

**ADDIS ABABA UNIVERSITY
ADDIS ABABA INSTITUTE OF TECHNOLOGY**

**SCHOOL OF CIVIL AND ENVIRONMENTAL
ENGINEERING**

CENG 5213: CONSTRUCTION EQUIPMENT

CHAPTER-1

**CONSTRUCTION EQUIPMENT AND PLANTS
INTRODUCTION TO CONSTRUCTION EQUIPMENTS**

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- *Introduction*

 - *General*

 - *Classification of Equipments*

- *Earth Work*

 - *Excavation, soil characteristics*

- *Crane Shovel Family*

 - *Face Shovel, Drag Line, Clam shells, Hoes*

- *Heavy Earth moving Equipments*

 - *Excavators, Loaders, Dozers, Scrapers*

- *Grading Equipment*

 - *Graders*

- *Compaction Equipment*

- *Hauling Equipment*



Animation Factory
MEMBERS ONLY



CONSTRUCTION EQUIPMENTS

1. Introduction

- ❑ Today contractors undertake many types of construction activities that require different *types*, *sizes*, and *groupings* of equipment for *earth moving*, *excavating*, and *lifting*.
- ❑ There is a piece of equipment for practically any work activity, large or small.
- ❑ *Materials*, *Money*, *Manpower* and *Machineries* (the *4 M's*) are usual resources recognized in most situations.
- ❑ The dependency and need for heavy construction equipment have grown with the size and complexity of construction projects.
- ❑ The development of automated heavy construction equipment for earthmoving, excavating, and lifting occurred in the last two centuries.

CONSTRUCTION EQUIPMENTS

1. Introduction

Types of Construction	Level of Use	Work Activities
Residential	Light	Finish site work, foundation excavation, ground material moving, up to three-story lifting, pneumatic assembly tools
Commercial	Moderate	Rough and finish site work, stabilizing and compacting, multiple story material and man lifting, ground and on-structure material moving, miscellaneous types of assembly and support equipment
Industrial	Heavy	Large volume rough and finish site work, stabilizing and compacting, ground and on-structure material moving, multiple story heavy lifting and precision placing, numerous miscellaneous special types of equipment for assembly and support
Highway	Intense	Mass dirt and material excavating and moving, stabilizing and compacting, ground material moving and hoisting, concrete and asphalt paving and finishing, miscellaneous special types of equipment for support
Specialty	Intense	Pipeline, power, transmission line, steel erection, railroad, offshore, pile driving, logging, concrete pumping, boring and sawing, many others

Level of equipment use by type of construction

CONSTRUCTION EQUIPMENTS

1. Introduction

- The *efficient* and *effective* implementation of construction projects requires good management of relationships for and among *resources*, *activities* and *stakeholders* as applied to the context where such projects are implemented.
- Equipment types used in a construction project is largely dependent on their :
 - Direct input to unit prices or not
 - Type of work or trades
 - Scope of work
 - Mobility
 - System of control and
 - Availability

CONSTRUCTION EQUIPMENTS

1. Introduction

Classification of Construction Equipments

- Generally equipment types can be classified into *Productive* and *Support equipments*.
 - I. *Productive equipments* are those units that alone or in combination lead to an end product which can be recognized as a unit for payment;
 - Include pavers, haulers, loaders, rollers etc.
 - II. *Support equipments* are those equipments which are required for operations related to the placement of construction such as movement of personnel and materials, and activities that influence the placement of environment.
 - Include represented hoists, lighting sets, vibrators, scaffolds as typical support equipments

CONSTRUCTION EQUIPMENTS

1. Introduction

Classification of Construction Equipments

- Another way of classifying construction equipments can also be based on whether the construction is a *heavy* or *light* construction works or services.
 - I. Heavy*: Road and Hydro Power works, Large Irrigation schemes, Water Supply and Sewage plants and High Rise buildings and often called *equipment intensive*.
 - II. Light*: Low rise buildings, water supply and sewerage lines, electric and telecommunication lines and small irrigation schemes and called *labor intensive* services.

CONSTRUCTION EQUIPMENTS

1. Introduction

Classification of Construction Equipments

□ For the purpose of this course two major classifications of equipments largely based on the *type of works* involved are covered.

I. Construction Equipments

- ***Earth works equipments:*** Bulldozers, Shovels, Clamshells and Draglines, Loaders, Graders, Scrappers, Rollers, Drills, Grouting pumps, Pile driving and Hammers.
- ***Hauling and Hoisting equipments:*** Tractors, Normal and Dump trucks, Scrapers, Hoists, Conveyors and Cranes.
- ***Compaction and stabilization equipments-*** Compactors
- ***Foundation Equipments*** - Pile Driving Equipments
- ***Pumping Equipments*** - Pumps, Hoses, Pipes, and Compressors.
- ***Concreting equipment:*** Mixers, Vibrators
- ***Tunnelling equipment***
- ***Drilling and blasting equipment***

CONSTRUCTION EQUIPMENTS

1. Introduction

Classification of Construction Equipments

II. Construction Plants

- Aggregate production plants,
 - Crushers, Screens, Conveyors, and Feeders.
- Asphalt mixing plant and
 - Aggregate Batchers, Bitumen Emulsifier, and Mixers.
- Concrete Batching Plants and
 - Feeders, Mixers and Silos.



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

- ❑ Earth work includes:
 - Site preparation, excavation, loading, hauling
 - Embankment construction,
 - Backfilling, dredging,
 - Preparing base course,
 - Sub-base and sub-grade,
 - Compaction, road surfacing
- ❑ All the above works involve the use of a large number of highly efficient and versatile equipment.
- ❑ The proper selection of these equipment and the length of time they will have to be used are an essential part of the estimator's work.

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

- ❑ Earth work equipments are broadly classified into *earth moving, compaction, grading* and *hauling equipments*.

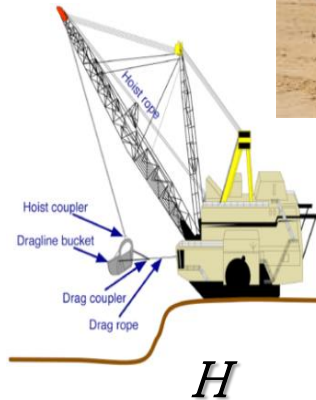
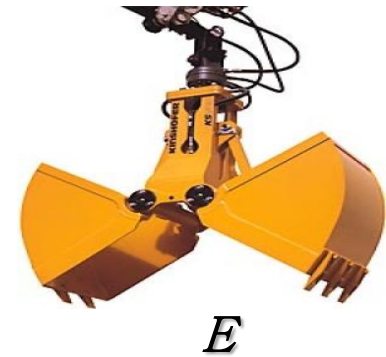
Earth Work

- ❑ ***Definition***:- Earth work is a process of moving soil or rock from one location to the other and processing it, so that it meets construction requirements of location, elevation, density, moisture content, etc.
- ❑ All the above works involve the use of a large number of highly efficient and versatile equipment.
- ❑ The ***proper selection*** of these equipment and the ***length of time*** they will have to be used are an essential part of the estimator's work.

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

- ❑ Excavators
- ❑ Loaders
- ❑ Shovels
- ❑ Clamshells
- ❑ Draglines
- ❑ Scrapers
- ❑ Dumpers
- ❑ Dozers
- ❑ Graders
- ❑ Rollers



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Kinds of Work	Equipments
Clearing	Bulldozer, Rakedozer, Backhoe, Chipper
Excavating	Shovel (Backhoe, Dragline, Clamshell) Bulldozer, Ripper, Rock breaker
Loading	Wheel Loader, Track Loader Loading shovel (Front shovel)
Excavating / Loading	Power shovel (Backhoe, Dragline, Clamshell)
Excavating / Hauling	BWE (Bucket Wheel Excavator) Bulldozer, Scrapedozer, Scraper
Hauling	Dump truck (Rigid, Articulated), Wagon, Conveyer Crawler dump
Spreading / Grading	Bulldozer, Wheel dozer, Motor grader
Compacting.	Tire roller, Steel roller, Vibration roller, Tamping roller, Vibration compactor, Tamper, Bulldozer
Trenching	Trencher, Backhoe
Maintaining macadam road	Motor grader
Slant finishing	Backhoe, Motor grader
Rock Braking	Drill, Breaker, Splitter

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Excavation Types

- ❑ ***Common Excavation***: refers to ordinary earth excavation.
- ❑ ***Rock Excavation***: rock excavation cannot be done by ordinary earth handling equipment.
 - Rock materials must be removed by drilling and blasting or by some other methods.
 - This normally results in a considerably greater expense than earth excavation.
- ❑ ***Muck Excavation***: includes materials that will decay or produce subsidence in embankments.
 - It is usually a soft organic material having a high water content.

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

EXCAVATION

❑ *Muck Excavation:*

- Typically, it would include such things as decaying stumps, roots, logs, and humus.
- These materials are hard to handle and can present special construction problems both at their point of excavation, and in transportation and disposal.

❑ *Unclassified Excavation:* refers to the materials that cannot be defined as soil or rock.

- The removal of common excavation will not require the use of explosives, although tractors equipped with rippers may be used to loosen consolidated formations.

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

General Soil Characteristics

- ❑ As earth moving equipments are mostly related to works related to soil, important aspects of soil shall be reviewed.
- ❑ From the characteristics of soils ***trafficability***, ***loadability*** and ***volume change*** are vital for earth works. Accordingly,
 - ***Trafficability*** - property that shows the ability of soil to support repeated traffic loading
 - ***Loadability*** - property that tells the ease or difficulty of excavating and loading
 - ***Soil Volume Change*** - property that is related with volumes of soil samples on different stress or compaction levels.

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

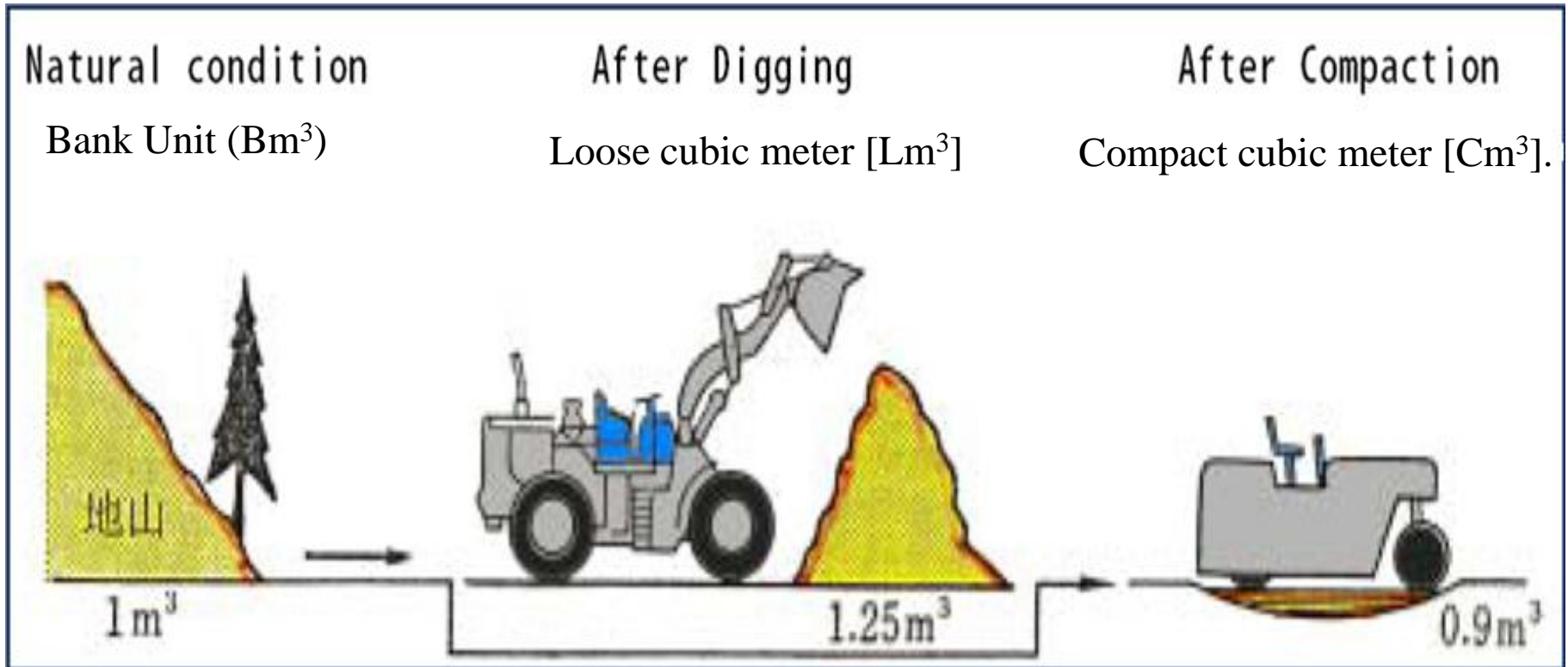
Soil Volume Change Characteristics

- ❑ There are three principal conditions or states in which soil may exist: **bank**, **loose**, and **compacted**. The meanings of these terms are as follows:
 - **Bank State** - This is the state when the material is in its natural state i.e. before disturbance. Often referred to as “in – place” or “in situ.”
 - Unit - Bank cubic meter [Bm³]
 - **Loose State** - This is the state after the material is excavated or disturbed.
 - Unit - Loose cubic meter [Lm³]
 - **Compacted State** - This is the state after the material is compacted.
 - Unit- Compact cubic meter [Cm³].

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Soil Volume Change Characteristics



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Soil Volume Change Characteristics

Relationship between the three states

Swell: - an increase in volume of soil due to excavation

$$\begin{aligned}\text{Swell (\%)} &= \frac{\text{Loose Volume} - \text{Bank Volume}}{\text{Bank Volume}} \times 100 \\ &= \frac{V_L - V_B}{V_B} \times 100 = [V_L/V_B - 1] \times 100\end{aligned}$$

Since,

$$\gamma = W/V \implies \gamma_L = W/V_L \text{ and } \gamma_B = W/V_B$$

$$\text{Swell (\%)} = [V_L/V_B - 1] \times 100$$

$$\begin{aligned}&= \frac{[W/\gamma_L - 1] \times 100}{W/\gamma_B} = [\gamma_B/\gamma_L - 1] \times 100\end{aligned}$$

Shrinkage: - this is a decrease in volume of soil due to compaction

$$\text{Shrinkage (\%)} = \frac{\text{Bank Volume} - \text{Compacted Volume}}{\text{Bank Volume}} \times 100$$

$$= \frac{V_B - V_C}{V_B} \times 100 = [1 - V_C/V_B] \times 100$$

$$= [1 - \gamma_B/\gamma_C] \times 100$$

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Soil Volume Change Characteristics

❑ Load and Shrinkage Factors:

- In performing earthmoving calculations, it is important to convert all material volumes' to common unit of measure.
- Bank cubic meter is most commonly used
- Pay load is the volume unit specified as the basis for payment in an earth moving contract.

Load factor: - is the ratio of bank volume to loose volume.

$$f_L \text{ (load factor)} = V_B / V_L$$

$$f_L = \frac{1}{1 + \text{swell}}$$

Shrinkage factor: - is the ratio of compacted volume to bank volume.

$$f_s \text{ (shrinkage factor)} = V_C / V_B$$

$$f_s = [1 - \text{shrinkage}]$$

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

Soil Volume Change Characteristics

- Swell values for different class of earth

Material	Bank weight		Loose weight		Percent swell	Swell factor
	lb/cu yd	kg/m ³	lb/cu yd	kg/m ³		
Clay, dry	2,700	1,600	2,000	1,185	35	0.74
Clay, wet	3,000	1,780	2,200	1,305	35	0.74
Earth, dry	2,800	1,660	2,240	1,325	25	0.80
Earth, wet	3,200	1,895	2,580	1,528	25	0.80
Earth and gravel	3,200	1,895	2,600	1,575	20	0.83
Gravel, dry	2,800	1,660	2,490	1,475	12	0.89
Gravel, wet	3,400	2,020	2,980	1,765	14	0.88
Limestone	4,400	2,610	2,750	1,630	60	0.63
Rock, well blasted	4,200	2,490	2,640	1,565	60	0.63
Sand, dry	2,600	1,542	2,260	1,340	15	0.87
Sand, wet	2,700	1,600	2,360	1,400	15	0.87
Shale	3,500	2,075	2,480	1,470	40	0.71

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

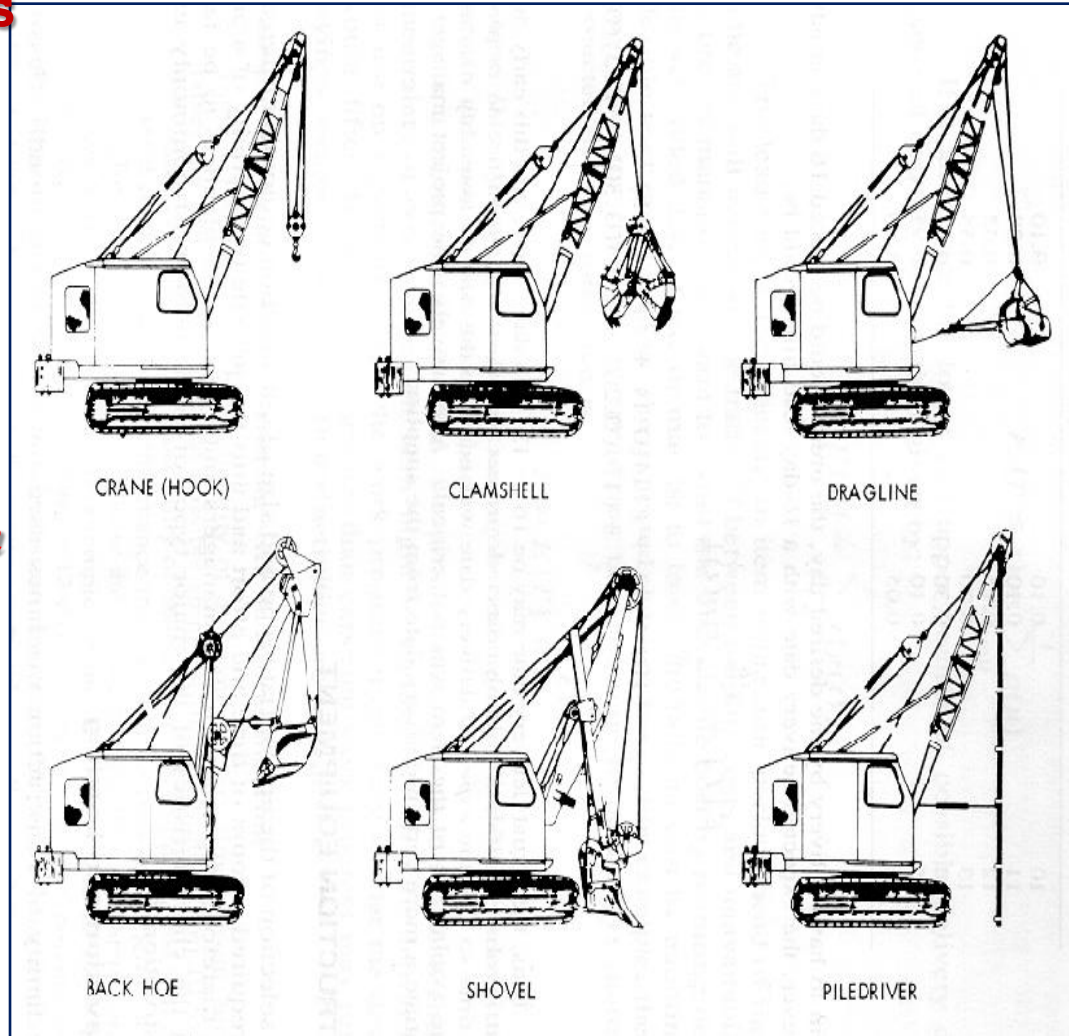
□ Common Features

▪ *Mounting*

- Crawlers/Tracks
- Wheels
- Tracks

▪ *Superstructure or control room*

▪ *Front end attachment*



CONSTRUCTION EQUIPMENTS



2. Earth Work Equipments

2.1 Crane Shovel Family

A. Face Shovel

- ❑ Face shovel is equipment used mainly in quarries, pits and on construction sites to excavate and load blasted rock.
- ❑ These equipments are more effective for excavations above the *wheel or grade level*.
- ❑ The basic parts of a power shovel include the mounting, cab, boom, dipper stick, dipper (bucket), and hoist line.
- ❑ *Optimum depth of cut*: is that depth which produces the greatest output and at which the dipper comes up with full load without undue crowding.
 - The depth varies with the class of soil and the size of the dipper.
- ❑ It may cost about 10 Million ETB

CONSTRUCTION EQUIPMENTS

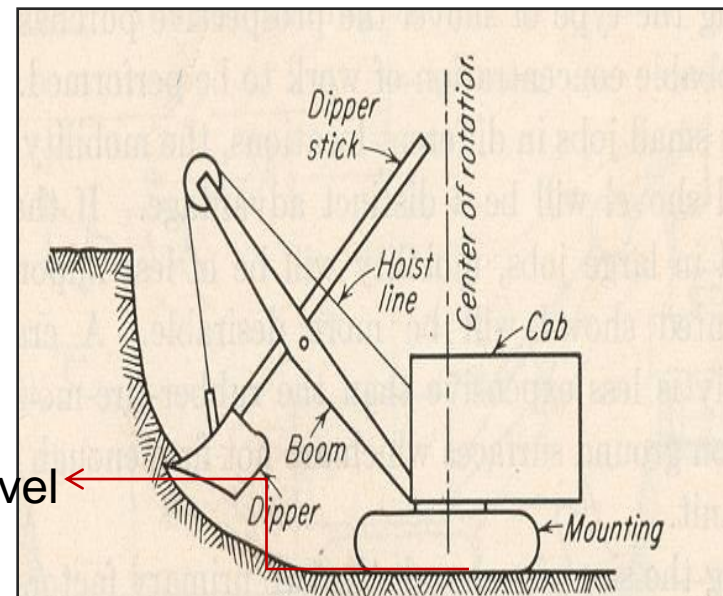
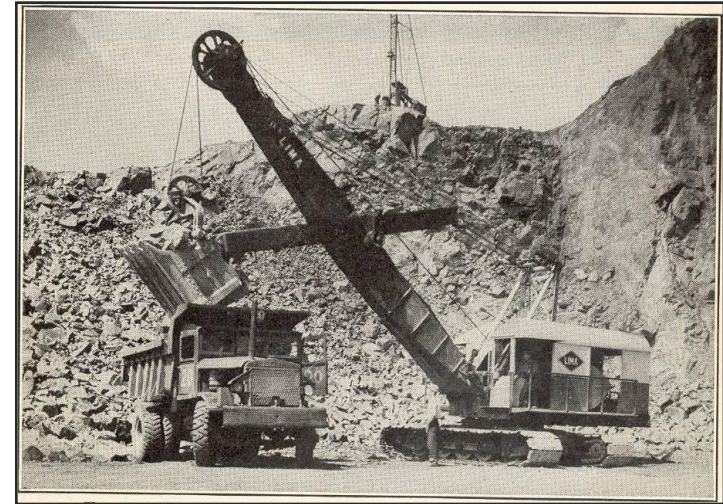
2. Earth Work Equipments

2.1 Crane Shovel Family

A. Face Shovel

- The output of a shovel is affected by numerous factors, including the following:
 - Class of material,
 - depth of cut,
 - angle of swing,
 - job conditions,
 - management conditions,
 - size of hauling units,
 - skill of operator and
 - physical condition of the shovel.

Wheel Grade Level ←



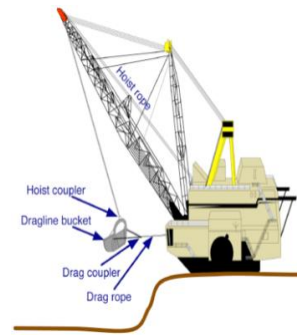
CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line

- ❑ Draglines are used to excavate earth and load it into hauling units, such as trucks or tractors-pulled wagons, or deposit it into levees, dams and spoil banks near the pits from which it was excavated.
- ❑ These equipments are more efficient for excavation below the grade level and have the longest reach of all shovel equipments.
- ❑ A dragline can be used for dragging out sediments and is efficient for under water construction.
- ❑ These equipments are weak while excavating hard materials and have a lesser productivity than a face shovels.



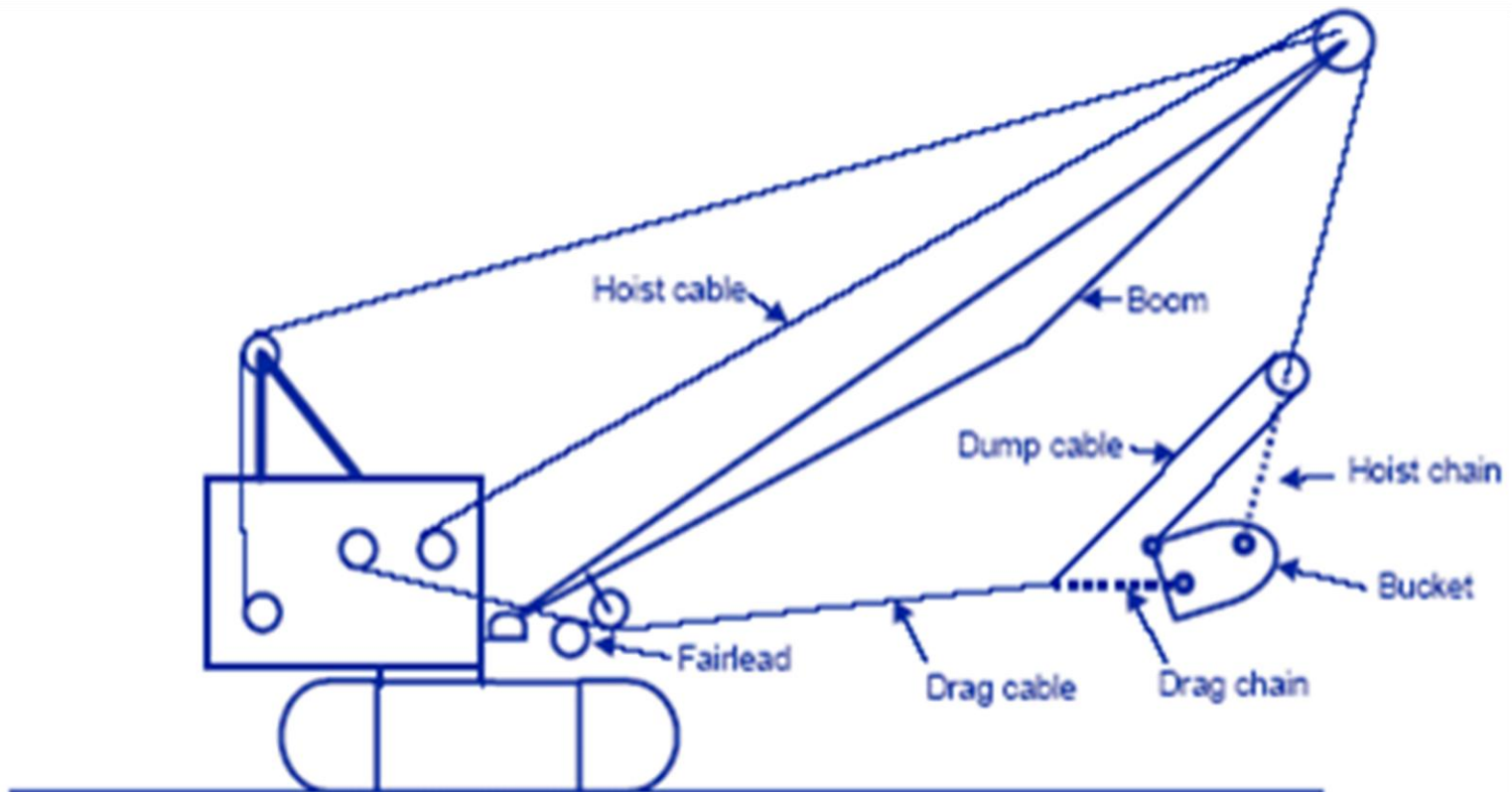
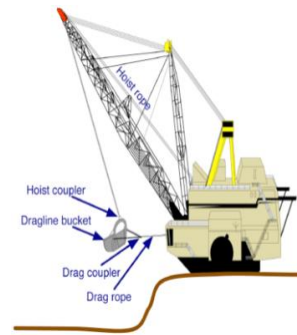
CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line

- Basic Components of a drag line

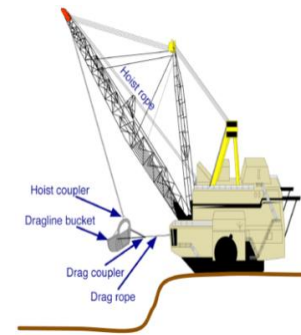


CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line



- ❑ ***Types of Drag Lines***: Drag lines may be divided into three types:
 - Crawler-mounted
 - Wheel-mounted, self-propelled
 - Truck-mounted
- ❑ ***Crawler-mounted draglines*** can operate over soft ground conditions that would not support wheel -or truck- mounted equipment.
 - The travel speed of a crawler machine is very slow, frequently less than 1 mph,
 - It is necessary to use auxiliary, hauling equipment to transport the unit from one job to another.
- ❑ ***Wheel-and track-mounted*** units may have travel speeds in excess of 30 mph.

CONSTRUCTION EQUIPMENTS

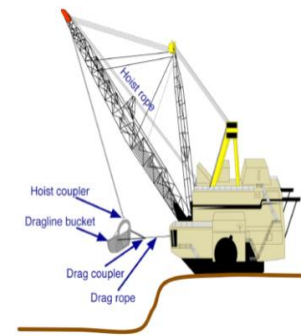
2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line

Size of a Drag Line

- ❑ The size of a dragline is indicated by the size of the bucket, expressed in cubic meter (cu m).
- ❑ Most draglines may handle more than one size bucket, depending on the length of the boom utilized and the class and weight of the material excavated.
- ❑ Since the maximum lifting capacity of a dragline is limited by the force which will tilt the machine over, it is necessary to reduce the size of the bucket when a long boom is used or when the excavated material has a high unit weight.
- ❑ In practice, the combined weight of the bucket and its load should not be greater than 75% of the force required to tilt the machine.



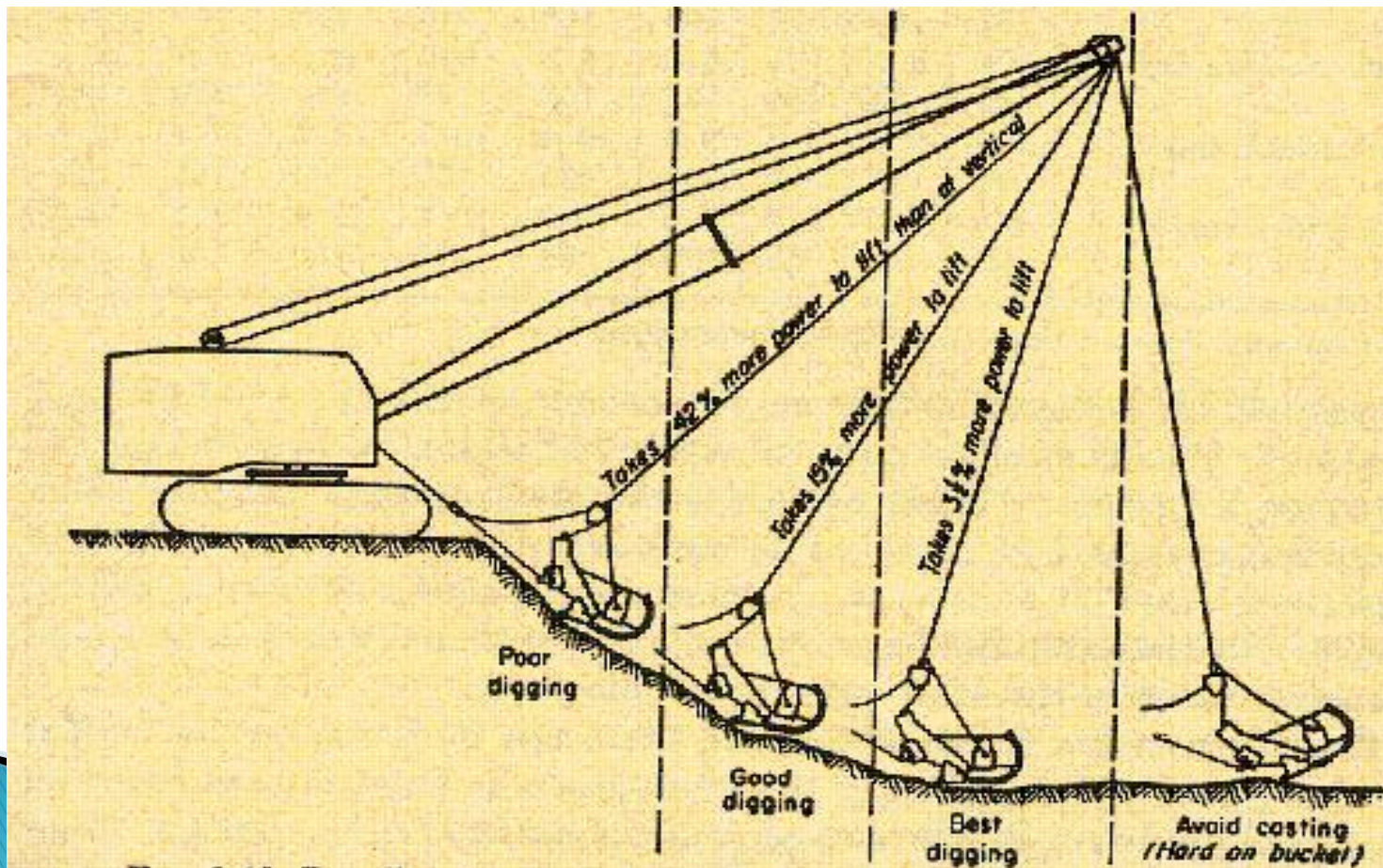
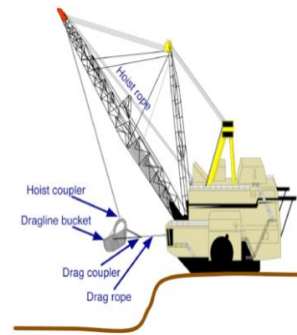
CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line

Operation of a Drag Line



CONSTRUCTION EQUIPMENTS

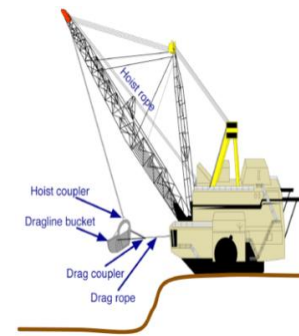
2. Earth Work Equipments

2.1 Crane Shovel Family

B. Drag Line

Output of drag lines

- The output of drag lines will vary with the following factors
 - Class of material
 - Depth of cut
 - Angle of swing
 - Size and type of bucket
 - Length of boom
 - Method of disposal, casting, or loading
 - Size of the hauling units, when used
 - Skill of the operator
 - Physical condition of the machine
 - Job conditions



CONSTRUCTION EQUIPMENTS



2. Earth Work Equipments

2.1 Crane Shovel Family

C. Clamshells

- ❑ Clamshells are used primarily for *handling loose materials* such as sand, gravel, crushed stone, coal, etc. and for removing materials from inside cofferdams, pier foundations, sewer manholes, sheet-lined trenches, etc.
- ❑ They are specially suited to *vertically lifting materials* from one location to another, as in charging hoppers and overhead bins.
- ❑ The limits of vertical movements may be relatively large when they are used with long crane booms.
- ❑ Clamshell buckets are available in various sizes, and in *heavy-duty types* for digging, *medium-weight types* for general-purpose work and *lightweight types* for rehandling light materials.



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

C. Clamshells

- ❑ Manufacturers supply buckets either *with removable teeth* or *without teeth*.
- ❑ Teeth are used in digging the harder types of materials but are not required when a bucket is used for re-handling purposes.



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

C. Clamshells

- ❑ The capacity of a clamshell bucket is usually given in cubic meter.
- ❑ The variable factors affecting operations include:
 - The difficulty of loading the bucket,
 - The size load obtainable,
 - The height of lift,
 - The angle of swing,
 - The method of disposing of the load, and
 - The experience of the operator.



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

D. Hoes

- ❑ Hoes are used primarily to excavate below the natural surface of the ground on which the machine rests.
- ❑ hoe is sometimes referred to by other names, such as *backhoe* or *back shovel*.
- ❑ They are adapted to excavating trenches, pits for basements, and general grading work, which requires precise control of depths.
- ❑ Because of their rigidity they are superior to draglines in operating on close-range work and dumping into trucks.
- ❑ Because of the direct pull on the bucket, backhoes may exert greater tooth pressures than face shovels.
- ❑ In storm drain and utility work the hoe can perform the trench excavation and handle the pipe, eliminating a second machine.

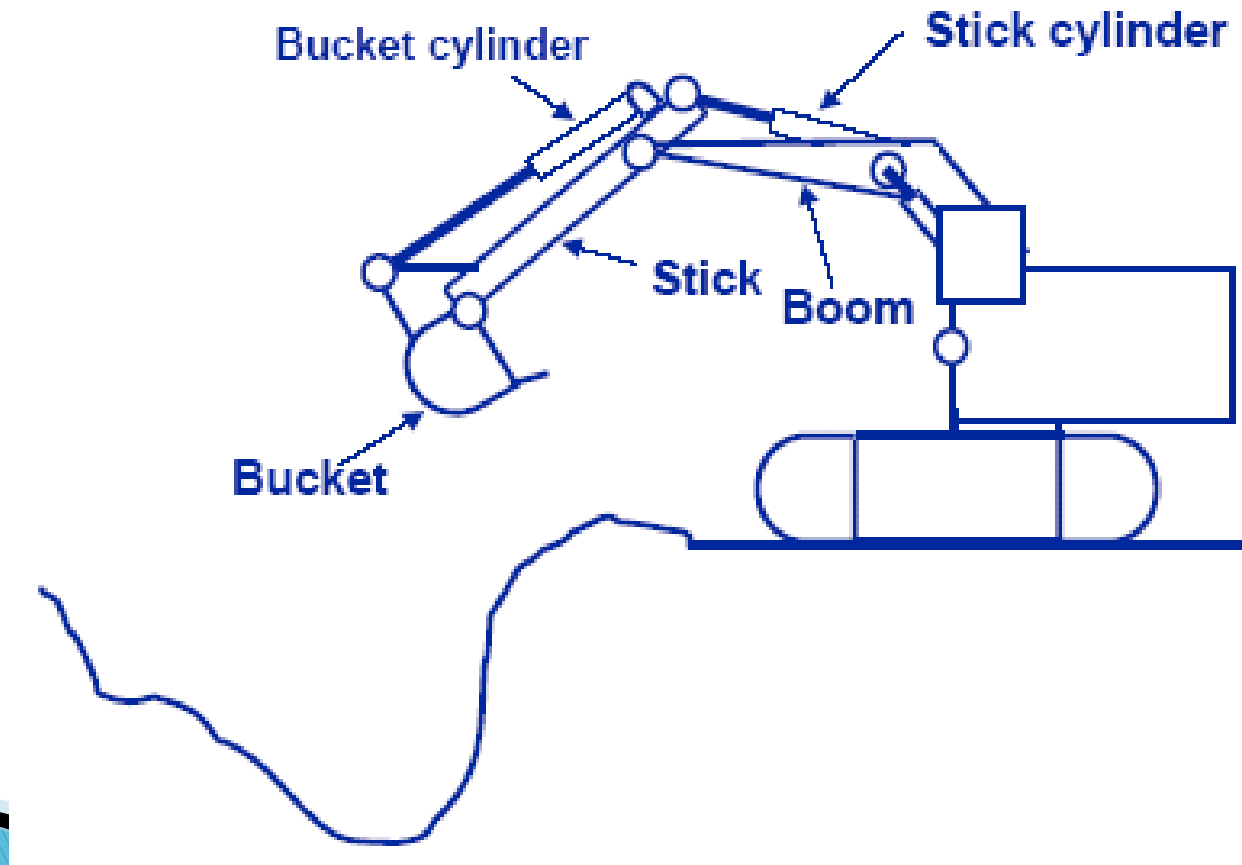
CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

D. Hoes

Basic component of backhoes



CONSTRUCTION EQUIPMENTS

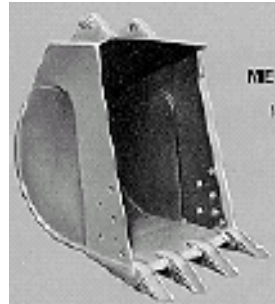
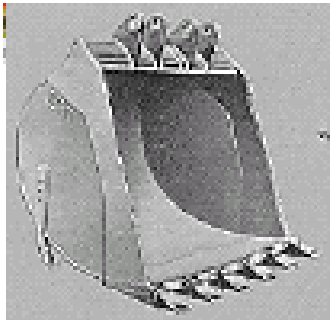
2. Earth Work Equipments

2.1 Crane Shovel Family

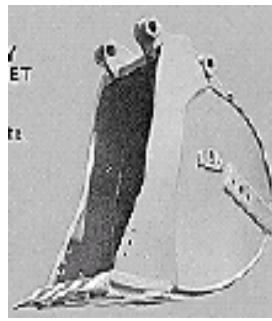
D. Hoes

Hoe Buckets

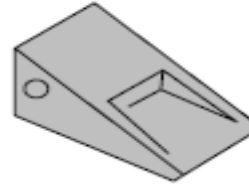
- There are special buckets for everything from light sand to hard rock digging.



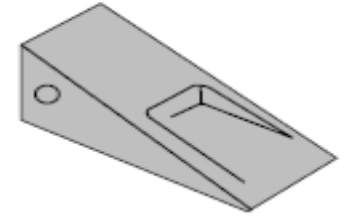
Bucket option



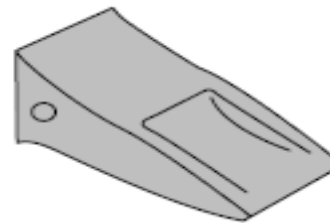
Short



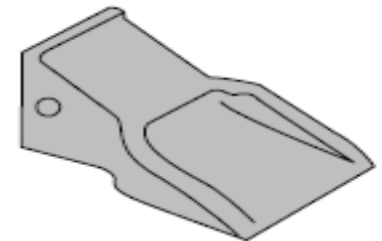
Long



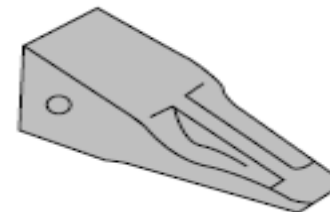
Heavy-duty long



Heavy-duty abrasion



Penetration



Teeth option

CONSTRUCTION EQUIPMENTS

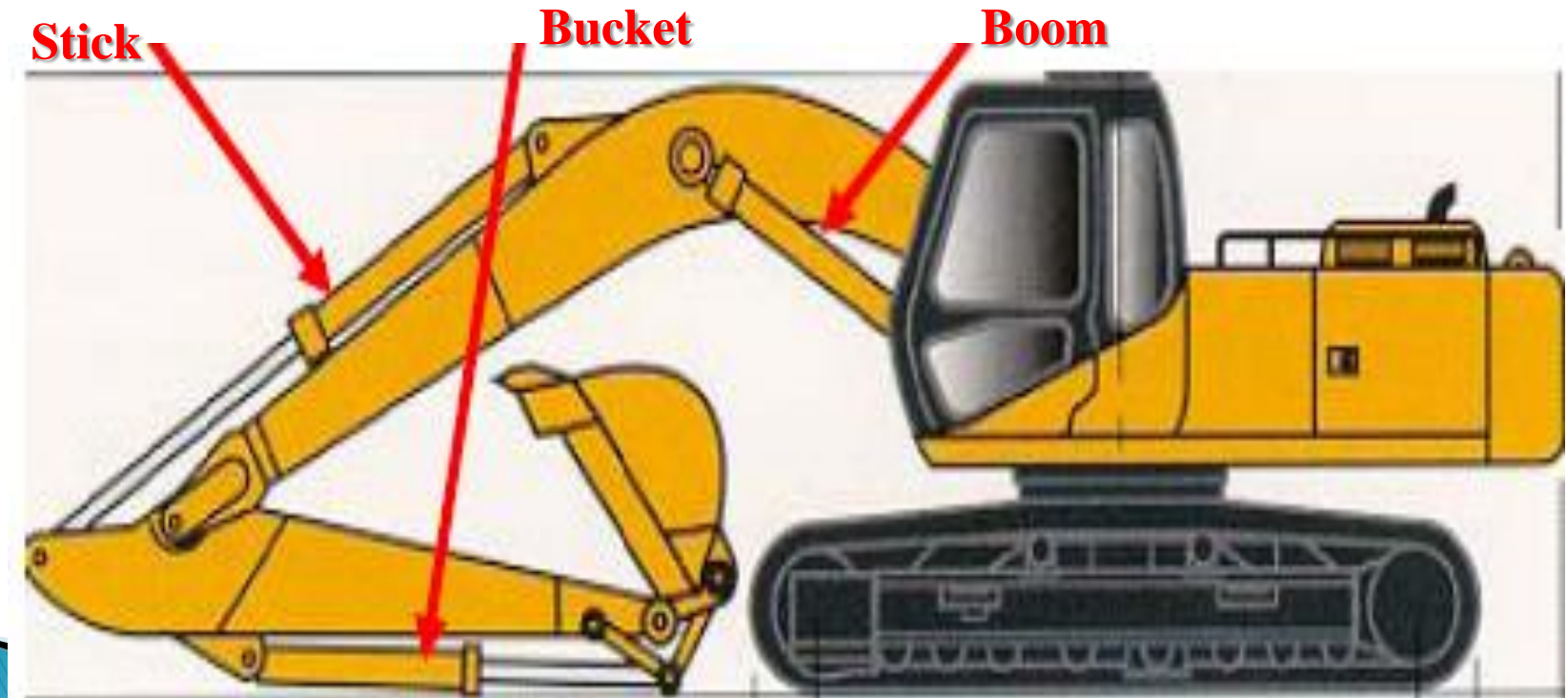
2. Earth Work Equipments

2.1 Crane Shovel Family

D. Hoes

Hydraulic Hoes

- Bucket penetration (break out force) is developed by the *hydraulic cylinders* of the *boom*, *stick* and *bucket*.



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

D. Hoes

Hydraulic Hoe Types

- ❑ The hoe can be track or wheel mounted



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

D. Hoes



CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.1 Crane Shovel Family

Comparison between the shovel family

Comparison between the shovel family members:

No.	Parameters of comparison	Face shovel	Dragline	Backhoe	Clamshell
1	Operation in hard soil or rock	Good	Poor	Good	Good
2	Reach distance b/n machinery and digging point	Small	Longest	Small	Long
3	Loading efficiency on vehicles	Very good	Fair	Fair	Precise but slow
4	Digging Level	Mainly above grade level	Below its grade level	Below its grade level	At, above or below grade level

CONSTRUCTION EQUIPMENTS

2. Earth Work Equipments

2.2 Heavy Earth moving Equipments

A. Excavators

- ❑ Replaced the cable operated crane shove family
- ❑ Excavators are basically digging machines, having the following three main components
 - An ***undercarriage*** to give mobility. This may be crawler track mounted or wheel mounted.
 - A ***superstructure*** with operator's cabin mounted on either a slew ring to traverse through 360° or on a rigid frame.
 - Hydraulically articulated ***boom*** and ***dipper arms with bucket***.
- ❑ Excavators are designed to excavate below the ground surface on which the machine rests.
- ❑ Good mobility and versatility and excellent for general-purpose work, such as excavating trenches and pits.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Basic Parts of Excavator



● Arm

This part functions same as our lower arm; from the elbow to the wrist.

● Boom

This part functions like our upper arm; from the shoulder to the elbow.

● The important devices to make the machine move are stored here. They include fuel, oil, an engine, a motor, and other things.

● Bucket

This part can be replaced with a drill type, scissors type, or other types.

● Crawler

The crawler makes it possible for the machine to literally 'crawl'. It has no problem moving on very rough roads.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

- ❑ Functions of excavators:
 - Excavating – Earthworks
 - Loading Excavated Material
 - Scarification
 - Making of Drains
- ❑ Advantages of hydraulic excavators include:
 - Faster cycle time,
 - Higher bucket penetrating force,
 - More precise digging, and easier operator control.
 - Many attachments can be made to increase the versatility of the equipments.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Types of excavators

- ❑ Excavators are of the following types based on the type of carriers on which they are mounted:
 - I. Crawler mounted excavator
 - II. Truck mounted excavator
 - III. Self propelled excavator
 - IV. Excavators mounted on barge or rail

I. Crawler mounted excavator:

- ❑ These excavators are mounted on the crawler system and are very suitable for carrying out large works in rough terrain.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Types of excavators

I. Crawler mounted excavators:

- ❑ Crawler excavators have the following main characteristics;
 - Can be used for work on soft or wet grounds
 - Can be used on sharp rocks or other adverse conditions
 - These can climb steep grades (even up to 40 percent)
 - Requires very less turning space
 - Have very less speed for travelling
 - Can be shifted from one site to another only on trailers



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Types of excavators

II. Truck mounted excavators:

- These excavators are mounted on truck chassis and has the following main characteristics:
 - High road speed and mobility is the main advantage.
 - Lower stability over sides and hence require counter-weight or outriggers.
 - Require more operating space.
 - Tyres or outriggers give high ground pressure and hence it requires firm and smooth operating locations.
 - Have two engines and two cabs, separately for truck chassis and excavator.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Types of excavators

III. Self propelled excavators:

- ❑ These excavators are self propelled and has rubber tyres. The main characteristics are:
 - Medium travel speed generally between 10-30 Km per hour.
 - Has one engine and one cab for control by one operator.

IV. Excavators on barge or rail:

- ❑ These excavators are mounted on barge or rail to carry out work of excavation in water or near railway line respectively.



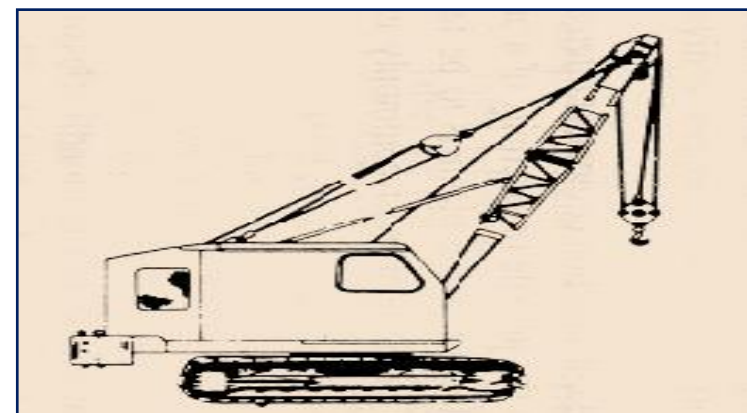
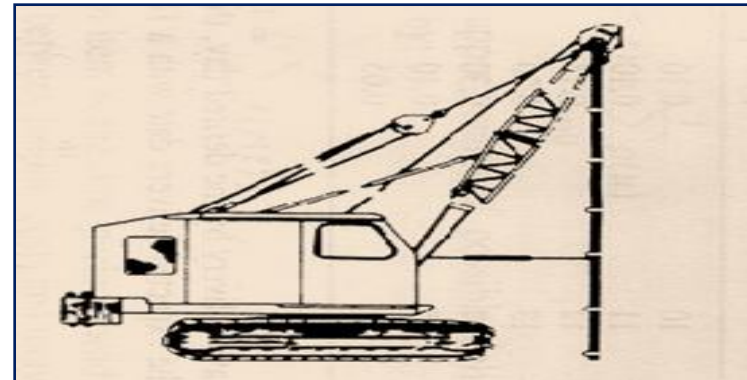
CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

A. Excavators

Common attachments

- Some common attachments include:
 - ***Augers***: Drills holes for poles, posts, soil sampling, and ground improvement
 - ***Jack Hammer***: vibratory hammer used to break up concrete and rock.
 - ***Bucket Ripper***: The bucket sides and bottom are lined with ripper teeth to break up hard soil or soft rock.
 - ***Thumb Bucket***: attached to bucket to provide a hook capacity.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments



B. Loaders

- ❑ A bucket is attached to the arms and capable of being raised, lowered, and dumped through mechanical or hydraulic controls.
- ❑ The loaders having bucket in the front, known as “*front end loaders*” are very common.
- ❑ The loaders are versatile, self propelled equipment mounted either on crawler or wheel-type running gear.
- ❑ These are equipments used primarily:
 - To load excavated materials to a hauling unit,
 - Excavate soft to medium materials,
 - Loading hoppers,
 - Stockpiling materials,
 - Backfilling ditches, and
 - Moving concrete and other construction materials.

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Basic Parts of a loader



● Bucket

Wheel loaders hold a lot of stuff on this part and load it on dump trucks. A bucket can be replaced with differently shaped equipment just like a hydraulic excavator.

● This is where the driver's seat is. Some types have a roof only, and others have a room like this one.



● Tires

There are a lot of different types of tires, depending on what kind of sites and surfaces they will be used.

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Types of Loaders

- Loaders are of the following two types:
 - Crawler loaders
 - Wheel Loaders



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Types of Loaders

I. Crawler loaders

- ❑ Crawler track types are generally preferred for digging and loading jobs where ground conditions are poor and low pressure characteristics are required.
- ❑ They are preferable for applications involving rock and sharp stony ground as there is no possibility of tyre damage.
- ❑ These are best employed for short moves between loading and dumping points.
- ❑ They should be transported from one site to another after loading on the trailers.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Types of Loaders

II. Wheel loaders

- ❑ As a result of the development of more capable power trains (axel and tires), there was a steady trend towards wheel loaders at the expense of crawlers.
- ❑ Wheel loaders are generally ***four wheel drive***. However, for handling light jobs on good ground conditions ***two-wheel drive*** variants are also used.
- ❑ ***Four wheel drive loaders*** are generally used for ***construction jobs***, whereas, ***two wheel drive loaders*** are used for ***bulk handling*** of coal, cement, fertilizer etc.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

II. Wheel loaders

- ❑ From manoeuvrability point of view, wheel loaders are of
 - A. Articulated type (Pivot steer)
 - B. Rigid frame- two wheel steer or all wheel steer.

A. Articulated type of loaders

- ❑ They are hinged in the middle of the front and rear axels.
- ❑ Due to their ***operational characteristics*** and capability of ***working in limited space*** and ***short turning radius***, resulting higher speed of work, they have become popular.
- ❑ The articulation permits the loader to pivot 30-45 degree either side of the center.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

II. Wheel loaders

A. Articulated type of loaders

- ❑ Some advantage of articulated type of loaders are:
 - Quick manoeuvring and thereby easier spotting of loads
 - Less rolling resistance on turns
 - Better mobility on soft surface
 - Give better performance and high productivity.

B. Rigid frame type loaders

- ❑ These are comparatively cheaper than articulated frame type of loaders.
- ❑ Manoeuvring back and forth before dumping is required in most cases.
- ❑ Rigid frame loaders are of two types, namely two wheel steer and all wheel steer.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

II. Wheel loaders

- Some models of wheel loaders are designed as a combination of a backhoe and loader and often called *backhoe loader*.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Backhoe loader features

- ❑ Very common piece of equipment
- ❑ Many subcontractors own/lease
- ❑ Very versatile
- ❑ Easily transported
- ❑ “Low” maintenance costs
- ❑ Operator “friendly”
- ❑ Easily rented



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Operations

- ❑ Loaders are used to carry out the following main operations;

A. Loading

- ❑ Loading operation is the main operation performed by the loaders.
- ❑ Loading consists of scooping, lifting, turning and dumping materials such as sand, gravel, and crushed materials from stockpiles, bank or construction site into the hauling units.

B. Hauling

- ❑ Wheel loaders are excellent for moving loose materials over short distances to dump into hauling units, hoppers, conveyors, bins, or any other place of work in the construction site.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders

Operations

C. Excavating

- ❑ Crawler loaders and heavy duty wheel loaders are excellent for many excavation jobs.
- ❑ These loaders can excavate as well as lift the excavated material and dump it into trucks or on the stockpiles

D. Clearing

- ❑ Loaders can scoop up and load the debris of demolished buildings into hauling units.
- ❑ Loaders are the first equipment to prepare the site for building and construction operations; and also the last equipment in order to backfill, spread, level and top with selected good soil.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders



Attachments

- ❑ The following are main attachments which can be fitted to a wheel loader
 - a) *Back filling attachment*
 - ❑ Back filling can be done with the bucket of this attachment when used with the loader.
 - b) *Forklift attachment*
 - ❑ An industrial forklift when attached with the loader gives more stability, more tractive power and greater clearance than the normal.
 - c) *Sweeping attachment*
 - ❑ A sweeping attachment can be fitted to a wheel loader for general cleaning of roads and parking areas in the industries.

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

B. Loaders



Attachments

- ❑ The following are main attachments which can be fitted to a wheel loader
- d) Multi purpose bucket*
- ❑ A multi purpose or four-in-one bucket can be used as a dozer, scraper, clamshell and a general purpose loading.
- e) Ripper-scarifier a attachment*
- ❑ These are mounted on the rear of the loader to loosen hard surfaces.
- f) Miscellaneous other attachments*
- ❑ A large number of attachments for specialized jobs are also available for fitting to the loaders. Some of these are pipe laying attachments, pole handling attachments, boom for loader crane set up.

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

- ❑ Dozers are machines designed primarily for *cutting* and *pushing* the material over relatively short distance.
- ❑ They consist of a tractor equipped with a *front-mounted earthmoving blade* controlled by *hydraulic cylinders* to vary the depth of cut.
- ❑ A dozer moves earth by lowering the blade and cutting until a full blade load of materials is obtained. It then pushes the material across the ground surface to the required location.
- ❑ Rear mounted hydraulic *scarifiers* and *rippers* can be fitted to loosen hard material prior to dozing.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers



● This is where the driver's seat is. Some types have a roof only, and others have a room like this one.



● **Ripper**
The sharp ripper at its bottom can dig up the ground.



● **Blade**
This part is used to push soil and rocks, and level the ground.

● **Crawler**
With this crawler, bulldozers can move even on rough surfaces. Some crawlers can move on muddy surfaces too.

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Application of Dozers

- The following are the main dozer application
 - *Clearing land* of timber and stumps,
 - *Opening up pilot roads* through mountains and rocky terrain,
 - *Moving earth* for the haul distances up to approximately 100m,
 - *Helping load* tractor-pulled scrapers,
 - *Spreading* earth fills,
 - *Backfilling* trenches,
 - *Side hill cuts*
 - *Clearing* construction sites of derbies, and
 - *Maintaining* haul roads.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Application of Dozers



Moving earth



Helping scrappers

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Application of Dozers



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Dozer Blades

- ❑ A heavy blade of *slightly concave profile* is attached in the front of the tractor.
- ❑ The blades has a *replaceable cutting edge*, which wears out with the use of the blade.
- ❑ The dozer blades are available in sizes from *2m to 7.5m wide* and *0.8m to 1.5m height*.
- ❑ Dozer blades are of the following types:
 - A. *U-Blade*: Used for moving *big loads* over *longer distances*; curved shape and side and top extensions reduce the spillage of loose material; best suited for *lighter materials*.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Dozer Blades

- B. *Straight Blade***: Used primarily for *shallow surface removal*, land clearing; designed to push dirt for short distances, versatile, lightweight and maneuverable, handles a wide range of materials.
- C. *Angle Blade***: It is designed to move material towards the sides of a cut, backfilling or cutting ditches, and sustainably reduces the amount of maneuvering.
- D. *C (cushion Blade)***: Used primarily with scrapers for “on the go” push loading; can be used for lighter excavation and other general tasks.
- E. *Land fill Blade***: These blades are specially designed to handle refuse and/or fill material.

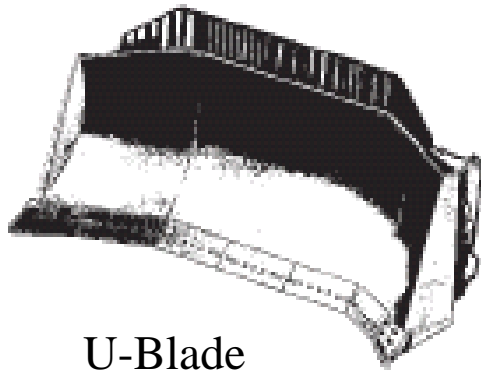


CONSTRUCTION EQUIPMENTS

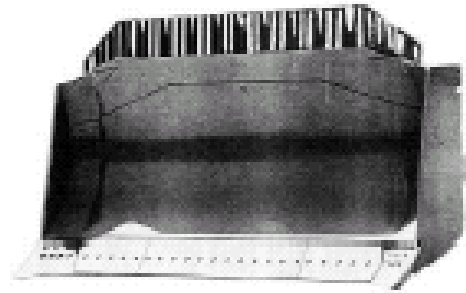
2.2 Heavy Earth moving Equipments

C. Dozers

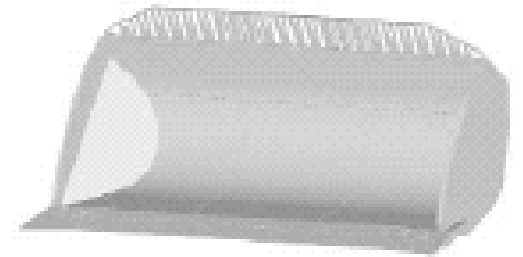
Dozer Blades



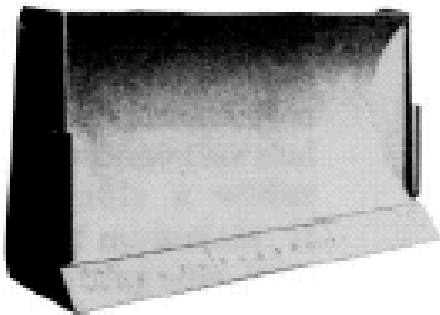
U-Blade



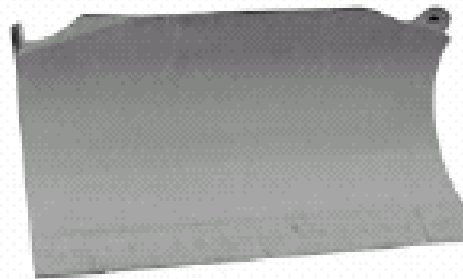
SU-Blade



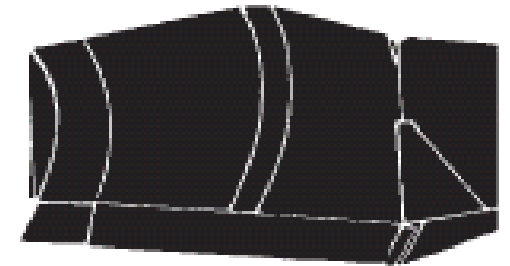
Carry Dozer "CD" Blade



Straight "S" Blade



Power Angle &
Tilt Blade



Variable Radius
"VR" Blade

CONSTRUCTION EQUIPMENTS

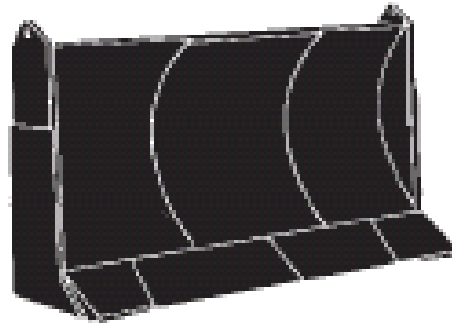
2.2 Heavy Earth moving Equipments

C. Dozers

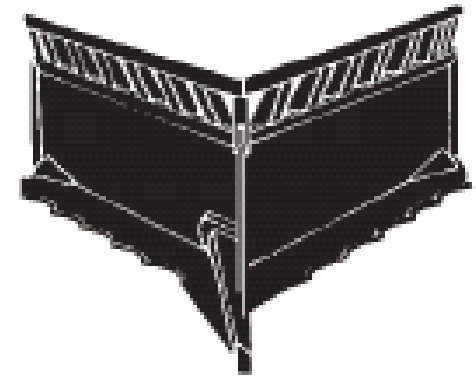
Dozer Blades



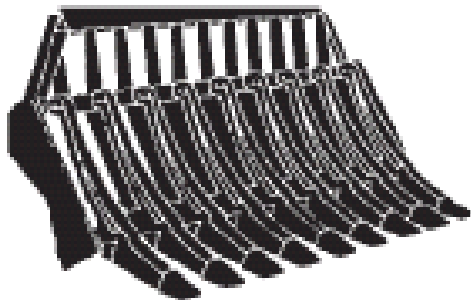
Angle "A"-Blade



Cushion "C"-Blade



V-Tree cutter -Blade



Rakes



K/G -Blade

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Blade adjustments



Tilting



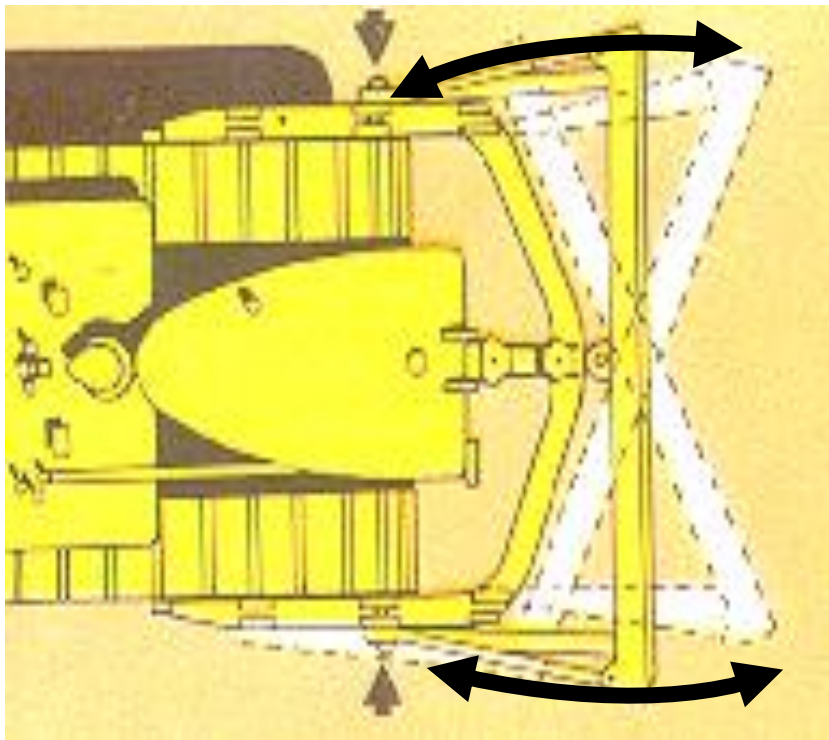
Angle adjustment

CONSTRUCTION EQUIPMENTS

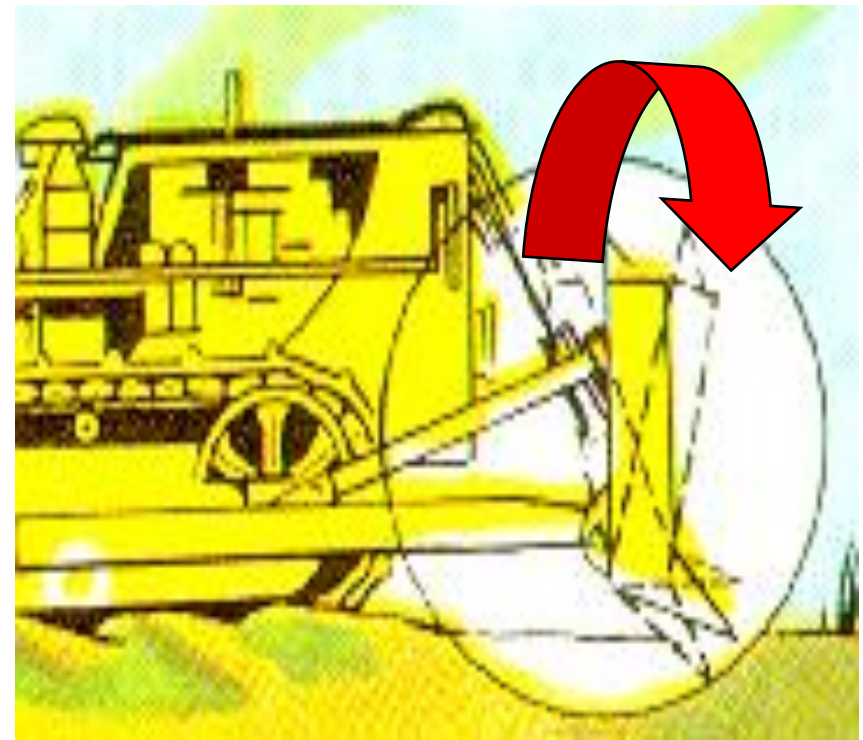
2.2 Heavy Earth moving Equipments

C. Dozers

Blade adjustments



Angle adjustment (Top View)



Pitch adjustment

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Dozer Blades and Material Evaluation

- ❑ Besides job requirement, several other consideration determine choice of attachment.
- ❑ *Moisture content*, *particle size*, and *number of voids* are the more important characteristics influencing dozing performance.
 - a) *Moisture content*: If the moisture content increases above the optimum, material becomes heavy and will thus have a *negative effect on dozing performance*.
 - b) *Particle size*: Large particles resist penetration more than smaller ones, requiring more dozing power.
 - Materials consisting of *irregularly* and *sharp-edged* particles are more difficult to doze than material composed of *round-edged* particles



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Dozer Blades and Material Evaluation

- c) ***voids***: Relatively dense materials with few voids contain large numbers of individual particles in close contact with each other . Because of this more force is required to break up this tightly bonded material.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Rippers

- ❑ Crawler-tractor, mounted with ripper is finding increasing use in construction, mining and quarrying.
- ❑ *Characteristic of material* to be ripped influence the selection of *ripper type*; *number of shanks* required, *ripping speed* and *amount of ripper penetration*.

Types of Rippers

- Fixed multiple-shank ripper*: used for comparatively simple ripping operations.
- Variable multiple-shank ripper*: These are used where there are many boulders, or where the quality of rock is not consistent.



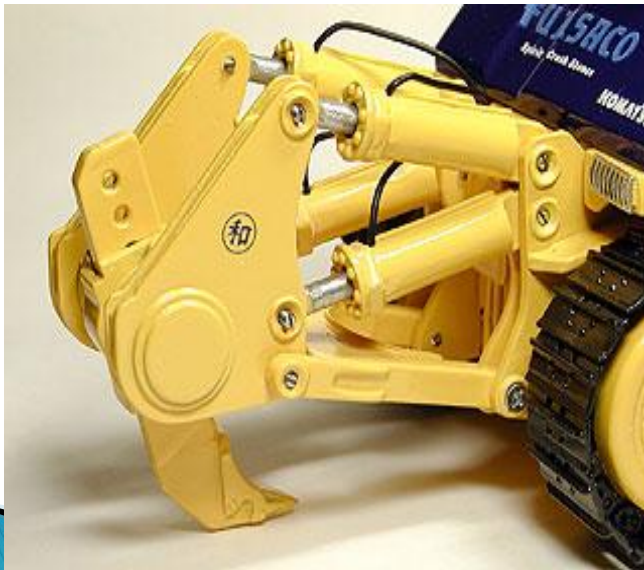
CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Types of Rippers

- C. Fixed giant ripper:** has only one single powerful shank, but is not common as compared to variable giant rippers.
- D. Variable giant ripper:** has a single powerful shank . The angle of this ripper can be changed according to the ground requirements.

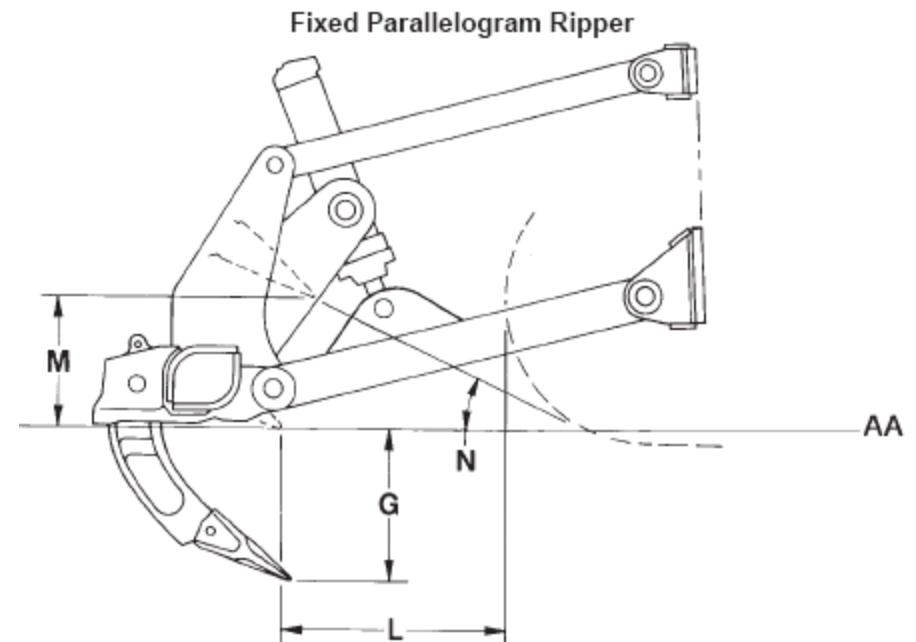
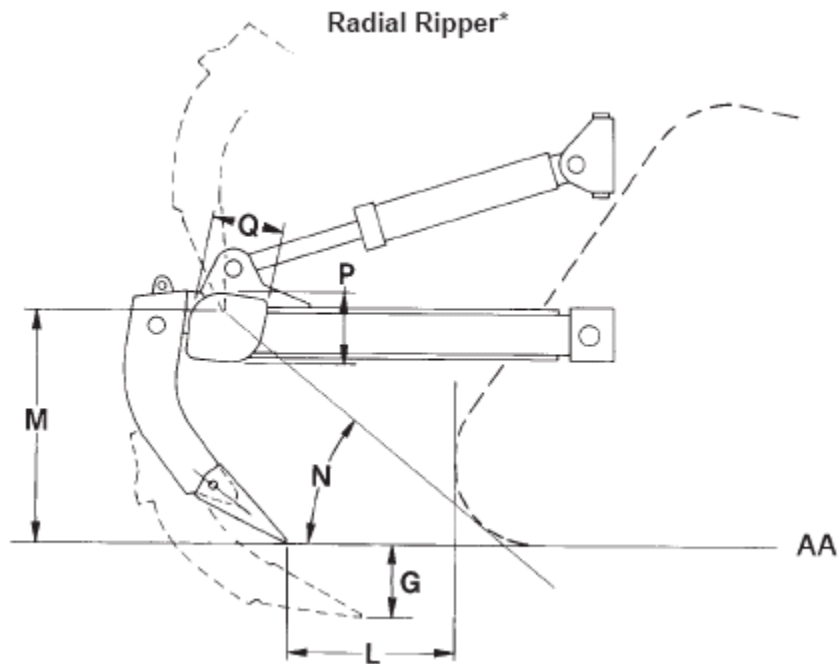


CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Types of Rippers



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Ripping Efficiency

- In order to achieve *high ripping efficiency*, following suggestion should be considered.
 - 1) When material is not broken, loosen the surface in one direction, then cross-ripping should be adopted.
 - 2) If material is soft, use more than one shank ripper.
 - 3) Ripping should be done downhill.
 - 4) Avoid reversing when shank is in the ground.
 - 5) When both dozing and ripping operations are required to be done, it should rip going out and doze on the way in.
 - 6) For hard material, use shorter tips, and for ordinary work use longest and sharpest point.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Crawler Vs Tyre Tractors



A. Crawler Mounted tractors



B. Wheel Mounted tractors

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Crawler Vs Tyre Tractors

- ❑ Each type of tractor has certain advantages in certain conditions.
- ❑ ***Advantages of crawler mounted tractors:***
 - 1) More tractive effort, hence can also operate on loose or muddy soil.
 - 2) In absence of tyres, can easily operate in rocky conditions.
 - 3) Where maintenance of haul roads is difficult, it can easily travel, especially in rough terrain.
 - 4) Crawler tractors are more compact and powerful and hence can handle difficult jobs as well.
 - 5) Greater floatation because of the lower pressure under the trucks.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

C. Dozers

Crawler Vs Tyre Tractors

❑ *Advantages of wheel mounted tractors:*

- 1) Can travel at higher speeds during operations and also from one job to the other.
- 2) Ease in operation. Operator feels less fatigue.
- 3) Can travel on paved roads without damaging them.
- 4) Can travel long distances at its own power, whereas crawler mounted needs trailers.
- 5) When work is spread over long area, these are found to be producing more output.
- 6) Operation, maintenance and repair costs are less in wheeled tractor as compared to crawler tractors.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

- ❑ Scrapers are capable of *excavating*, *hauling*, and *dumping* material *over medium- to long-haul distances*.
- ❑ The scrapers are designed to *dig*, *load*, *haul*, *dump* and *spread* and sometimes called as *carry all*.

Types of scrapers

- ❑ The scrapers are of three types:

I. Towed scrapers:

- They are provided with either cable or hydraulic control.
- They are becoming obsolete.
- When coupled to a suitably powered crawler tractor, they can operate in extremely adverse conditions.
- Travel at *slower speed* and can be used for short hauls only.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Types of scrapers

II. Self propelled or motorized or conventional scrapers:

- Generally manufactured in ranges from **10-20** cubic meters.
- Needs push loading by a crawler mounted or wheeled tractor.
- Have **more hauling speed** and hence are suitable for long distance hauling .

III. Self loading or elevating scrapers:

- The problem of loading by a pusher is overcome by these type of scrapers.
- These are twin engine scrapers and can work completely independently of all other plants.
- Pay loads are restricted because of the additional weight of the loading elevator and its drive system.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Types of scrapers

□ Another classification method of scrapers

I. Push-loaded (Conventional):

- Single powered axel
- Tandem powered axels

II. Self loading:

- Push-pull, tandem powered axels
- Elevating
- Auger



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Types of scrapers



Conventional (Push loaded)

Become uneconomical when

- Haul grades $> 5\%$
- Return grades $> 12\%$

Tandem powered Twin Engine

- Good for jobs having adverse grade
- Owning operating costs are about 25% higher



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Types of scrapers



Push-Pull



Push pull scrapers

- Can work as a team or operate individually with a pusher.
- Tire wear will increase in rock or abrasive materials.

Elevating scrapers

- Good for short hauls and in favourable materials.
- Can work alone in the cut.
- Cost more initially and to operate.

Elevating

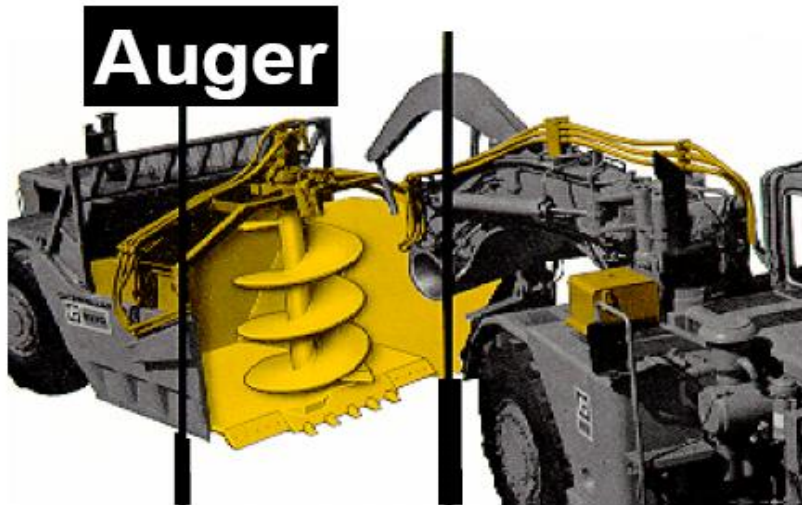


CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Types of scrapers



Auger Scrapers

- Can self load in difficult condition, laminated rock or granular material.
- The augers add weight to the scraper during travel and it is more costly to own and operate than the conventional.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Basic Parts of a scraper

□ A scraper has the following main parts:

i. Bowl

- The bowl is a pan to hold the scraped dirt
- It is hinged at the rear corners to the rear axle inside the wheels, and is capable of tilting down for digging or ejecting.

ii. Cutting edge

- The bowl has a cutting edge attached to the bottom.
- The cutting edge is lowered into the dirt to make a shallow cut.

iii. Apron

- This is a wall in front of the bowl, which opens and closes to regulate the flow of the earth in and out of the bowl.

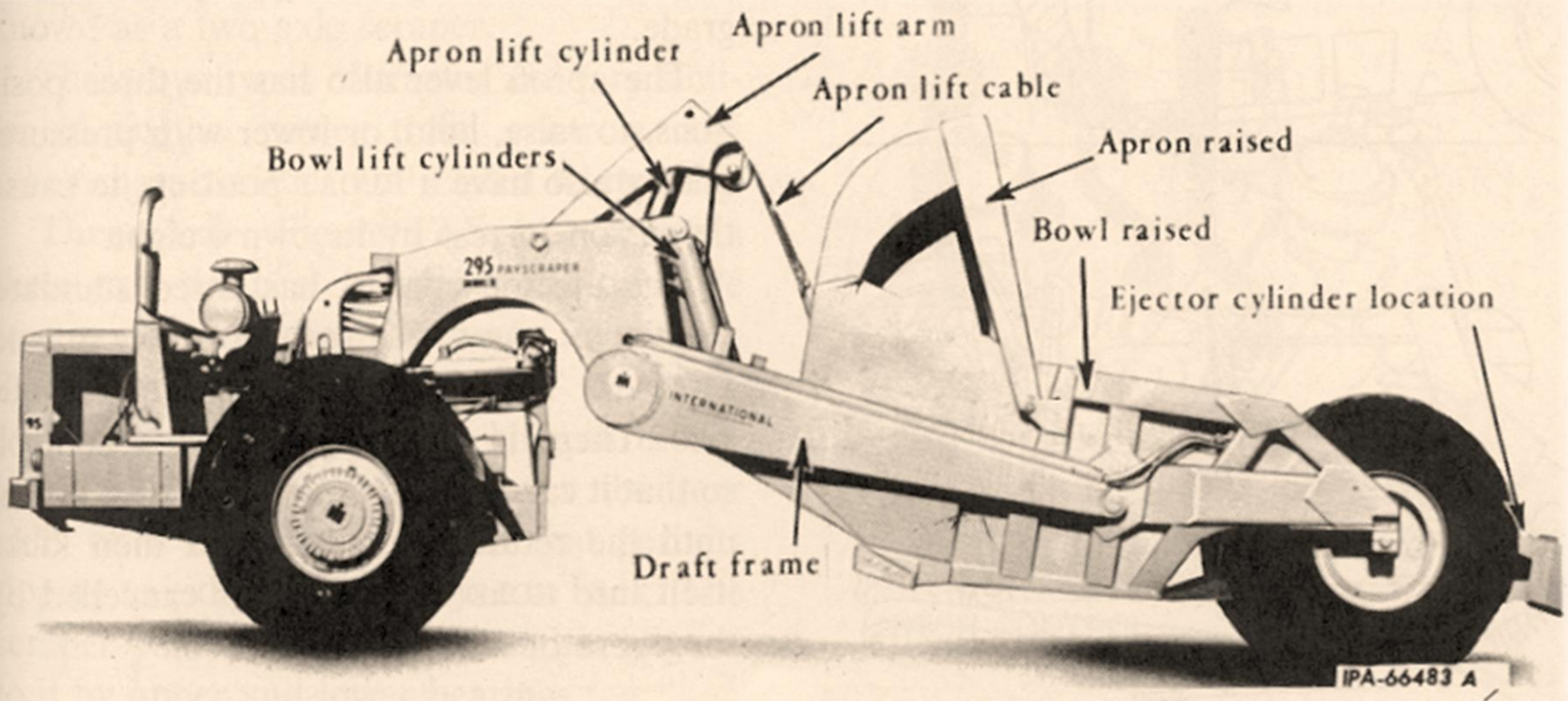


CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Basic Parts of a scraper



Courtesy of International Harvester Company

Fig. 17-2. Names of scraper parts

CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Basic Parts of a scraper

iv. Tail gate or ejector

- These are the rear of the pan which is capable of forward and backward movement inside the bowl



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Operation

❑ Operation of a scraper is described here under for an earth work:

i. Loading or digging

- The operator moves to the cut with the ejector at the rear and the apron raised approximately to 40 cm.
- The bowl is then lowered to the desired depth of cut, increase engine speed, move forward in first gear keeping optimum depth of cut.
- When the bowl is full, the apron is closed and the bowl is then raised.

ii. Transporting

- The bowl is transported in high gear in raised position to provide sufficient clearance.
- During transporting, apron should be fully closed to prevent loss of material



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Operation

□ Operation of a scraper is described here under for an earth work:

iii. Unloading

- The bowl should be positioned to spread the material to the desired depth during this operation.
- A partial opening of the apron during the initial unloading will help in even spreading.
- For wet and sticky material, the apron should be raised and lowered repeatedly until the material behind it is loosened and drops out of the bowl.
- Then the ejector is moved forward to push the remaining material out of the bowl at a uniform rate.
- When the dump is complete, the tail gate is fully retracted, the apron dropped and the 'bowl' raised to transporting position.



CONSTRUCTION EQUIPMENTS

2.2 Heavy Earth moving Equipments

D. Scrapers

Operation

- Following are some of the suggestions for *increasing scraper production*:
 - Construct and maintain smooth haul roads for faster travel.
 - Depth of cut should be according to the type of soil being cut.
 - Use ripper teeth in hard or abrasive materials for easy handling.
 - Where possible, loading be done in down grade
 - To increase the stability of the scraper during travel, carry the bowl as close to the ground as possible.
 - If necessary pre-wetting of the soil is done so that the soil is reasonably moist, as most soils load easily when they are moist.
 - Whenever possible, plan the work to eliminate all avoidable turns.



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders



- ❑ Grading is the process of bringing earth work to the desired *shape* and *elevation* (grade).
- ❑ Motor graders are used for leveling and smoothing the earthwork, spreading and leveling the base course in the construction of roads and air fields.
- ❑ Motor graders can be used for the following types of works:
 - Gravel road repairing
 - Road shoulder reshaping, bank cutting and reshaping
 - Ditch filling or digging
 - Levelled or slopped ground finishing
 - Base course spreading and levelling
 - Material mixing, hard surface cutting, snow clearance,
 - Land clearance, frozen top soil and asphalt breaking

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Comparison with dozers

- ❑ A grader is restricted to making shallow cuts in medium-hard materials.
- ❑ They should not be used for heavy excavations.
- ❑ A grader can move small amounts of material but cannot perform dozer-type work because of the structural strength and location of its moldboard.
- ❑ Graders can work on slopes as steep as 3:1.
- ❑ Grader are capable of progressively cutting ditches to a depth of 3 ft.



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Basic parts of grader

- The components the grader that actually do the finishing are:
 - *Blade (Moldboard)*
 - *Scarifier*
 - *Rippers*

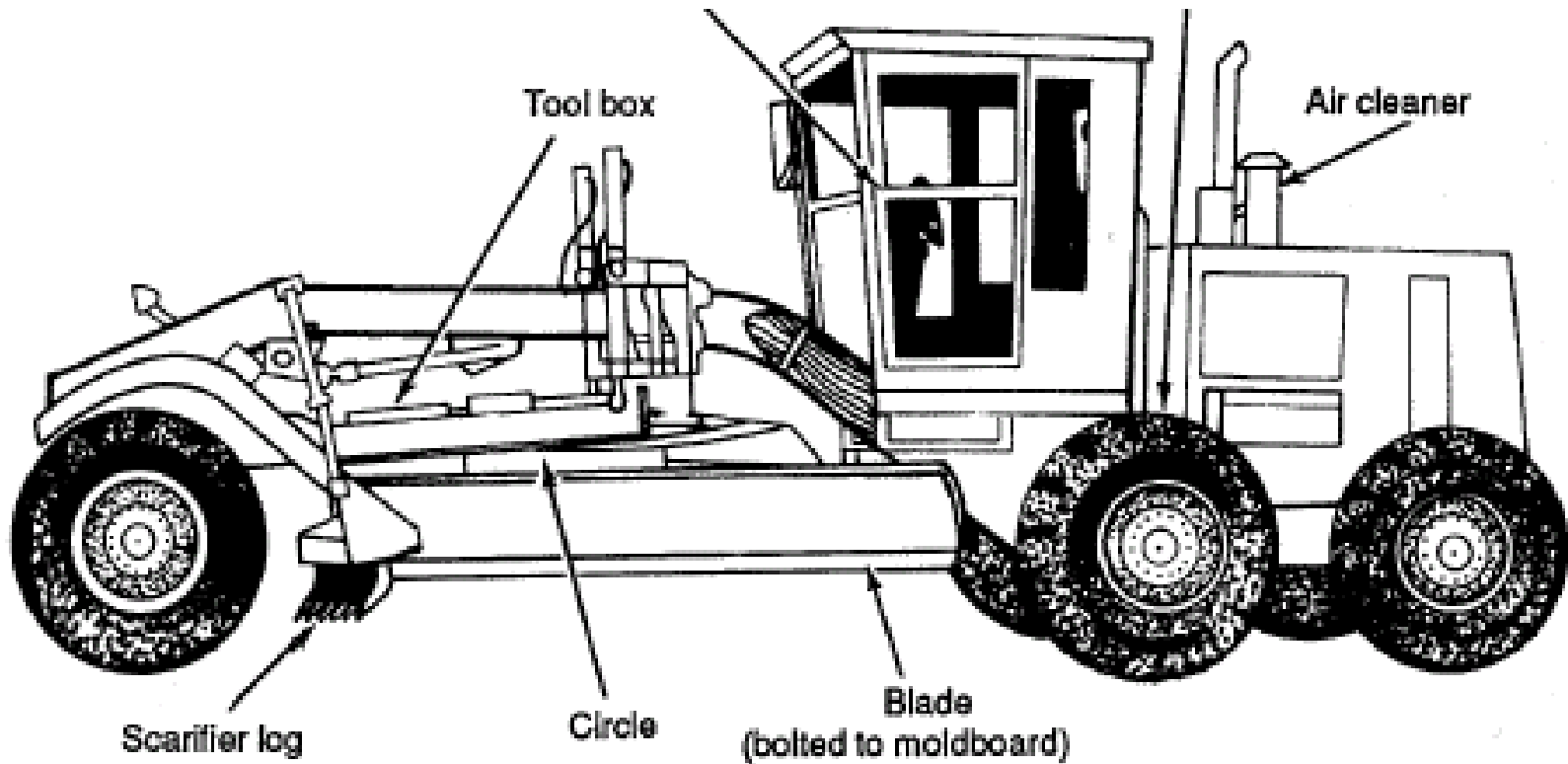


CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Basic parts of grader



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Blade



- ❑ The blade (Mould Board) is the *main tool* of the grader.
- ❑ It is carried by a *rotating circle* and is easily maneuverable to a wide range of cutting positions with the help of hydraulic controls.
- ❑ The blade and the circle are mounted on a frame and is supported at the front of the machine by a ball joint.
- ❑ The blade can be adjusted to any position with help of levers as indicated below:
 - *Side shift*: the blade has Blade Sideshift Ram
 - *Lifting the blade*: The blade can be lifted or lowered by levers operating the two rams.
 - *Rotating the circle*: A hydraulic motor is provided to rotate the circle and blade. Blade can be rotated either in clockwise or counter clockwise direction.

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Blade

- *Adjusting blade cutting angle (Blade pitch)*: The vertical angle of the blade can be adjusted.

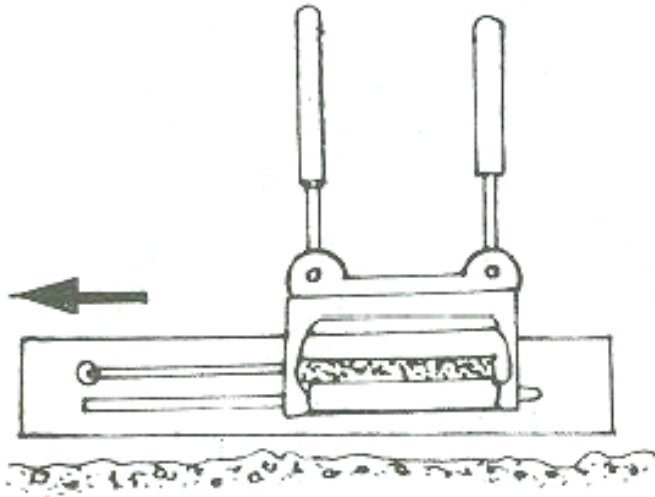


Fig. 4.2. Blade sideshift.

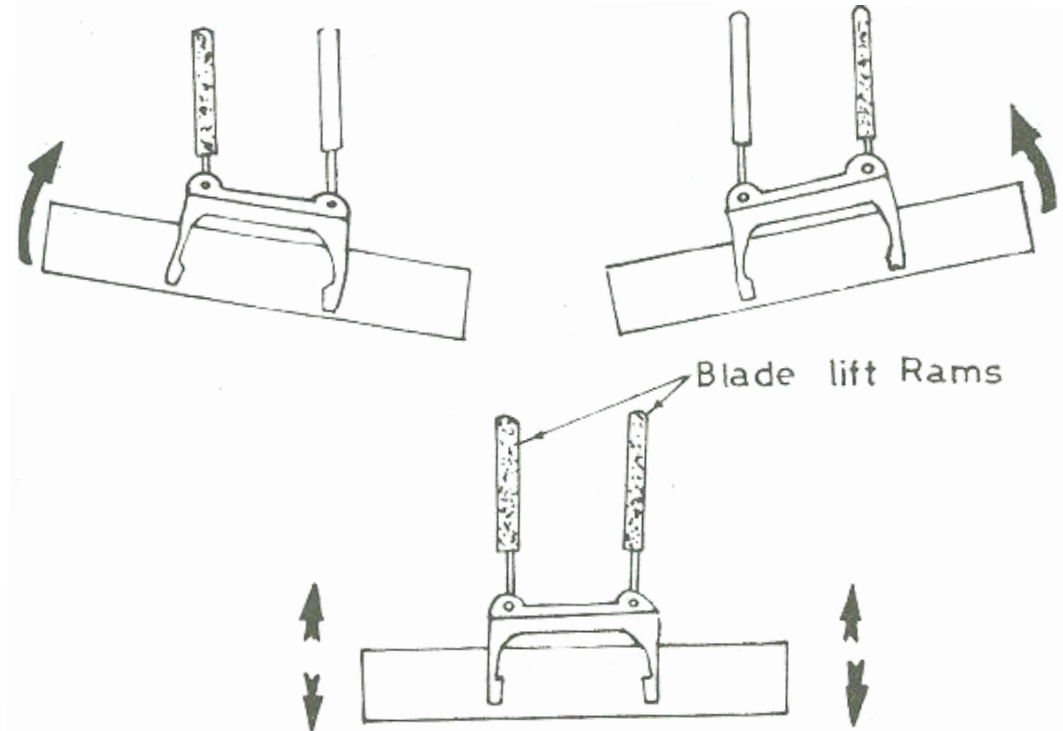


Fig. 4.3. Lifting the blade.

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Blade

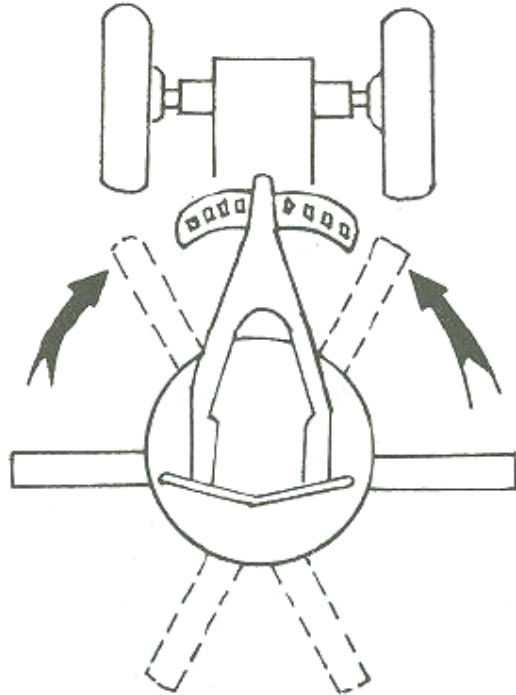
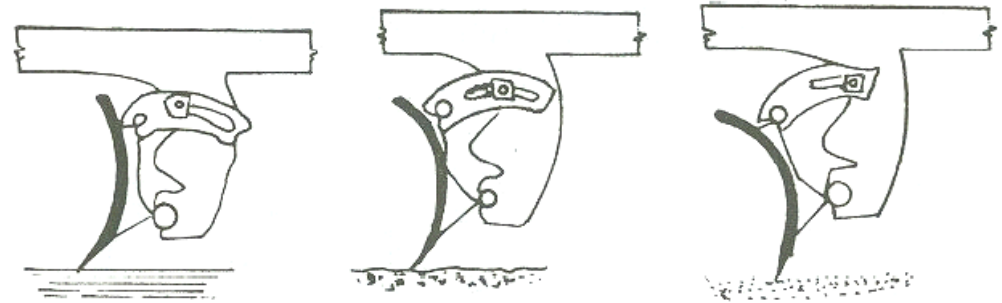
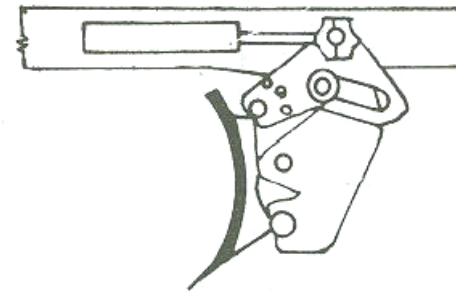


Fig. 4.4. Rotating the Circle.



(a) Manual Adjustment



(b) Hydraulic Adjustment

Fig. 4.5. Blade Cutting Angle.

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Blade



Adjusting blade cutting angle

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Blade



Adjusting blade cutting angle

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Scarifier



- ❑ Scarifier is a special tool attached with the motor grader for loosening the hard soil and has a set teeth mounted on adjustable shanks.
- ❑ This attachment digs up hard ground like asphalt, old pavement, frozen surface and hard soil with vegetation and brushes which can not be removed by the blade.
- ❑ The teeth are replaceable, and the number of teeth can be varied to suit the ground hardness.
- ❑ High strength alloy steel tips can be mounted on the teeth to prevent teeth wear and extend their service for economical performance.

CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Scarifier



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Ripper

- ❑ The ripper is used to break up materials too hard to cut with moldboard blade.
- ❑ The depth of cut is controlled by hydraulically operated ripper control lever.
- ❑ Type of material to be ripped will determine position of the ripper shank.



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Various Operations

A. Grading:

- ❑ Grading in road construction means flattening and smoothing the road surface and others by the scrapping action of the blade, includes working operation like, *surface skimming*, *light duty bulldozing*, *leveling*, *spreading* and *crowning*.
- ❑ A cutting depth of 2 to 3cm is considered to be the best for optimum efficiency. Under no circumstances it should be greater than 5cm.

B. Spreading:

- ❑ Gravel together with binding material is spread by the motor grader.
- ❑ For spreading the cutting angle is set at 60° nearly.
- ❑ Cutting edge of the blade is set above the ground at a distance equal to the depth to which the material is to be spread.



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Various Operations

C. Finishing and Leveling:

- ❑ In final finishing and leveling, surface have to be finished to fine limits.
- ❑ In such cases make the finishing pass with the blade only slightly angled and set to skim the surface.

D. Ditch Digging:

- ❑ The front end of the blade is tilted down and the rear end is tilted up above the road surface. The front end cuts into the ground.
- ❑ This is used to dig drainage ditches and road side ditches.

E. Cutting:

- ❑ For the purpose of cutting in soft dirt, set the blade to an angle b/n 40-55 degree, while in hard dirt an angle of 30-45 degree is proper.



CONSTRUCTION EQUIPMENTS

2.3 Grading Equipments

Graders

Various Operations



Laser Blade controls



Ditch Cutting

CONSTRUCTION EQUIPMENTS

2.4 Earth work Equipment Summary

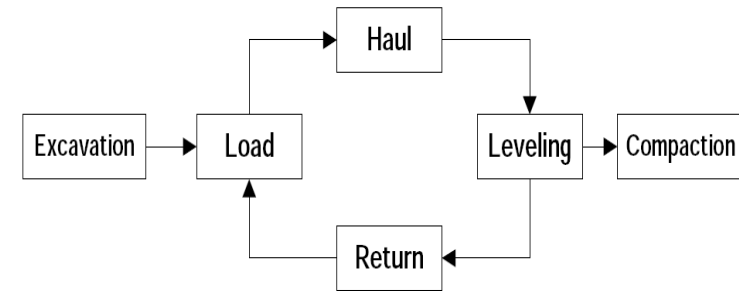


Fig.1 Earthmoving Flow

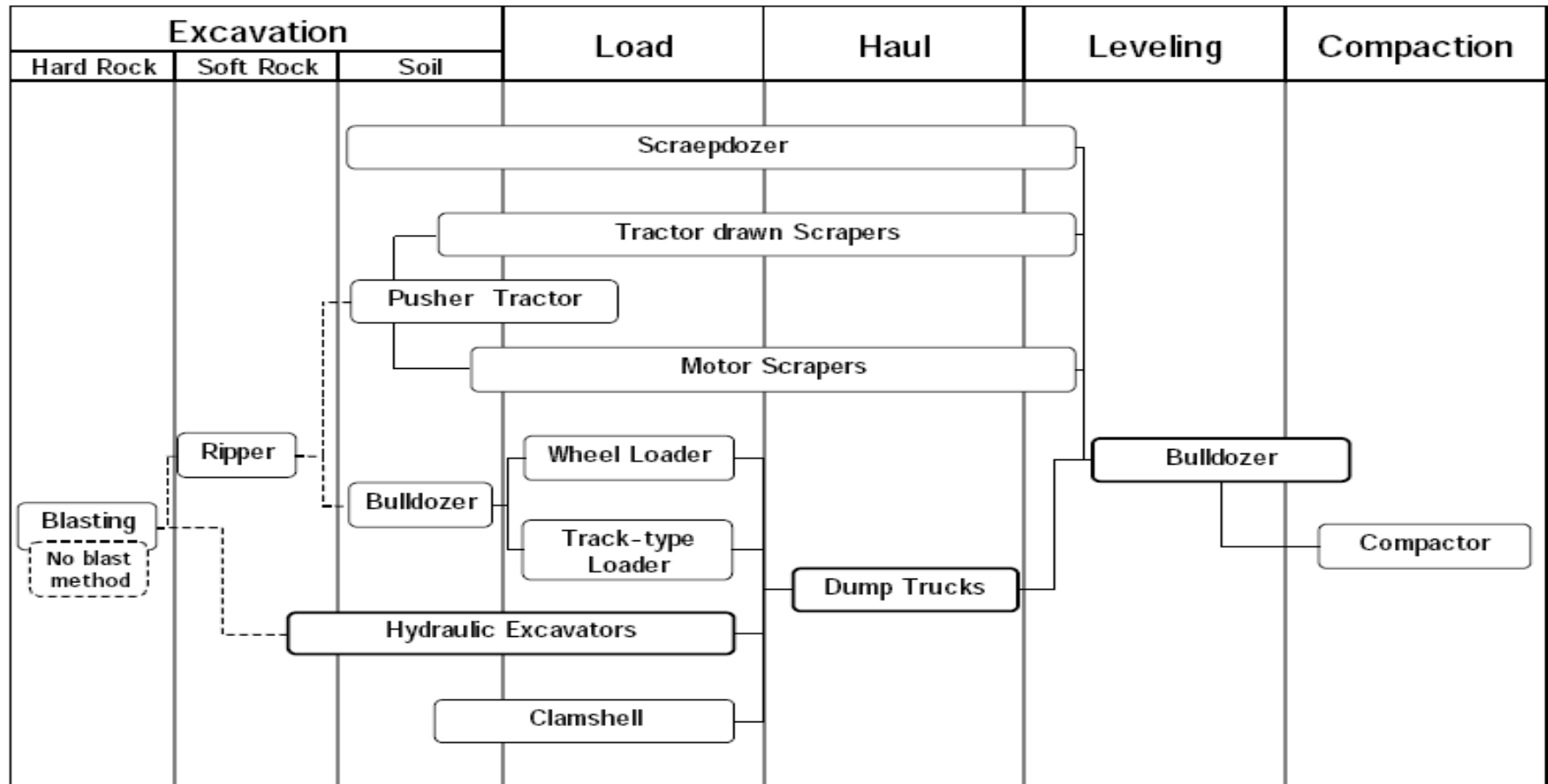


Fig.2 Co-Operation

CONSTRUCTION EQUIPMENTS



2.4 Earth work Equipment Summary

- ❑ Choice of Excavation Equipment for Building Site Excavation depends on:
 - Size of the job: - Bucket Size and Number of Excavators
 - Activity time constraints: - Number of equipment
 - Availability of equipment:
 - Cost of transportation of equipment:
 - Type of excavation:
 - Soil characteristics:
 - Geometric characteristics of elements of the soil to be excavated:
 - Space constraints:
 - Characteristics of haul units:
 - Location of dumping areas:
 - Weather and temperature:

CONSTRUCTION EQUIPMENTS

2.4 Earth work Equipment Summary

Earthmoving and Excavating Work Activities and Equipment Packages

Activity	Dozer	Loader	Grader	Scraper	Dump Truck	Backhoe	Excavator	Front Shovel
Excavating above grade								×
Excavating below grade	×			×		×	×	
Grubbing	×						×	
Heavy ripping	×							
Light ripping			×					
Tree stump removal	×						×	
Topsoil removal/storage	×		×	×				
Rough cutting	×			×			×	
Rough filling	×	×		×	×			
Finish grading			×					
Foundation excavation						×	×	
Foundation backfilling		×				×	×	
Footing excavation						×	×	
Road base construction	×	×	×		×			
Temporary road construction	×	×	×		×			
Haul road maintenance			×					
Culvert placement	×		×		×	×	×	
Earth berm/dam construction	×		×		×			
Drainage ditch maintenance						×	×	

CONSTRUCTION EQUIPMENTS

2.4 Earth work Equipment Summary

Earthmoving and Excavating Work Activities and Equipment Packages

Activity	Dozer	Loader	Grader	Scraper	Dump Truck	Backhoe	Excavator	Front Shovel
Haul less than 500'	×	×						
Haul 500' to 2 miles				×				
Haul over 2 miles					×			
Soil windrowing	×		×					
Soil spreading	×	×	×	×	×			
Excess loose soil removal		×			×			
Deep trench excavation							×	
Shallow trench excavation						×		
Trench backfilling	×	×				×	×	
Utility pipe placing — small						×	×	
Utility pipe placing — large							×	
Trench box placement/ movement						×	×	
Debris/trash removal		×			×		×	
Rock removal	×	×			×		×	
Asphalt paving removal	×	×			×		×	
Concrete removal	×	×			×		×	
Structure demo	×	×			×		×	
Assisting scrapers	×			×				
Towing other equipment	×	×						
Concrete placement — bucket							×	
Crane pad construction	×		×		×			
Detention pond excavation	×			×			×	
Benching	×		×				×	
Side sloping	×							

THANK YOU!