

# Chapter 3

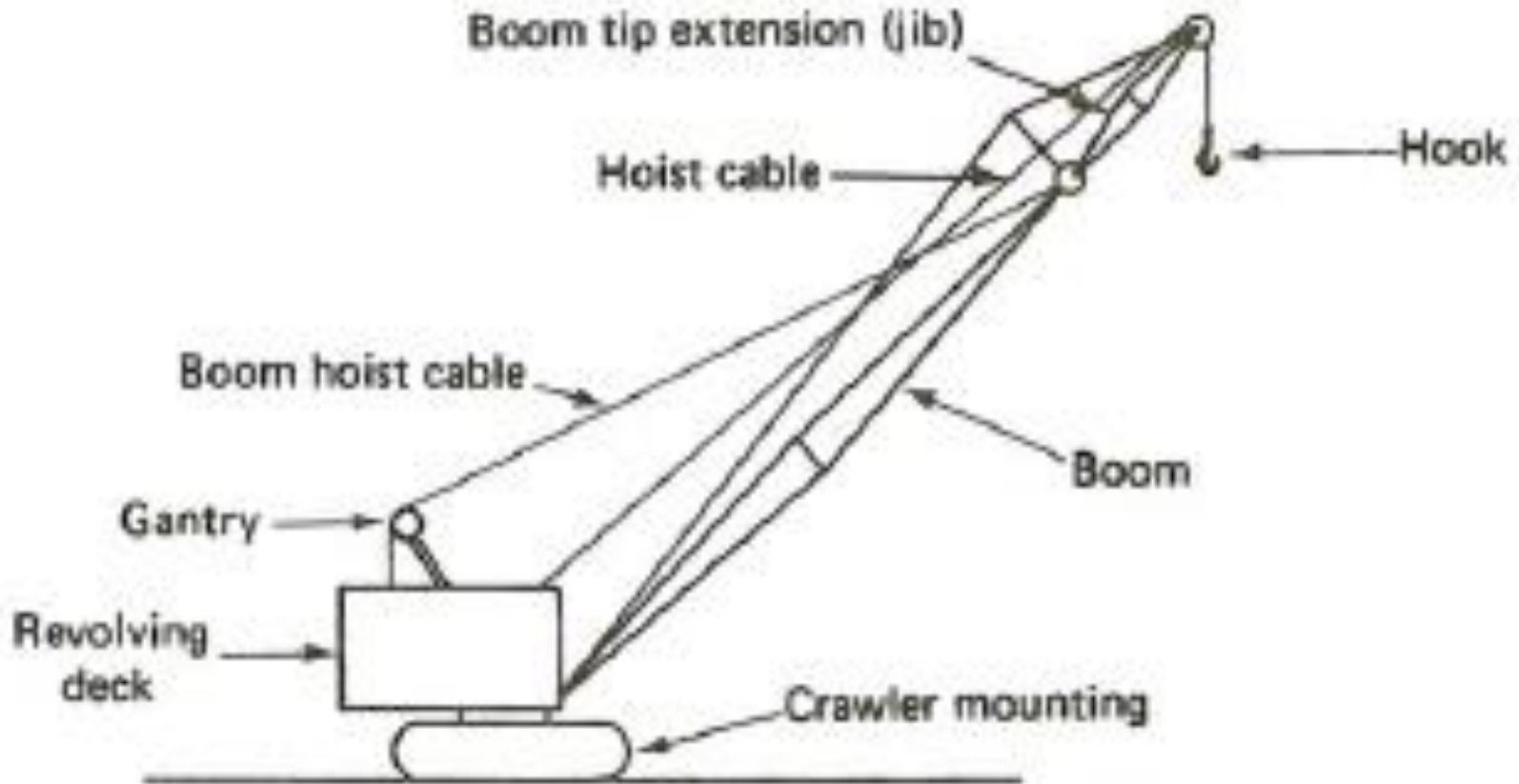
## **Excavating and Lifting**

### *Part 3*

# 3-7 CRANES

- **Heavy Lift Cranes**
- **Tower Cranes**
- **Job Management**

# FIGURE 3-22: Components of a crane

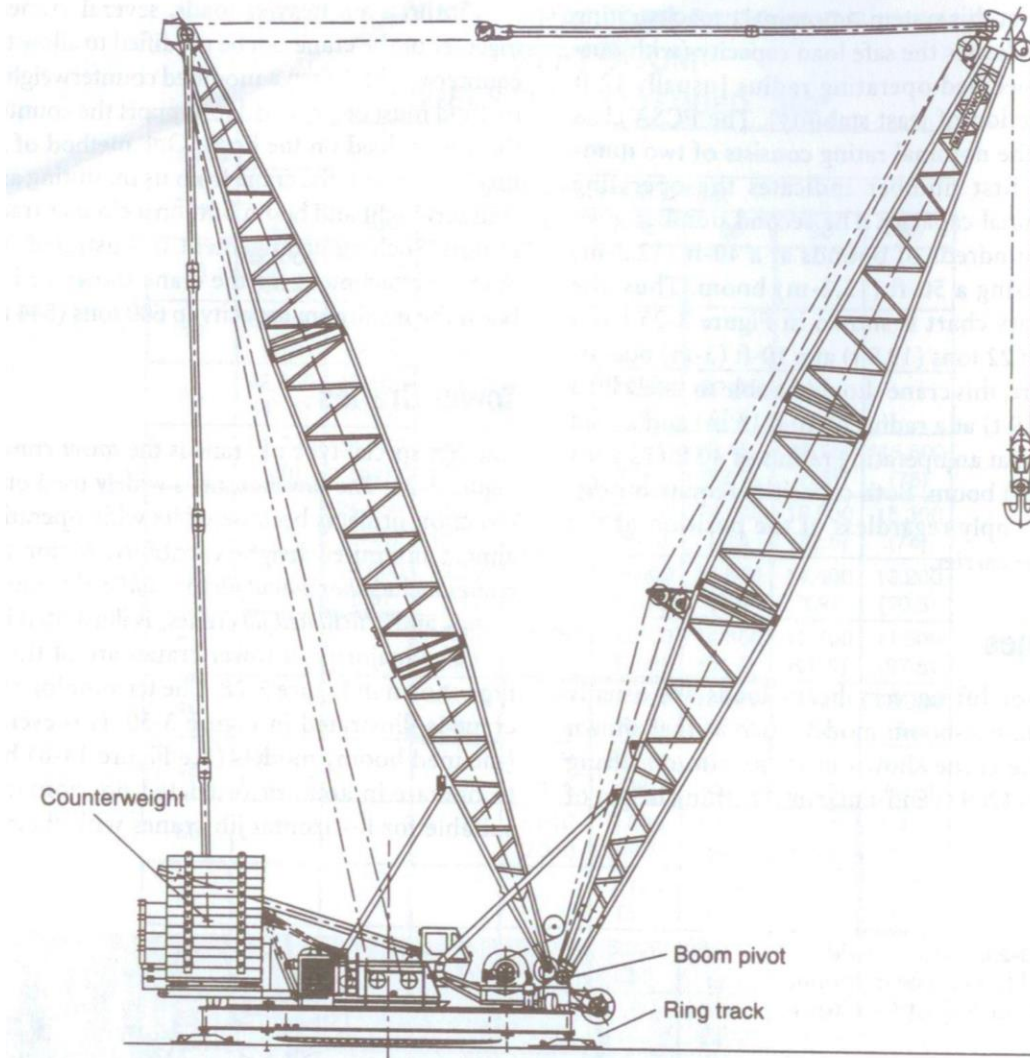


- *Cranes* are primarily used for:
  - lifting,
  - lowering, and
  - transporting loads (horizontal movement).
- They move loads horizontally by swinging or traveling.
- Most mobile cranes consist of a carrier and superstructure equipped with a boom and hook.

- The current trend toward the use of hydraulically operated equipment includes hydraulically powered telescoping boom cranes.
- The mobile telescoping boom crane is capable of lifting loads to the top of a 24-story building.



**Figure 3-27. Crane with ring attachment.**  
(Courtesy of Maintowoc)



# Tower Cranes

- The tower crane is widely used on building construction projects because of:
  - wide operating radius
  - almost unlimited height capability





# Tower Cranes

- Major types of tower cranes include:
  - *horizontal jib* (or *saddle jib*) cranes,
  - *luffing boom* cranes, and
  - *articulated jib* cranes



Horizontal jib



Luffing boom



Articulated jib

- **Comparison between the 3 types:**
  - luffing boom (inclined boom) models have the ability to **operate in areas of restricted horizontal clearance** not suitable for horizontal jib cranes with their fixed jibs and counterweights.
  - Articulated jib cranes are able to reposition their hinged jibs to convert excess hook reach into added hook height.

- Types of tower crane by method of mounting include:
  - static (fixed mount) tower cranes,
  - rail-mounted tower cranes,
  - mobile tower cranes and
  - climbing cranes.

Rail-mounted tower cranes



Static tower cranes

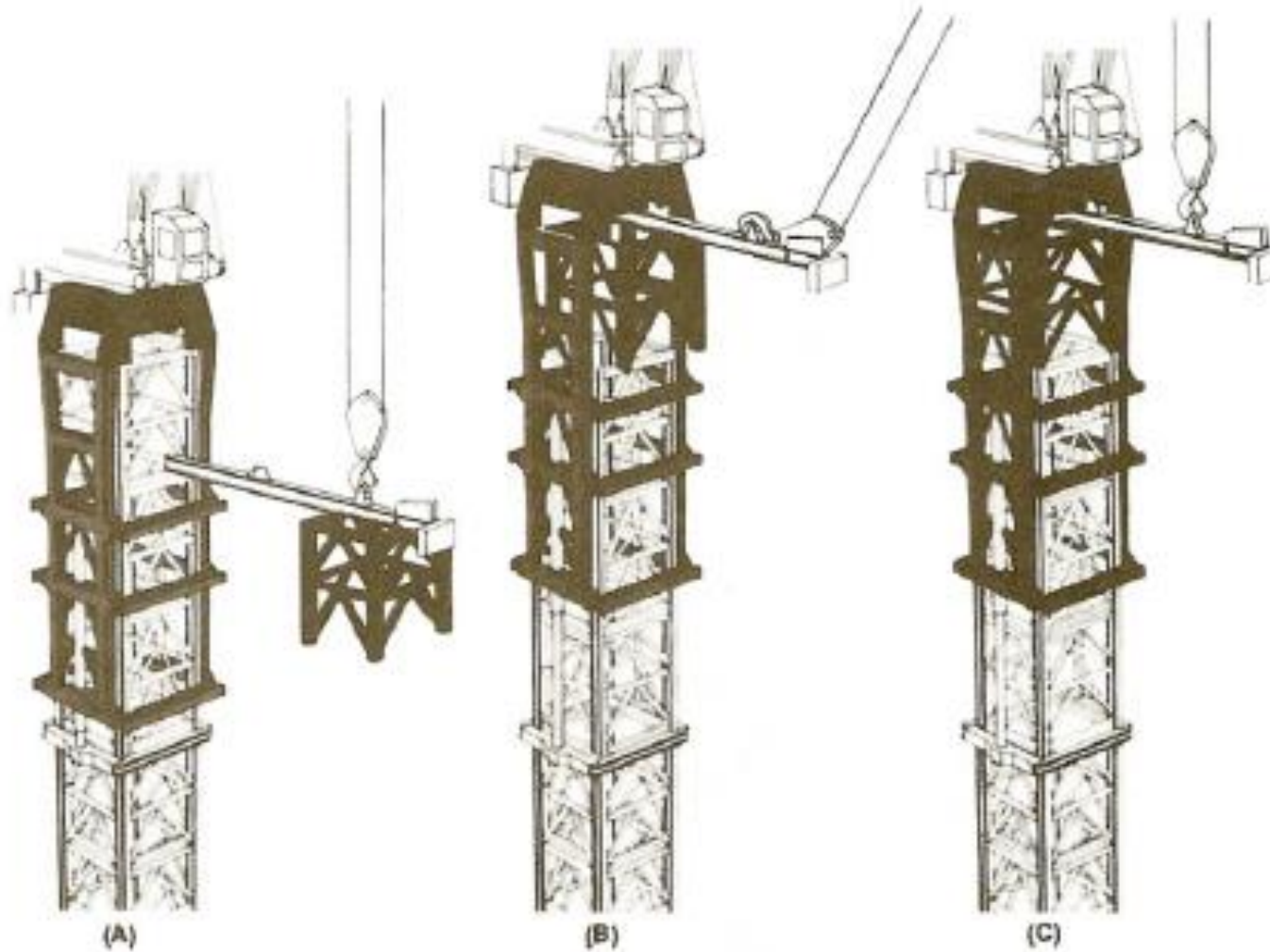


# Mobile tower cranes



- Climbing cranes:
  - are supported by completed building floors and are capable of raising themselves from floor to floor as the building is erected.
  - Most tower cranes incorporate self-raising masts.

**FIGURE 3-30: Self-raising tower crane mast.**  
(Courtesy of FMC Construction Equipment Group)



- The major factor controlling the load that may be safely lifted by a crane is:
  1. *Operating radius* (horizontal distance from the center of rotation to the hook).
- Some other factors:
  2. Position of the boom in relation to the carrier,
  3. Whether or not *outriggers* (beams that widen the effective base of a crane) are used
  4. Amount of counterweight
  5. Condition of the supporting surface



# *Outriggers*



- Safety regulations:
  - limit maximum crane load to a percentage of the *tipping load* (load that will cause the crane to actually begin to tip).
  - Notice that hook blocks, slings, spreader bars, and other load-handling devices are considered part of the load and their weight must be included in the maximum safe load.

- A standard method of rating the capacity of mobile cranes:
  - has been adopted by the PCSA Bureau of the Construction Industry Manufacturers Association (CIMA).
  - Under this system, a nominal capacity rating is assigned which indicates the safe load capacity (with outriggers set) for a specified operating radius
    - usually 12 ft (3.6 m) in the direction of least stability.

**Table 3-10** Maximum capacity vs. lift radius for a tower crane  
[pounds (kilograms)]

<b>Lift Radius ft (m)</b>	<b>Boom Length (maximum hook radius)—ft (m)</b>					
	<b>260 (79.2)</b>	<b>230 (70.1)</b>	<b>200 (61.0)</b>	<b>170 (51.8)</b>	<b>140 (42.7)</b>	<b>110 (33.5)</b>
110 (33.5)	21564 (9781)	23607 (10708)	28458 (12908)	34857 (15811)	39680 (18000)	39680 (18000)
120 (36.6)	19584 (8883)	21465 (9737)	25938 (11765)	31842 (14444)	38097 (17281)	
130 (39.6)	17802 (8075)	19548 (8867)	23652 (10729)	29124 (13211)	34920 (15840)	
140 (42.7)	16380 (7430)	18018 (8173)	21861 (9916)	26982 (12239)		
150 (45.7)	15057 (6830)	16596 (7528)	20196 (9161)	24984 (11333)		
160 (48.8)	13699 (6214)	15143 (6869)	18534 (8407)	24705 (11206)		
170 (51.8)	12654 (5740)	14012 (6356)	17214 (7808)	23037 (10450)		
180 (54.9)	11818 (5361)	13119 (5951)	16160 (7330)			
190 (57.9)	10468 (4748)	11666 (5292)	14450 (6555)			
200 (61.0)	9700 (4400)	10811 (4904)	12440 (5643)			
210 (64.0)	9092 (4124)	10156 (4607)				
220 (67.1)	8208 (3723)	9215 (4180)				
260 (79.2)	7334 (3327)					

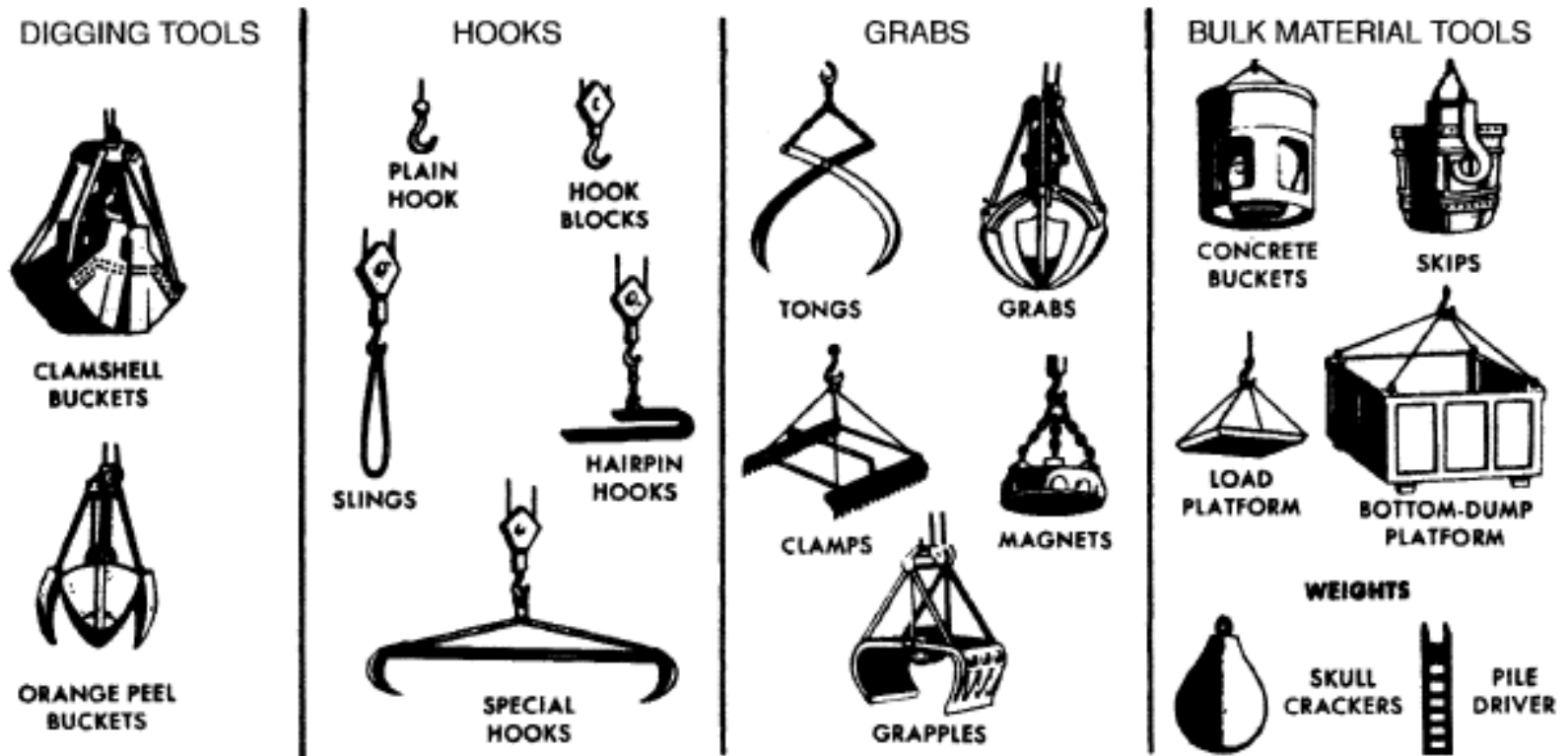
Minimum lift radius = 12.0 ft (3.6 m)

## **Job Management**

- A number of attachments besides the basic hook available to assist the crane in performing construction tasks.
- Several of these attachments are illustrated in Figure 3-31.

**FIGURE 3-31:** FIGURE 3-28 Lifting attachments for the crane. [Permission to reproduce this material has been granted by the Power Crane & Shovel Assn.]

Among these attachments, concrete buckets, slings, and special hooks are most often used in construction applications.



High-voltage lines present a major safety hazard to crane operations.

- U.S. Occupational Safety and Health Act (OSHA) regulations prohibit a crane or its load from approaching closer than 10 ft (3 m) to a high-voltage line carrying 50 kV or less.
  - An additional 0.4 in. (1 cm) must be added for each kilovolt over 50 kV.
- These safety clearances must be maintained:
  - unless the line is deenergized and visibly grounded at the work site, or
  - unless insulating barriers not attached to the crane are erected which physically prevent contact with the power line.

- Crane accidents occur all too frequently in construction work particularly when lifting near-capacity loads and when operating with long booms.

<https://twitter.com/itsnotgonewell/status/1177358249135394816?s=12> Forklift accident

<http://www.youtube.com/watch?v=sRHwyKiSSqk> in Egypt

<http://www.youtube.com/watch?v=N8m3-ITXKjg> crane crash

<http://www.youtube.com/watch?v=LWlj5nEqRCE> very bad accident

[https://www.linkedin.com/posts/mrpreventive\\_activity-6601911290443247616-1TtV](https://www.linkedin.com/posts/mrpreventive_activity-6601911290443247616-1TtV) crane crash



- Some suggestions for safe crane operations include the following:
  1. Carefully set of outriggers on firm supports.
  2. The crane base must be level. Safe crane capacity is reduced as much as 50% when the crane is out of level by only 3° and operating with a long boom at minimum radius.

3. Use a communications system or hand signals when the crane operator cannot see the load at all times. Make sure that all workers involved in the operation know the hand signals to be used.
4. Provide *tag lines* (restraining lines) when there is any danger due to swinging loads.
5. Ensure that crane operators are well trained and know the capability of their machines.
6. Check safe-lifting-capacity charts for the entire range of planned swing before starting a lift. Use a load indicator if possible.