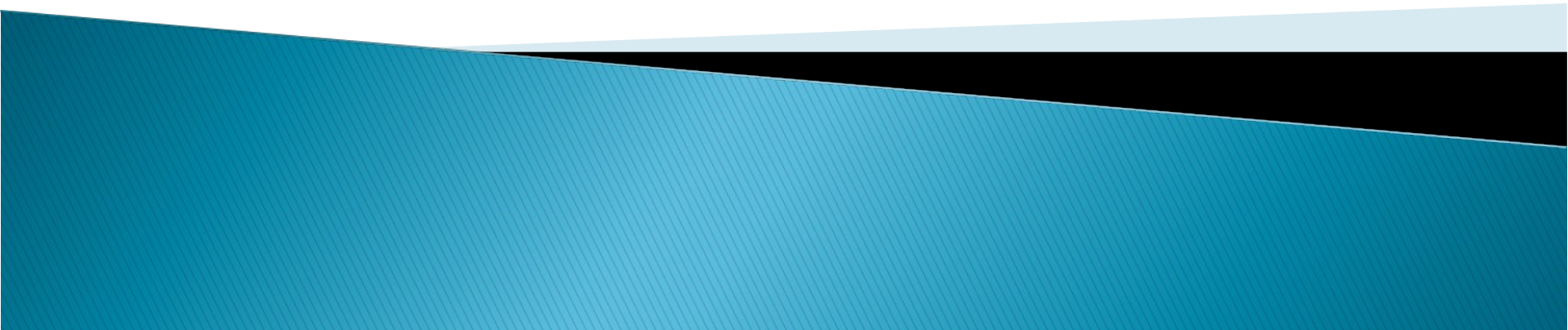


Wolaita Sodo University
CONSTRUCTION TECHNOLOGY AND MANAGEMENT
BSc. Program - Year III (Regular)

**CONSTRUCTION EQUIPMENT AND
PLANT MANAGEMENT(COTM 3161)**

CHAPTER-1
INTRODUCTION

(Henok B.)



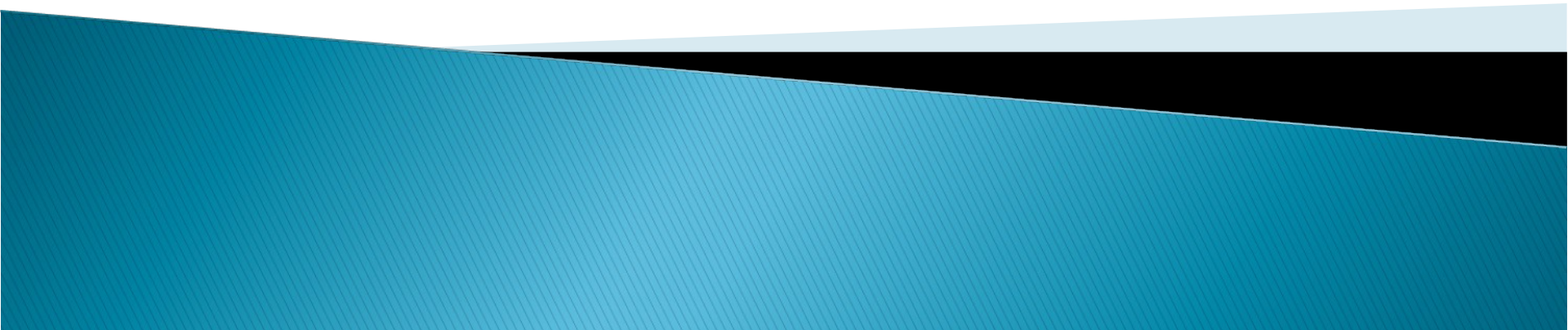
CONTENTS

1. INTRODUCTION

1.1. General

1.2. Selection of Construction Equipment

1.3. Properties of Soil



CONSTRUCTION EQUIPMENTS

1. Introduction

1.1. General

- 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. 1. General

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. 2 Selection of Construction Equipment

- ❑ 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.
- ❑ Selection of 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
 - Availability

CONSTRUCTION EQUIPMENTS

1. 2 Selection of Construction Equipment

- Specification requirement
- Weather condition
- Time schedule
- Management conditions
- Material influence
- Machine influence

CONSTRUCTION EQUIPMENTS

1.3. Properties of Soil

A) *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

❑ ***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

B) 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.

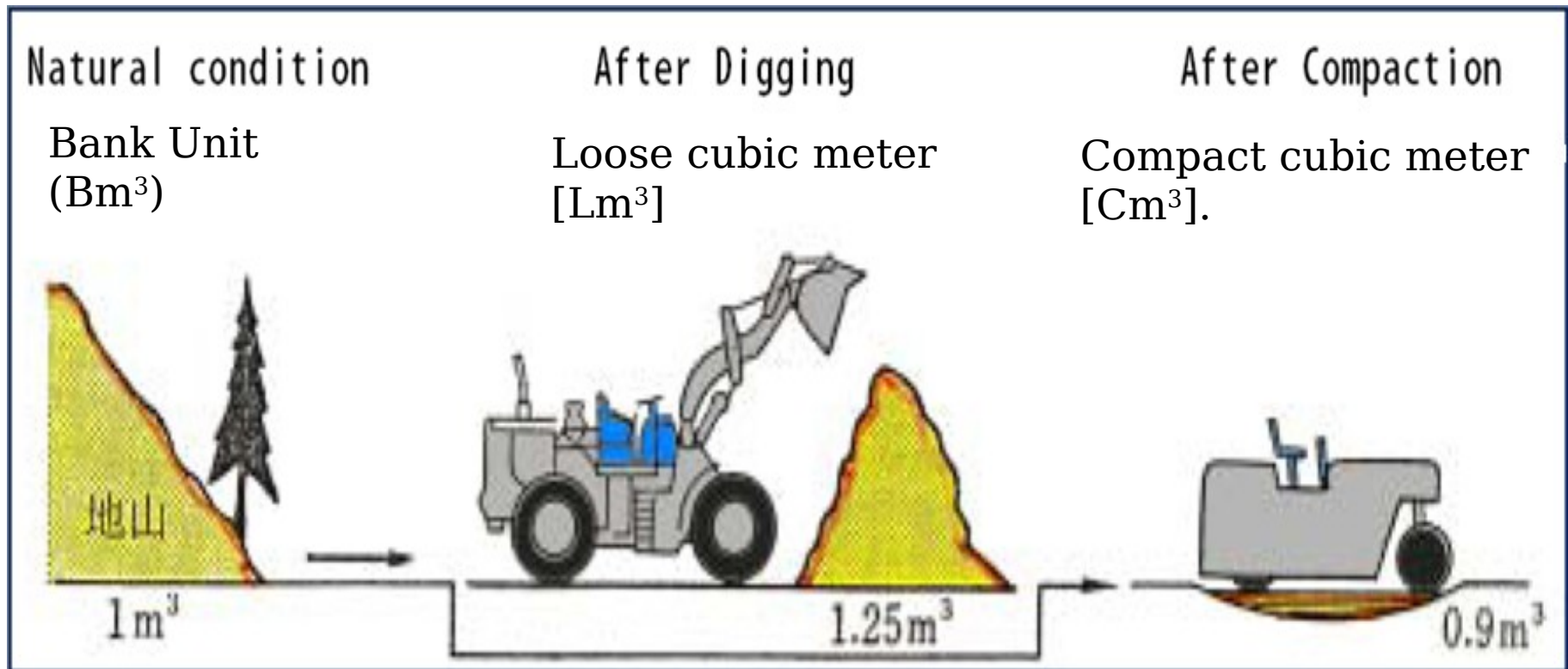
CONSTRUCTION EQUIPMENTS

C) 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

C) Soil Volume Change Characteristics



CONSTRUCTION EQUIPMENTS

C) 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

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

$$\begin{aligned}&= \frac{V_B - V_C}{V_B} \times 100 = [1 - V_C/V_B] \times 100\end{aligned}$$

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

CONSTRUCTION EQUIPMENTS

C) 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

C) 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	2,480	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	2,480	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

THANK YOU!