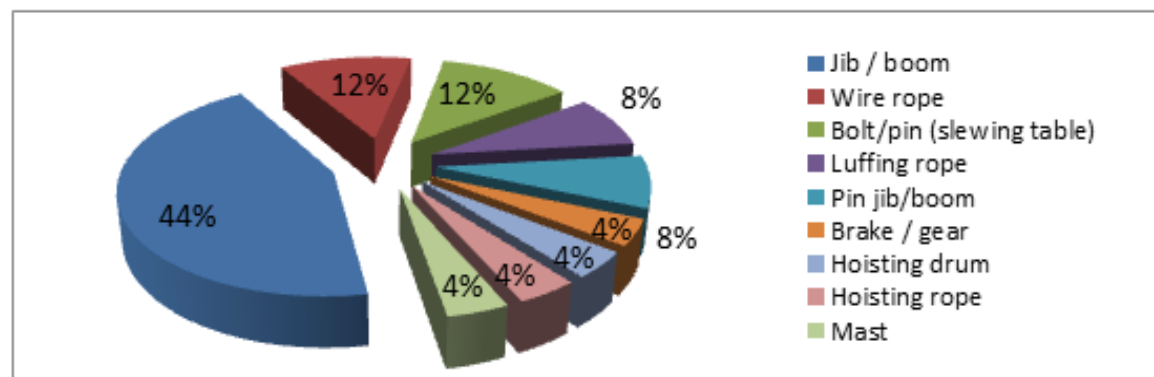
- There are five risks involving tower cranes:
  - Structural failures
  - The tower crane falls
  - Accidents with other tower crane movements
  - Load objects fall
  - Fall from altitude
- Safe design for tower cranes
  - Load Chart Standards and balancer need to be complied for crane stability
  - Base and site
  - Cranes fasteners are safe for use and safety steps from manufacturer must be complied with
  - Wind and weather controls should be adhered to in accordance with established standards
- Safety limiting indicator
  - Stop the crane movement if the crane movement exceeds the specified limit
  - Dependency of the tool
  - Freight limitation
  - Movement limiter tool
  - The allowed working radius
  - Dual braking system

# The cause of the accidents

- Accidents involving tower cranes are largely due to mechanical, electrical, crane structure, operator / rigger / signalman problems and so on.



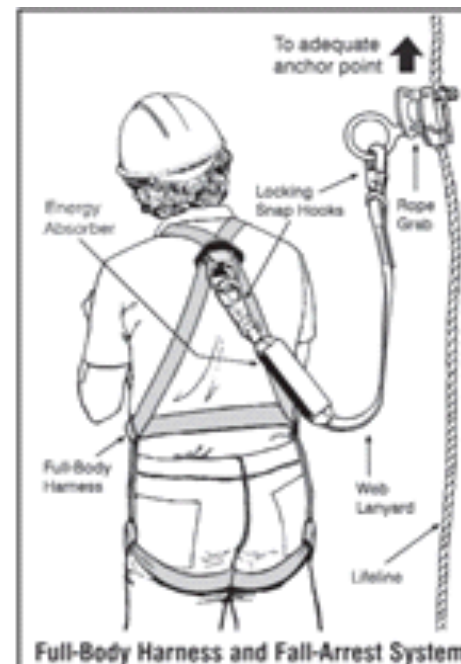
(a)



(b)

# Working at high altitude

- The higher the workplace, the higher the risk can be.
- Federal DOSH and government regulations on security of falling have outlined better and safer guidance for employee protection against falling as set out in the "Guidelines for the Prevention of Falls at Workplaces" set by the JKKP.



# Working at high altitude

Before working at a certain height, you must go through the following steps:

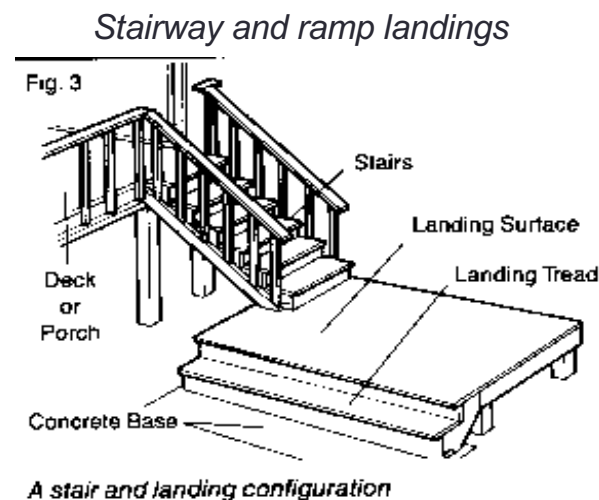
- Avoid working at altitude if there is another way to do so
- If working at altitude (inevitably), avoid falling by using / wearing proper protective equipment
- Reduce the distance and falling events by using proper equipment when the risk is inevitable.
- Ensure the protection equipment used is appropriate, stable and strong enough to work, maintain and check regularly
- Make sure you do not exceed the load or act recklessly when working in high places
- Take precaution when working on or near a brittle surface
- Protect the object from falling
- Consider emergency evacuation and rescue procedures in the event of a fall.

# Access and fixed platform

- All entry and stairs must have a minimum head release of 2.1 metres vertical of the steps
- The door should not open directly to the stairs or the road. A landing or platform level is required.
- For open stairs and ramped steps, the minimum width is 685 mm.
- When enclosed between walls, etc., the minimum width is raised to 815 mm, and the minimum width is 1 metre.
- The barrier should be installed for all exposed edges.



*Handrails, guardrails and toeboards*



*Stairways*



# Access and non-fixed platform

- All types of stairs (ladder, trestles, stairwells, etc.) and work platforms shall comply with the relevant Malaysian Standard or other accepted International Standards.
- For those that do not have the Standard sign, it is used for light work only and is not suitable for use at work.



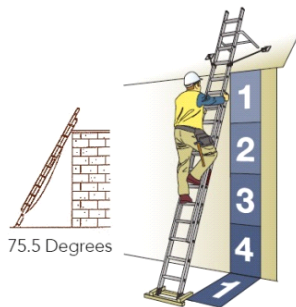
Perimeter perlindungan



*Cantilevered temporary work platforms*

## 4-to-1 Rule

Make sure you can set up your ladder at the required angle, using the 4-to-1 Rule: For every 4 feet (1.2 metres) up, place the base of your ladder 1 foot (0.3 metres) from the wall or upper support that it rests against.

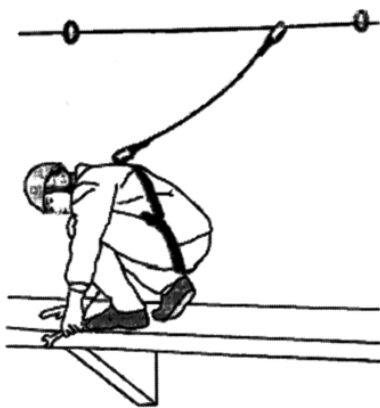


*Single and extension ladders*

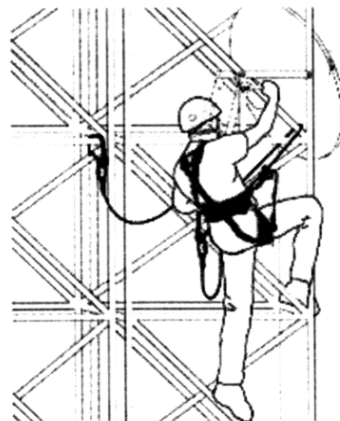
# Safety bands, belts and harnesses

The main points to note are:

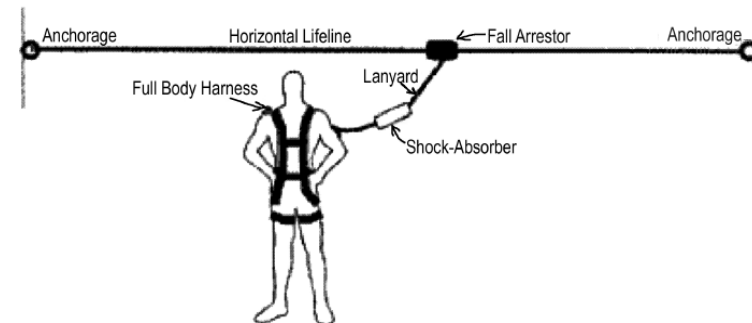
1. Assessment of work methods should be carried out to select the most suitable method of work and catching device.
2. All equipment should always be inspected and tested to ensure that it complies with MS Standard or other acceptable International Standards.
3. Equipment should be given detailed visual inspection by a trained person whenever it is used.
4. Always ensure that the equipment used is consistent with manufacturer's instructions.
5. Binding of static straps, anchored straps and restrictions are skilled operations that need to be run by trained people.
6. Person who uses the equipment must be trained or supervised to ensure that the belts or harnesses are mounted and properly aligned with anchored rope.
7. When a person is wearing a safety rope moving around, the rope can move across the working area and stuck around the barrier. This can cause the rope to jerk or jam, and become unbalanced. These ropes can also be stuck on objects such as roof tile or loose bolts, causing them to fall and other hazard events.
8. For work operations such as gas cuffing, grit blasting, or usage of sharp cuffing tools, precautions should be taken to prevent wear and damage to the equipment. Protective devices such as short steel lanyards wires, protective covers around straps, or other measures.



*Travel-restriction systems*



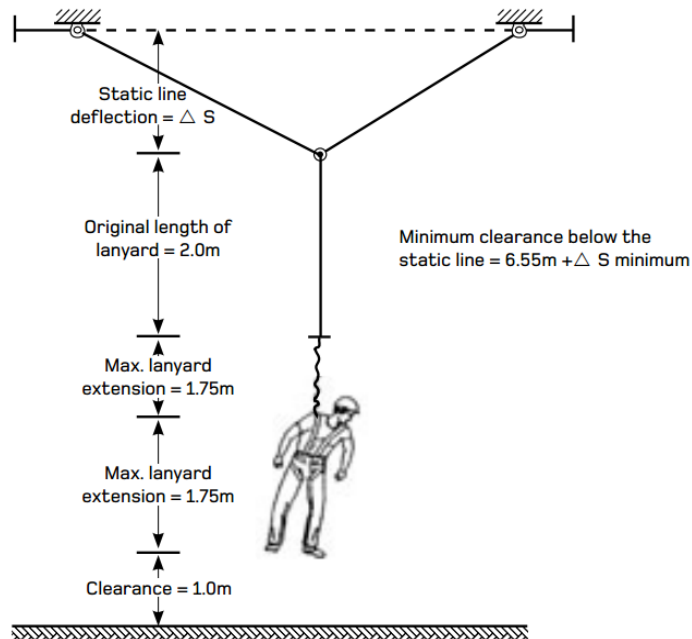
*Work-positioning systems*



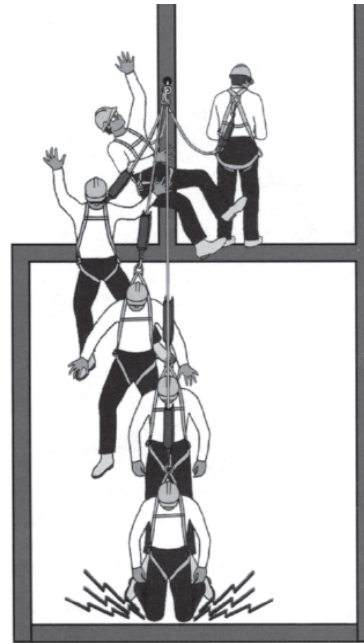
*Static line and anchorage techniques*



# Example of a poorly placed anchor point



*Bottoming out*



*Swing fall orpendulum*

