JECRC Foundation

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE

Year & Sem – 2nd & 4th sem
Subject – Geotechnical Engineering
Unit – I
Presented by – Hitesh Nagar (Asst.Professor , Civil Engg.)

VISION AND MISSION OF INSTITUTE

Vision-

To become a renowned centre of outcome based learning, and work towards academic, professional, cultural and social enrichment of the lives of individuals and communities.

Mission-

M1. Focus on evaluation of learning outcomes and motivate students to inculcate research aptitude by project based learning.

M2. Identify, based on informed perception of Indian, regional and global needs, areas of focus and provide platform to gain knowledge and solutions.

M3. Offer opportunities for interaction between academia and industry.

M4. Develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge in a range of professions.

VISSION AND MISSION OF DEPARTMENT

Vision-

To become a role model in the field of Civil Engineering for the sustainable development of the society.

Mission-

M1. To provide outcome base education.

M2. To create a learning environment conducive for achieving academic excellence.

M3. To prepare civil engineers for the society with high ethical values.

CONTENTS (TO BE COVERED)

Chepter-1

Part 1-

- Introduction: Objective, scope and outcome of the course.

Part 2-

- Soil and soil-mass constituents.
- Terms and properties of soil-water content, specific gravity, void ratio, porosity, degree of saturation, air void and air content, unit weights, density index etc.

LECTURE CONTENTS WITH A BLEND OF NPTEL CONTENTS

- Soil and soil-mass constituents.
- Terms and properties of soil-water content, specific gravity, void ratio, porosity, degree of saturation, air void and air content, unit weights, density index etc.

SOIL STRENGTH

Construction Materials

Concrete, Steel, Bricks, Wood, Aggregate, Soil, etc.

Most important property for Civil

Engineers? *Material Strength*

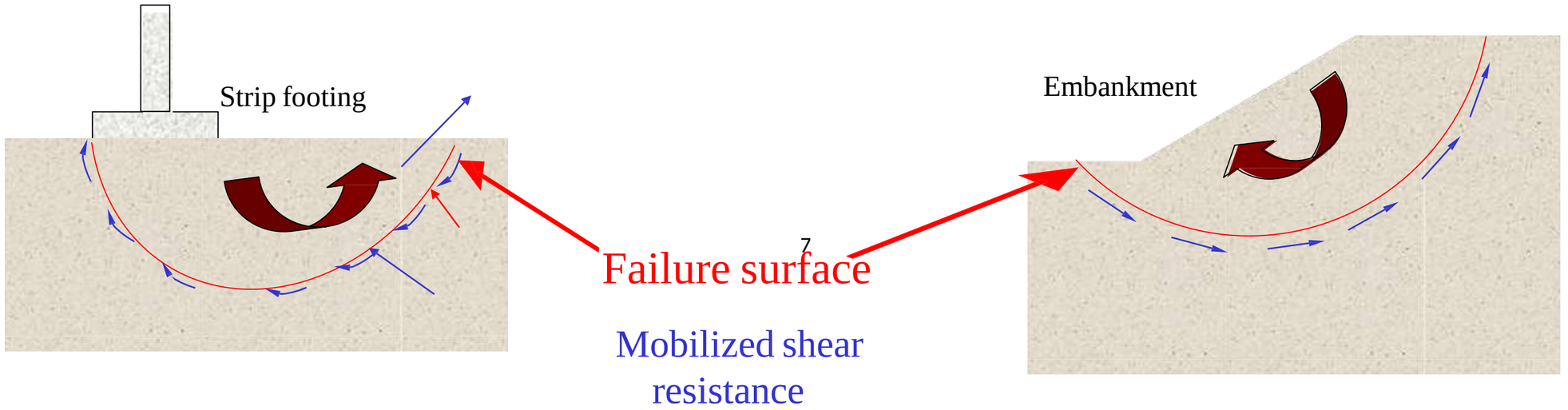
strength

- Concrete, Brick, Wood → *Compressive*
- Steel → *Tensile Strength*
- Soil ?

SOIL STRENGTH

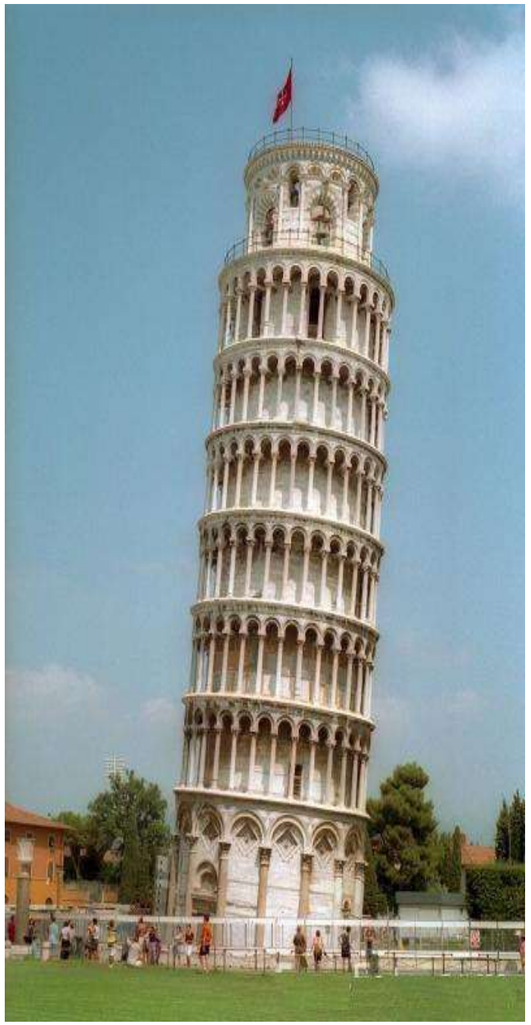
SOIL

- Mostly loaded in *compression*
- But fails mostly in *shear*



- *Greatest shear stress* a material can sustain before failure
- *Safety* of geotechnical structure dependent on *soil shear strength*
- Failure of *soil* → Failure of whole *structure*

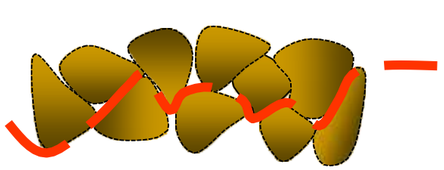
Typhoon triggered landslide Wakayama, Japan (September 2011)

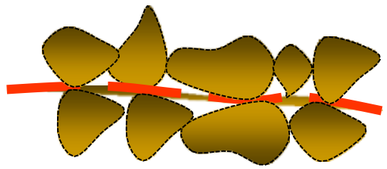


SHEAR STRENGTH OF SOILS

- Resistance to *shearing stresses*

- *Shear failure* occurs due to *sliding* or *rolling* of particles past each other.
- ***Sources*** of soil shear strength
  - Cohesion (stress *independent* component)
    - *Cementation* between sand grains
    - *Electrostatic attraction* between clay particles
  - Frictional resistance (stress *dependent* component)
    - *Interlocking between sand grains*

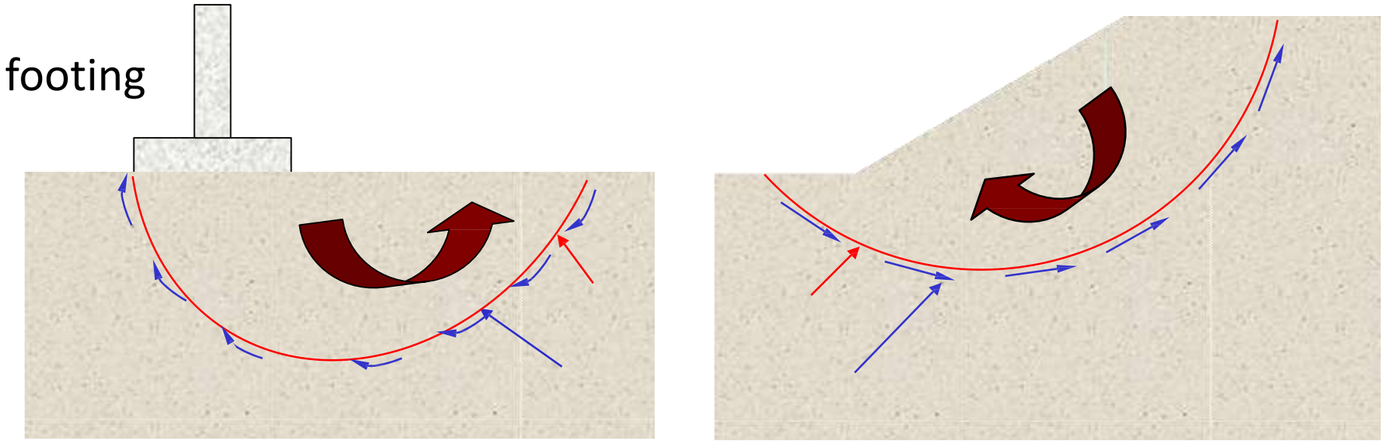




- Soils generally fail in *shear*

Strip footing

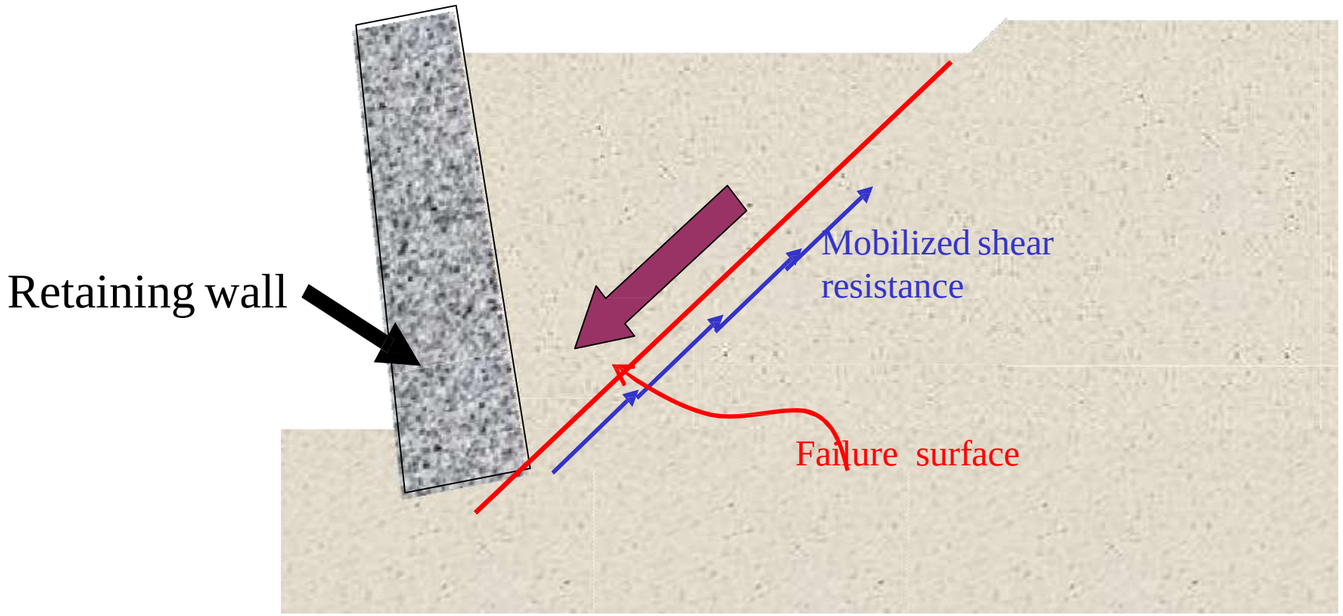
- Embankment



Failure surface Mobilized shear resistance

At failure, *shear stress/resistance along failure surface* (**mobilized shear resistance**) reaches the *shear strength*.


Retaining wall


Retaining wall
Mobilized shear resistance
Failure surface

Soil is formed due to the *weathering* of rocks.

Weathering

Weathering is a process whereby an intact rock mass is decomposed or broken into a loose material by the action of various atmospheric agents.

Types of Weathering

1. Mechanical/Physical Weathering
2. Chemical Weathering

MECHANICAL WEATHERING

Mechanical weathering agents;

1. Temperature changes
2. Freezing & Thawing
3. Erosion/Abrasion due to flowing of water/wind
4. Natural disasters (landsides, earthquakes, etc)
5. Activities by plants, animals, humans, etc.

- Soils formed by mechanical weathering have the same composition as that of the parent rock.
- Soils formed by mechanical weathering retains the minerals and material fibers as that of the parent rock.
- Coarse grained soils (gravels, sands and their mixtures) are the examples of mechanical weathering.

1. Residual soil deposits
   i. Coarse grained
   ii. Fine grained
2. Transported soil deposits
   i. Alluvial deposits
   ii. Aolean deposits
   iii. Colluvial deposits
   iv. Glacial deposits
   v. Lucastrine deposits
   vi. Marine deposits
   vii. Pyroclastic deposits
3. Organic soil deposits
   i. Peat (partially decomposed organic matter)
   ii. Muck (completely decomposed organic matter)

RESIDUAL vs TRANSPORTED SOILS

Residual soils

Deposited at the place of decomposition.

- Properties of *coarse grained soils* generally depend upon size of particles.
- Properties of *fine-grained soils* are greatly influenced by mineral content, moisture content, etc.
- The knowledge of "classical" geotechnical engineering is mostly based on behavior of transported soils. The understanding of residual soils is insufficient in general.

Transported soils

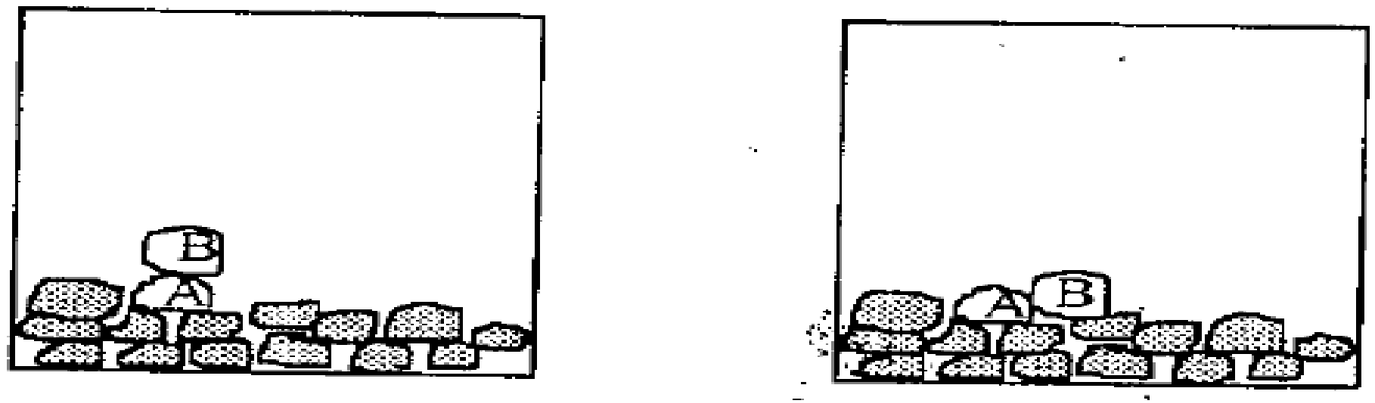
Moved and deposited at other places.

- Particle size generally depends on mode of transportation
- Transported soils can be categorize based on the mode of transportation and deposition.

1. **Glacial soils**: formed by transportation and deposition of glaciers.
2. **Alluvial soils**: transported by running water and deposited along streams.
3. **Lacustrine soils**: formed by deposition in quiet lakes.
4. **Marine soils**: formed by deposition in the seas.
5. **Aeolian soils**: transported and deposited by the wind.
6. **Colluvial soils**: formed by movement of soil from its original place by gravity, such as during landslide.
7. **Pyroclastic soils**: materials ejected from volcanoes, and transported through gravity and wind, etc.

Single Grained Structure

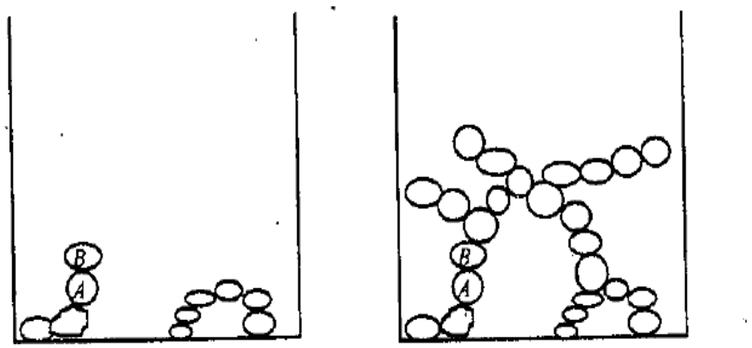
- Formed by the suspension of coarse-grained particles in a soil-fluid suspension.
- Generally formed by cohesionless particles (e.g. sands)
- In loose form soils may be weak and unstable but quality can be improved by compaction.



Single-grained soil structure

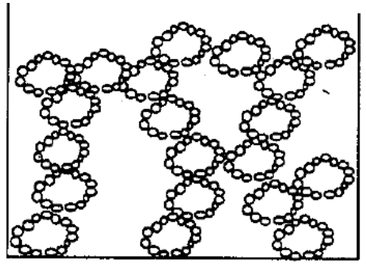
Honey Combed/Cellular Structure

- Formed by the particles having inter-particular attraction (cohesion) greater than their weight.
- Structure having large voids inside.
- Meta-stable structure.
- May be stable under static loads but can fail upon vibrations or dynamic load application.



Flocculent Structure

- Formed by very small sized particles (< $5x10^{-4}$cm)
- Soil particles floating at the surface join together and form *flocs*. Settling down of *flocs* give rise to flocculent structure.
- Double honey-combed structure.



REFERENCES/BIBLOGRAPHY

Soil Mechanics and Foundation Engineering written by Dr.**K.R. Arora**, B.E (Civil), M.E (Hons) Ph.D (IITD), F.I.E, M.I.G.S, FISDT, MIWRS,

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Thank you!