

# NPTEL COURSE

## GROUND IMPROVEMENT

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# Module I

- Need for Ground Improvement
- Different types of problematic soils
- Emerging trends in ground Improvement

# Need for engineered ground improvement

## Concerns

- Mechanical properties are not adequate
- Swelling and shrinkage
- Collapsible soils
- Soft soils
- Organic soils and peaty soils
- Sands and gravelly deposits, karst deposits with sinkhole formations
- Foundations on dumps and sanitary landfills
- Handling dredged materials
- Handling hazardous materials in contact with soils
- Use of old mine pits

Leaning tower of Pisa



Kandla Port Building after 2001 earthquake



## Effect of Swelling



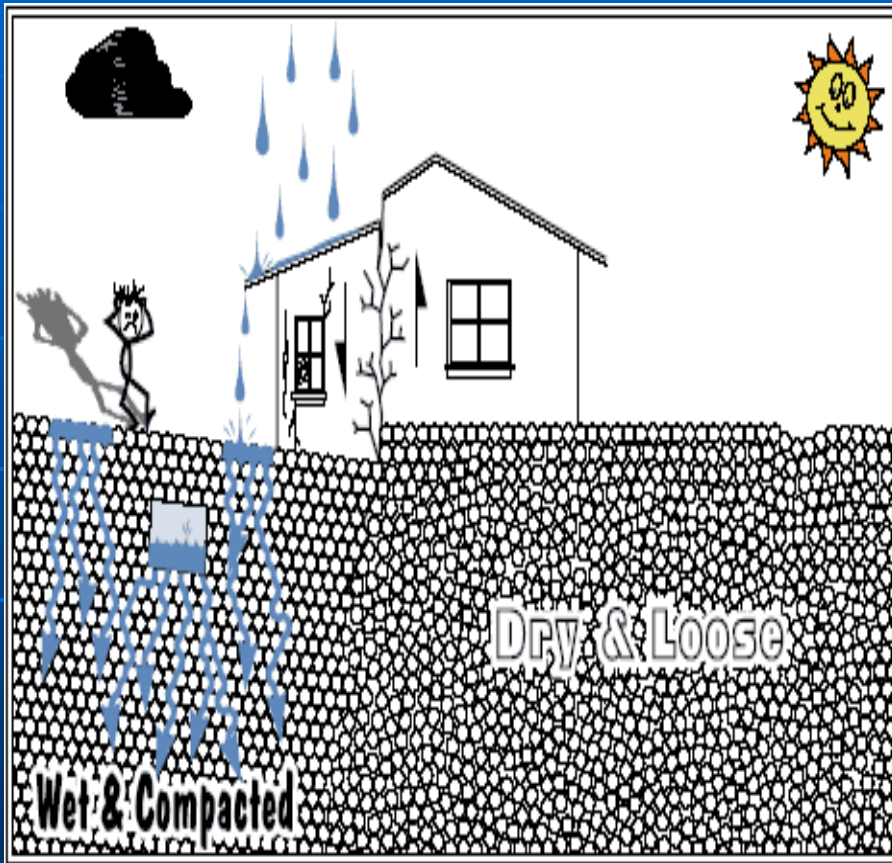
Expansive Soil

# Effect of shrinkage



Swelling and shrinking soils exist in many areas in India, Large tracts of Maharashtra, Andhra, Deccan plateau, Chennai

# Collapsible soils



Collapse occurs due to saturation, loss of cementation bonds, specific clay structure and areas in some areas in Rajasthan and in some counties abroad this is prevalent.

# Slope Failure in Sweden





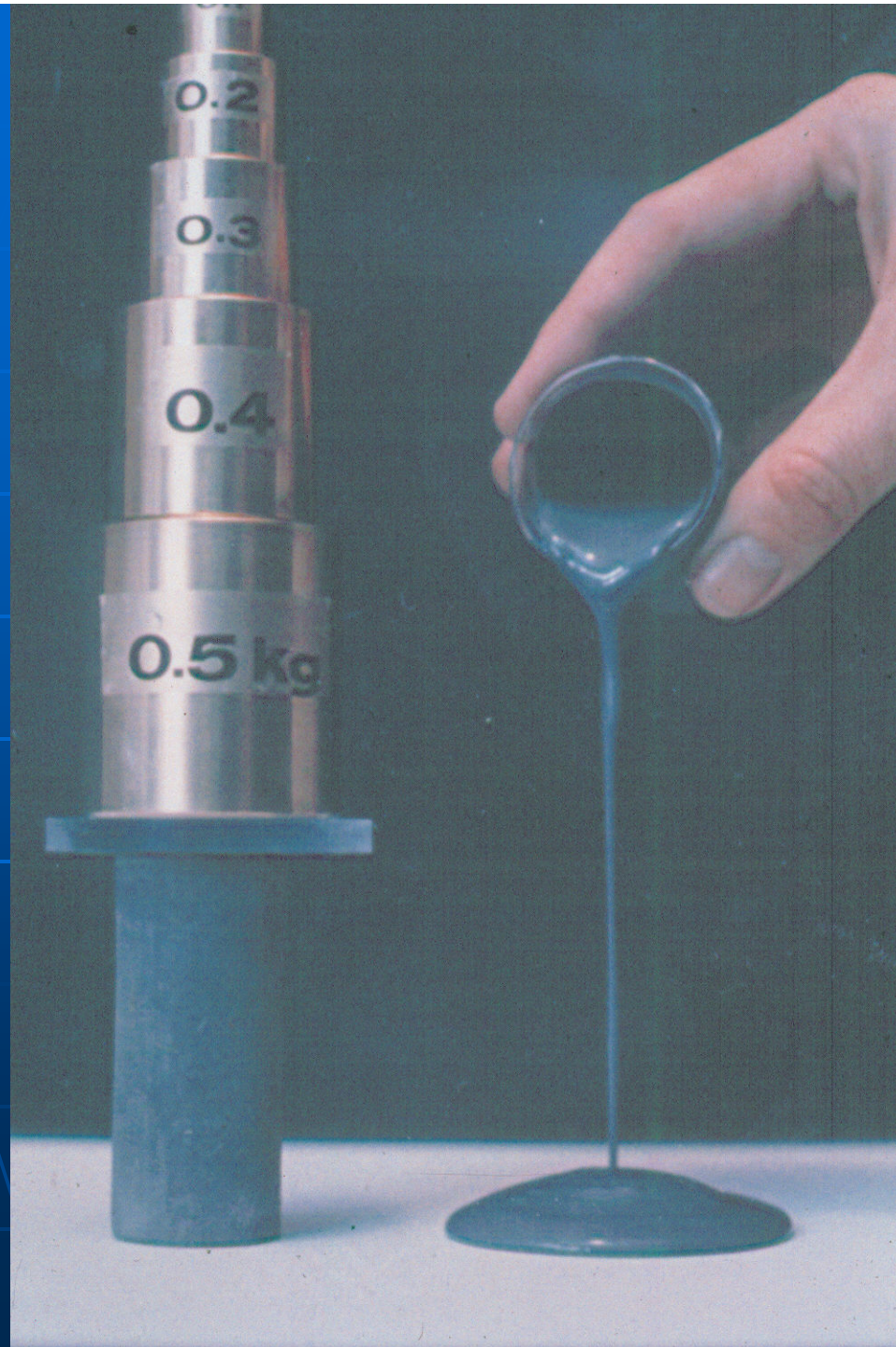
# Failure of slope



# Effects of liquefaction



# Effect of Disturbance on a Quick Clay



# Need for engineered ground improvement Strategies

When a project encounters difficult foundation conditions, possible alternative solutions are

- Avoid the particular site
- Design the planned structure (flexible/rigid) accordingly
- Remove and replace unsuitable soils
- Attempt to modify existing ground
- Enable cost effective foundation design
- Reduce the effects of contaminated soils
- Ensure sustainability in construction projects using ground improvement techniques

# Ground Improvement Techniques for different soil types

Ground improvement can be done through various mechanisms

- ❖ Compaction
- ❖ Dewatering
- ❖ Reinforcement
- ❖ Admixtures or grouting

## Reinforcement

- This method improves the soil response by interaction between soil and inclusion.
- The improving period depends on the life of inclusion.
- In this technique there is no change in the state of soil.
- It is a widely used technique as it can be done for many types of soils.

## Admixtures or Grouting

- Cementation plays a major role in improving the soil response.
- Short term/long term improvement techniques are possible.
- There is a change in soil state after adopting it.

## Compaction

- The state of soil is improved in this technique due to high densification.
- This is a long term improvement technique.
- There is a change in soil state after adopting it.
- This technique can be adopted for silty , sandy and gravelly soils.

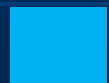
## Dewatering

- This is a technique similar to compaction.
- It is mostly adopted to clayey soils.

SNo	Type of soil	Reinforcement	Admixtures	Compaction	Dewatering
1	Organic soil	Applicable	Applicable	Not applicable	Applicable
2	Volcanic clay soil	Applicable	Applicable	Not applicable	Applicable
3	Highly plastic clay	Applicable	Applicable	Not applicable	Applicable
4	Lowly plastic clay	Applicable	Applicable	Not applicable	Applicable
5	Silty soil	Applicable	Applicable	Applicable	Applicable
6	Sandy soil	Applicable	Applicable	Applicable	Not applicable
7	Gravel soil	Applicable	Not applicable	Applicable	Not applicable



Soils for which the technique is not applicable



Soils for which the technique is applicable



# Classification of ground modification techniques

- Mechanical modification
- Hydraulic modification
- Physical and chemical modification
- Modification by inclusion and confinement
- Combination of the above