0941231
Geotechnical Engineering

Introduction to Geotechnical Engineering

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Outline

- Introduction to Geotechnical Engineering
- Topics to be learned
- Course objectives

What is Geotechnical Engineering?

- Soil Mechanics is the first course in a major civil engineering field called Geotechnical Engineering.
- Geotechnical Engineering involves the application of soil mechanics, rock mechanics, engineering geology, and other related disciplines to civil engineering design and construction.
- Geotechnical Engineering plays a **key role** in all civil engineering projects since **all structures are built in or in the ground.**

Geotechnical Engineering Applications

- Roadway construction
  - Embankments
  - Compaction
  - Drainage design
- Foundations
  - Shallow foundations
  - Deep foundations
- Excavations
- Slope stabilization
- Retaining walls
- Dams
- Tunnels
- Ports
- Mines
- Landfills
- Culverts

Roadway Construction

Embankments

Compaction

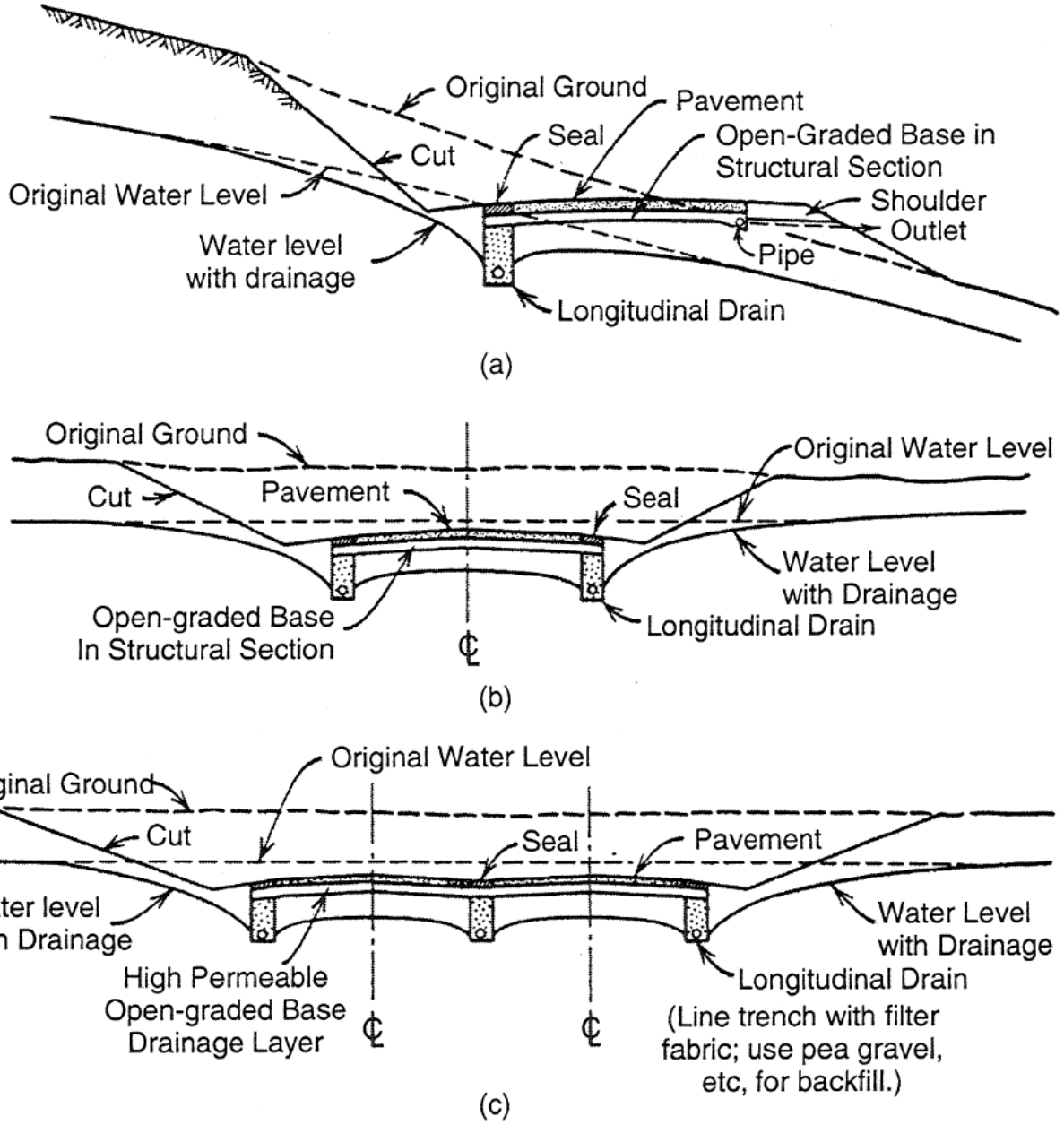
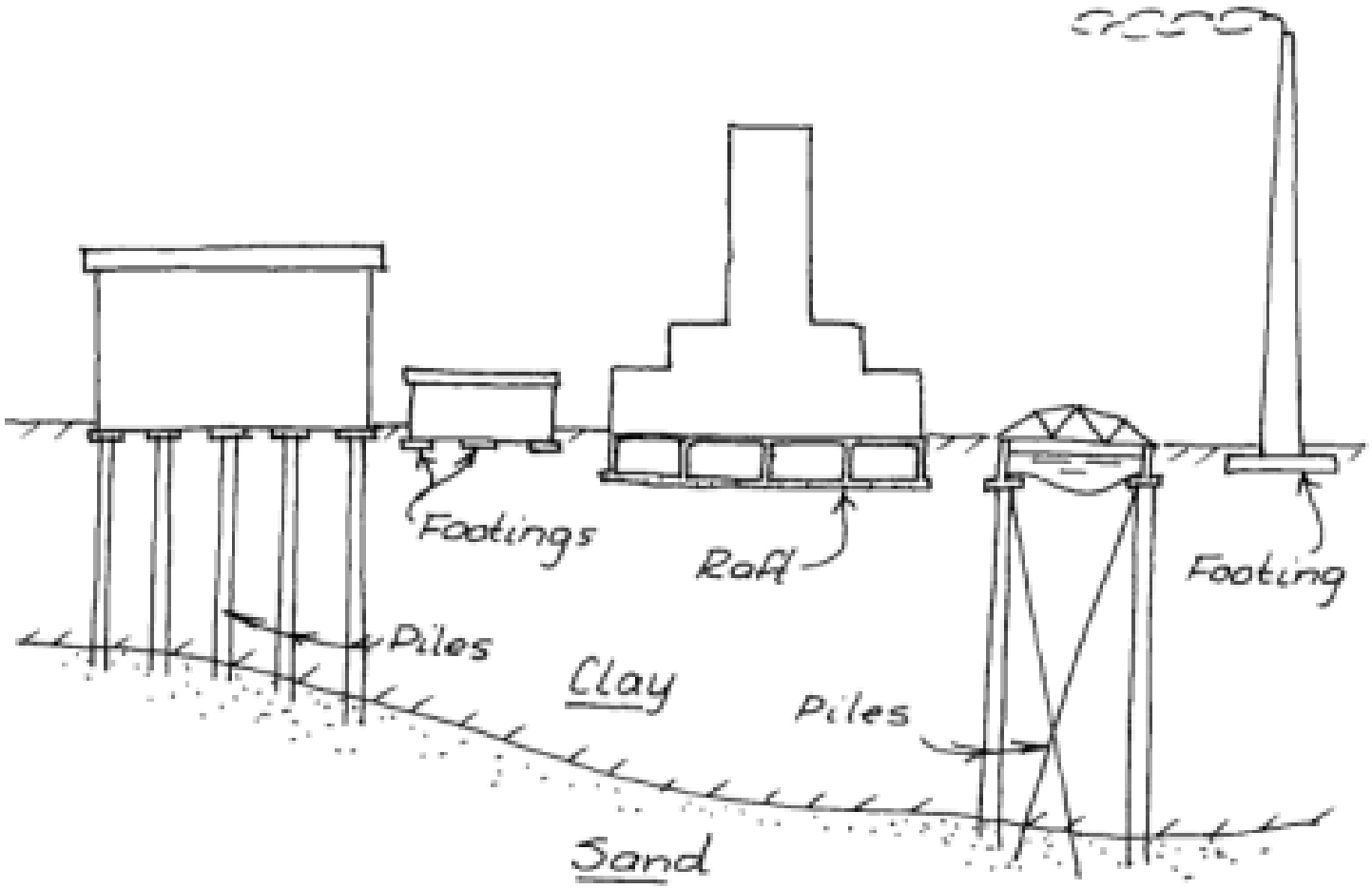


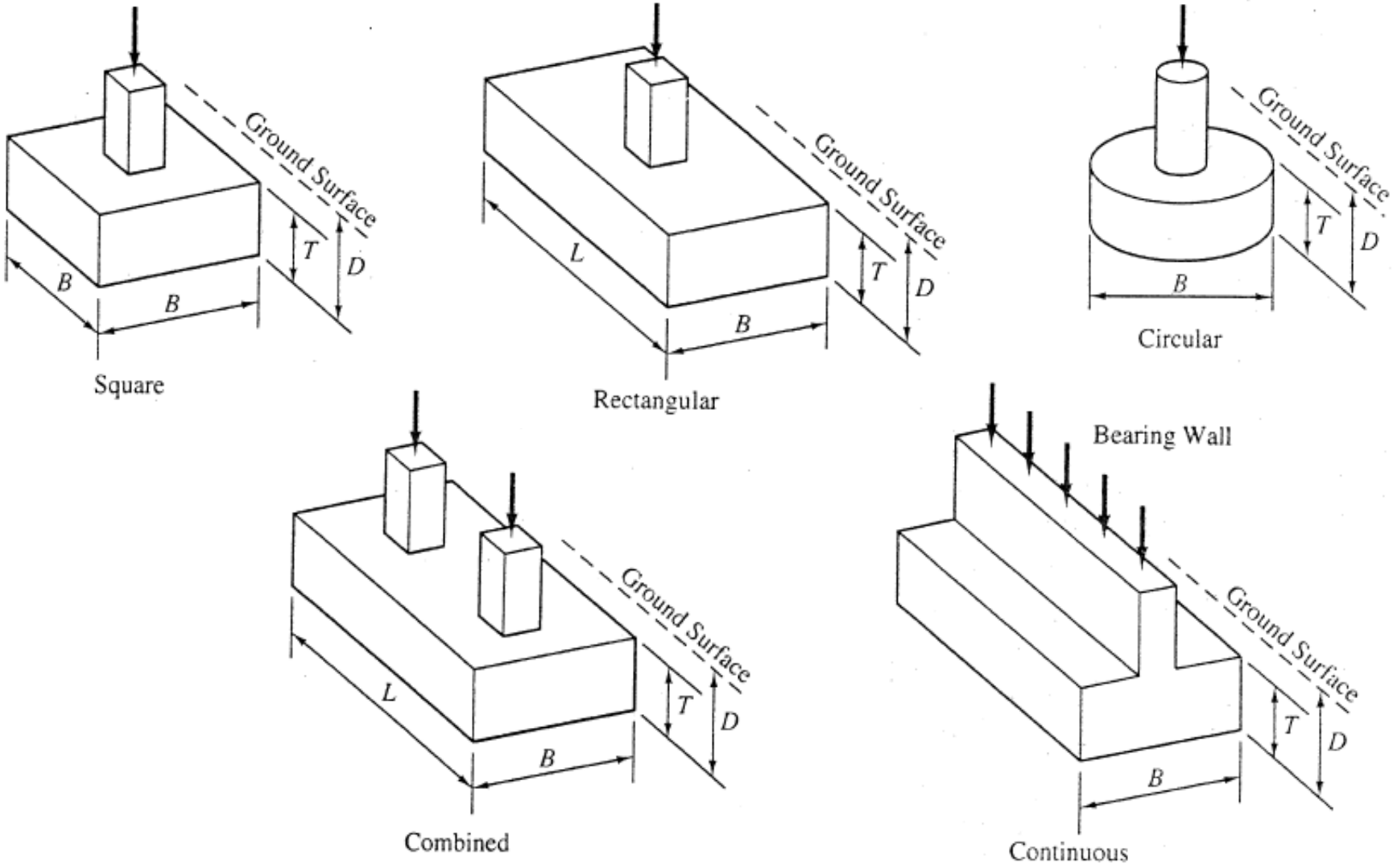
Figure 10.1
Drainage of Ground Water Seepage under Pavement (Ref. 8)

Foundations

Foundations



Shallow Foundations



Shallow Foundations

Mat Foundation

Grade Beam connecting column foundations

Courtesy of Prof Ross Boulanger, UC Davis

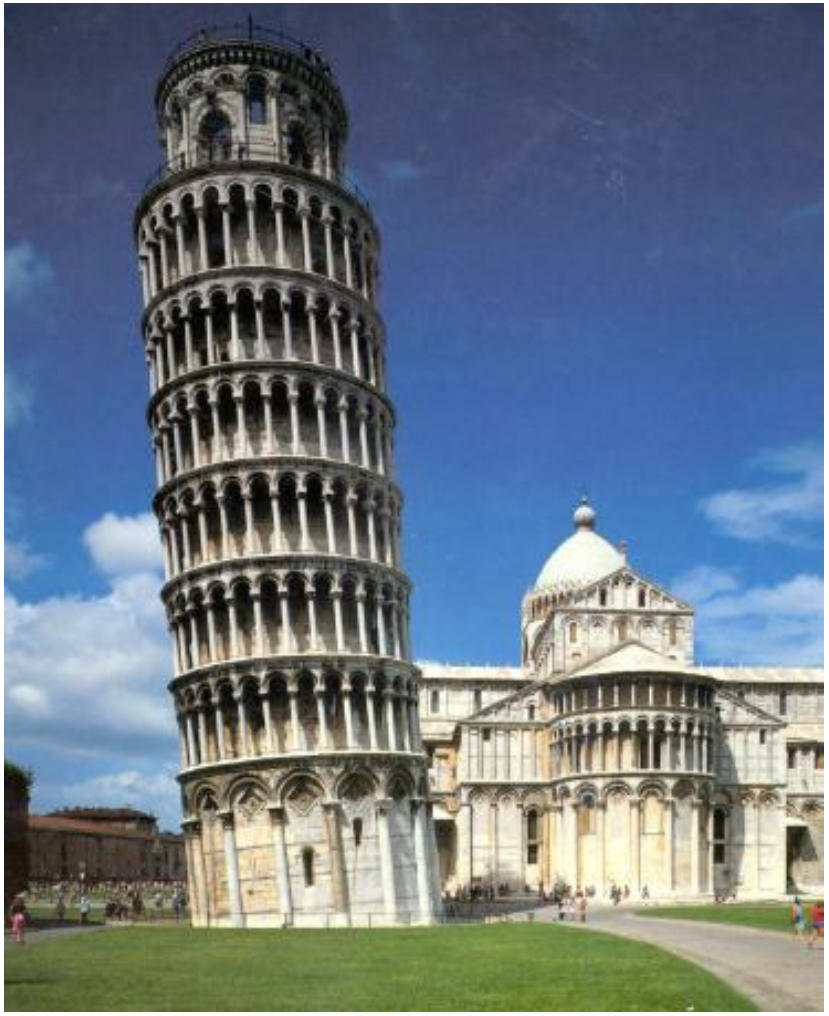
Deep Foundations

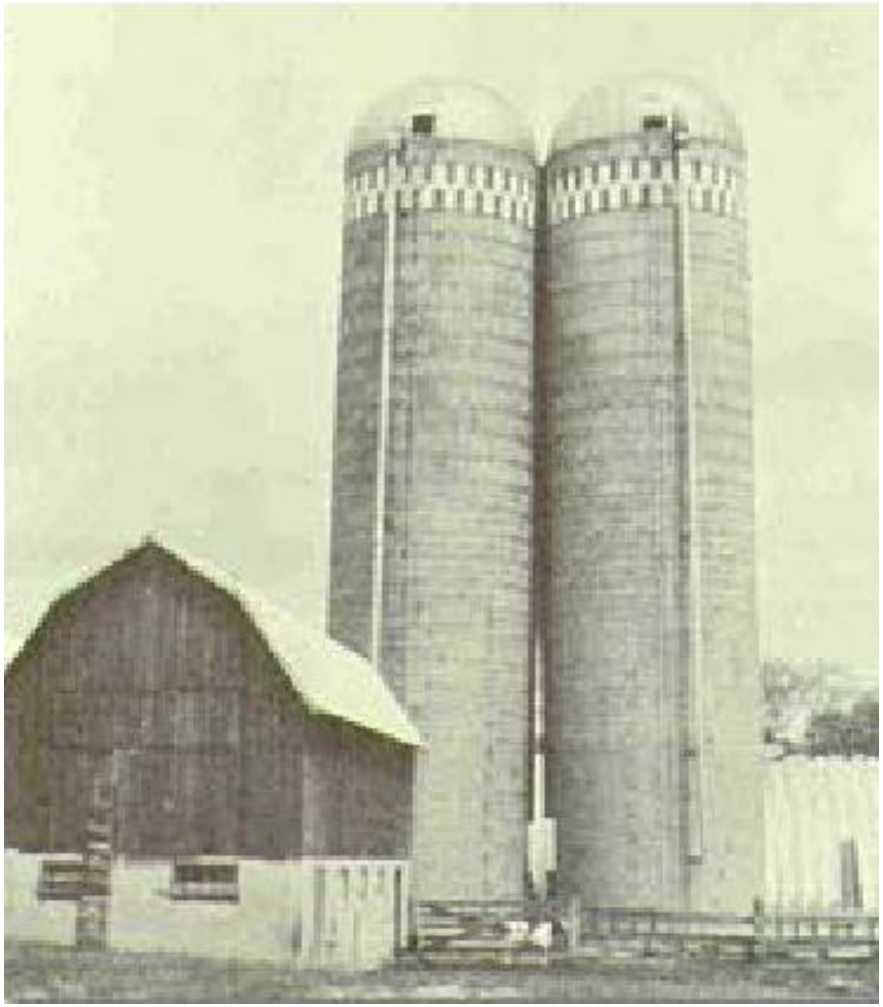
Driven Piles

Deep Foundations

Drilled Shafts

Foundations Failure





Foundations Failure

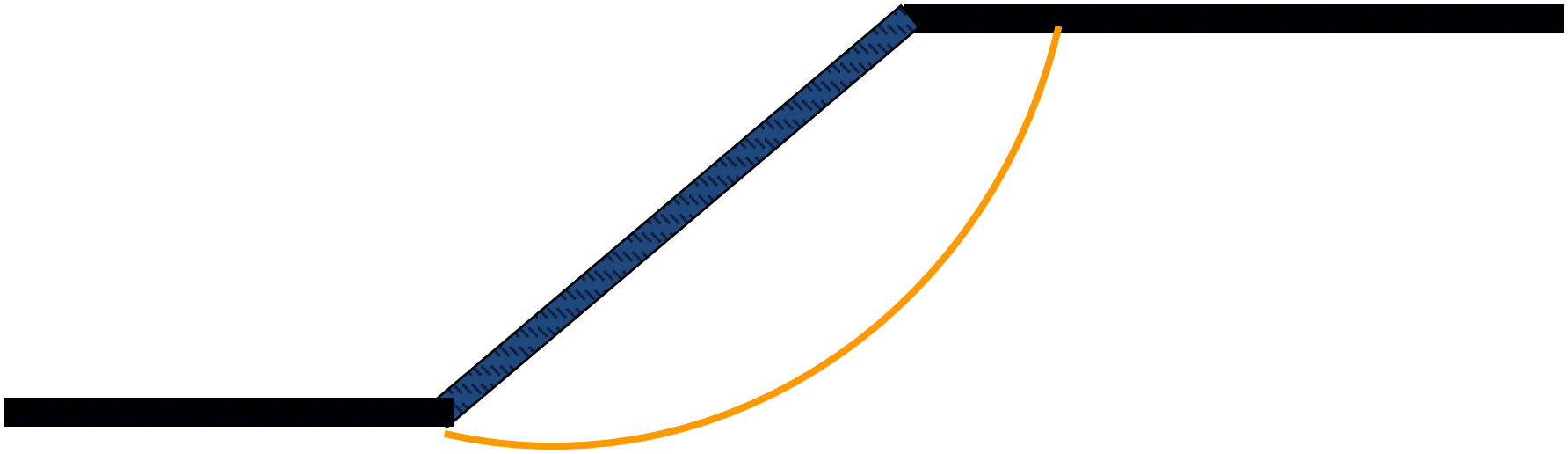
Excavations

Excavations

Courtesy of Prof Ross Boulanger, UC Davis

Slope Stability

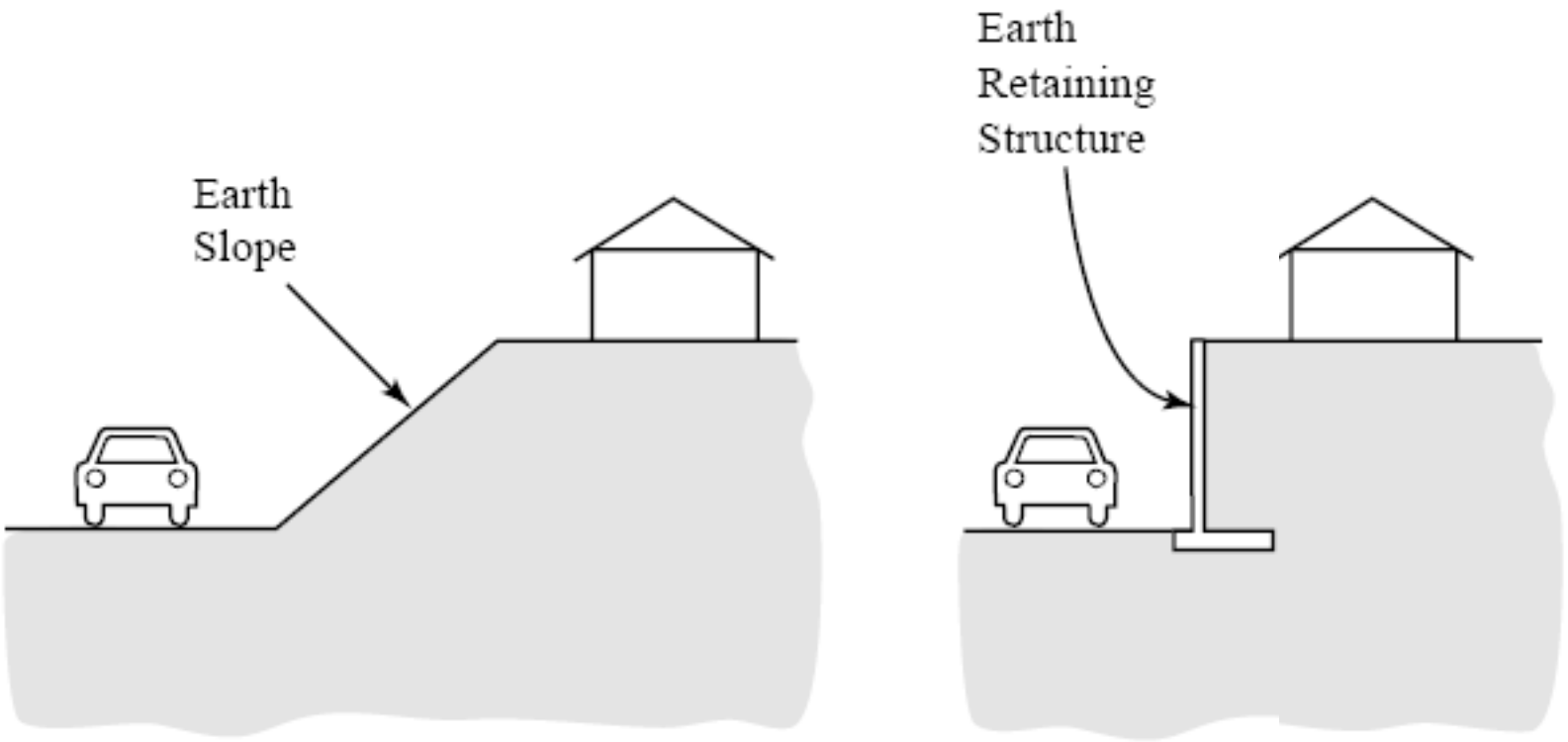
Slope Stability



FS = Resisting Force/Driving Force

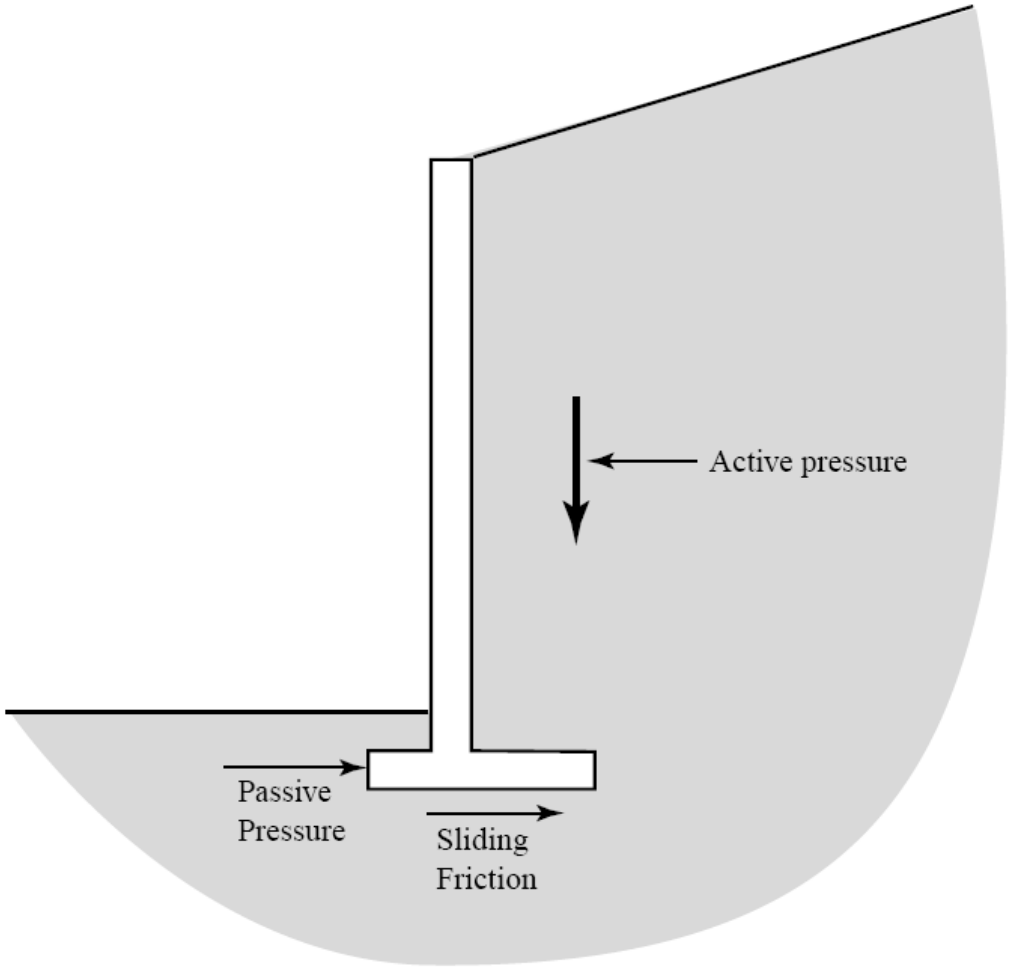
Retaining Walls

Earth Slope and Retaining Walls

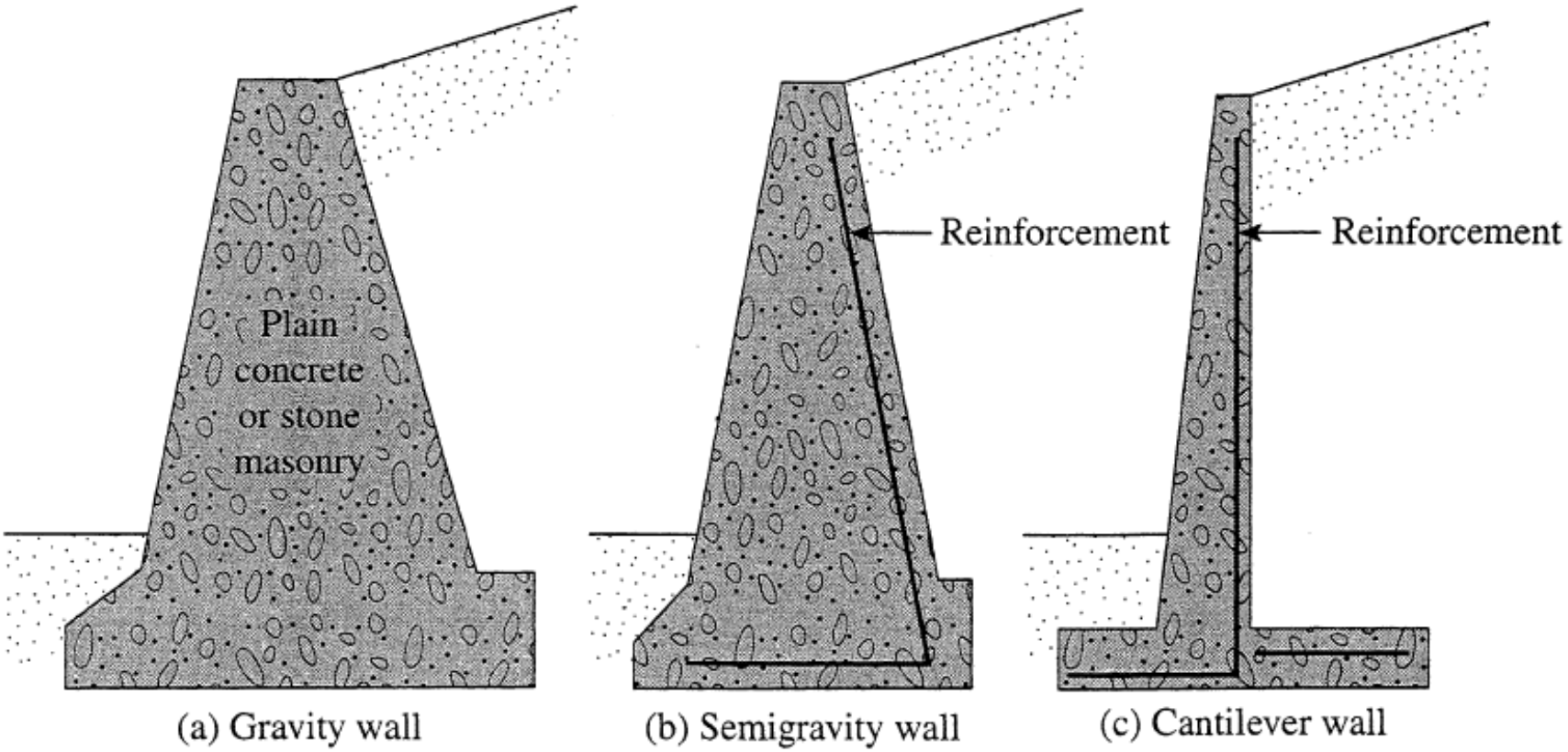


Earth slopes and earth retaining structures are used to maintain two different ground elevations.

Lateral Earth Pressure



Retaining Walls

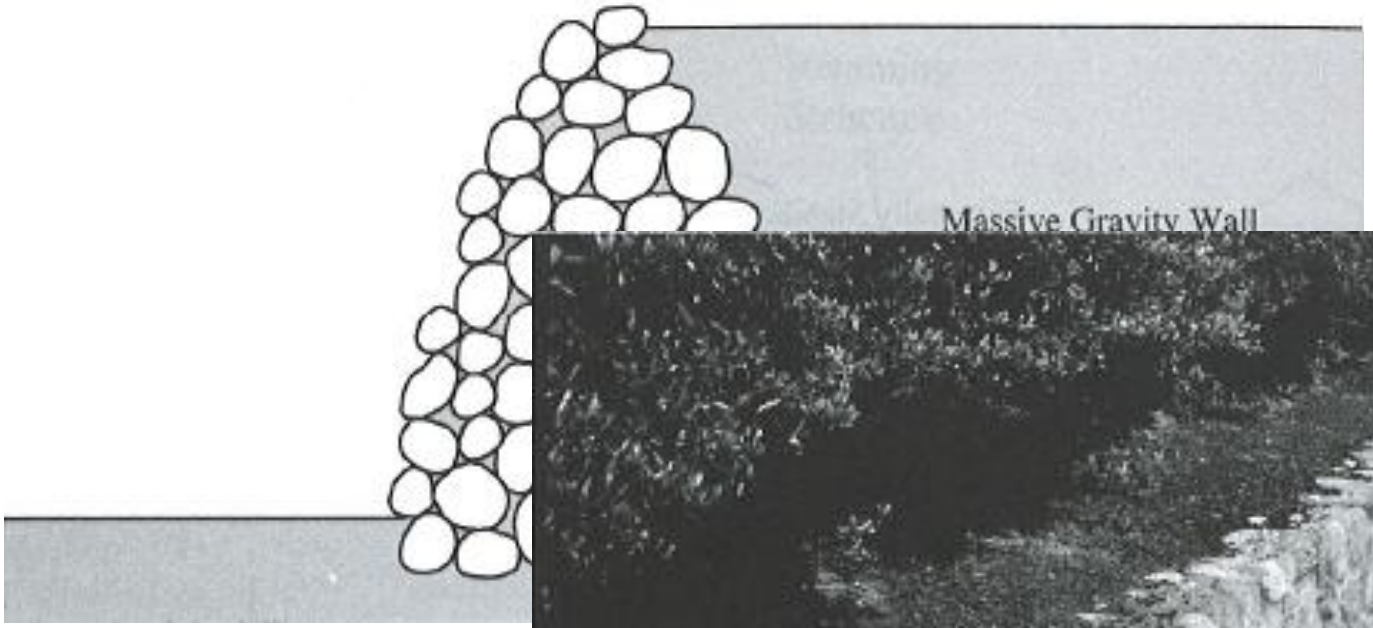


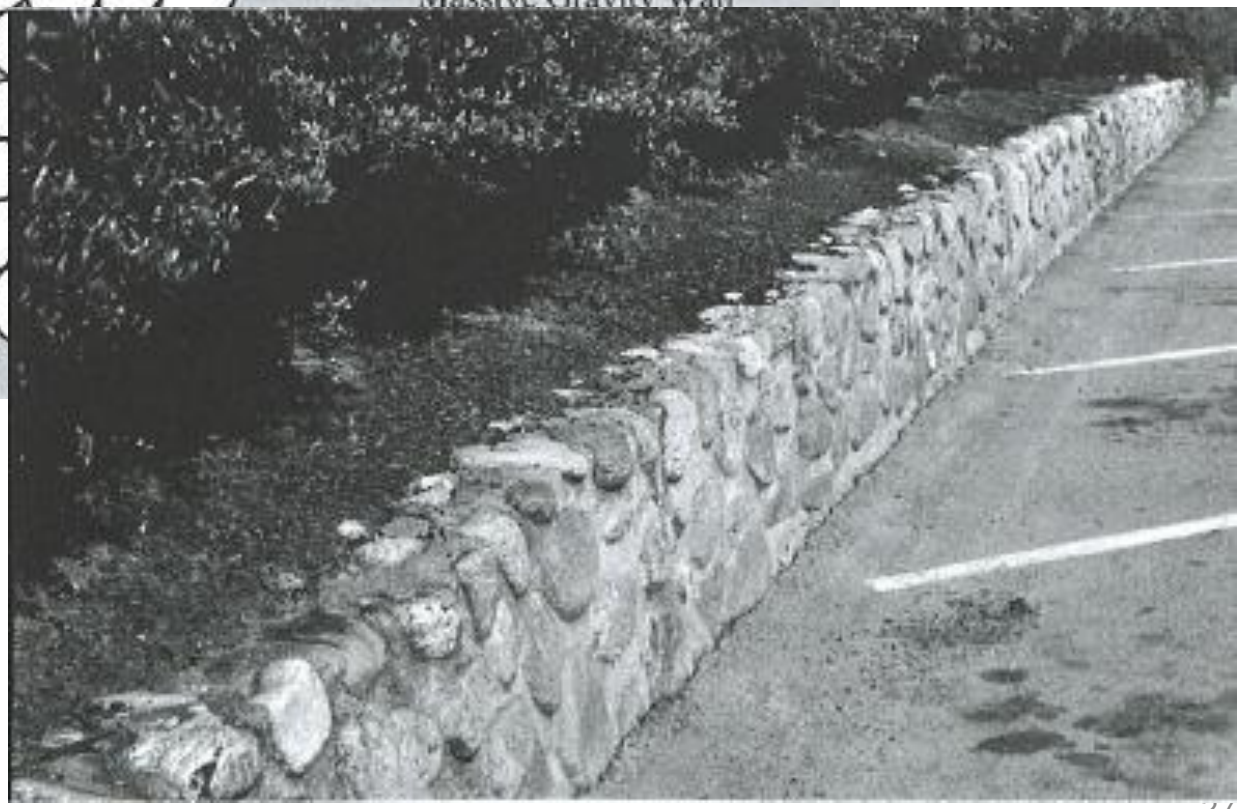
(a) Gravity wall (b) Semigravity wall (c) Cantilever wall

Retaining Walls

Retaining Walls

Retaining Walls

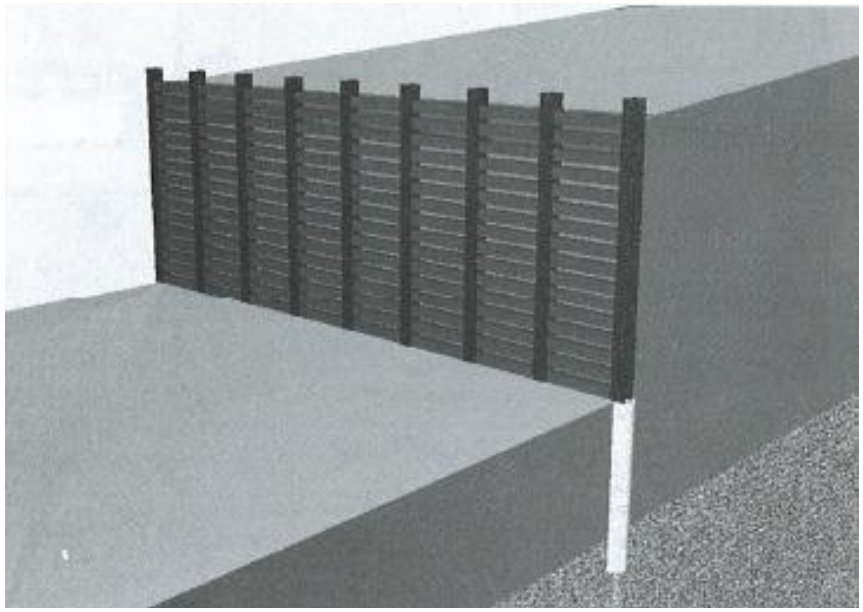




Massive Gravity

Retaining Walls

Soldier Pile Wall



Retaining Walls

Retaining Wall of Drilled Shafts

Retaining Walls

Sheet Piles

Dams

Dams

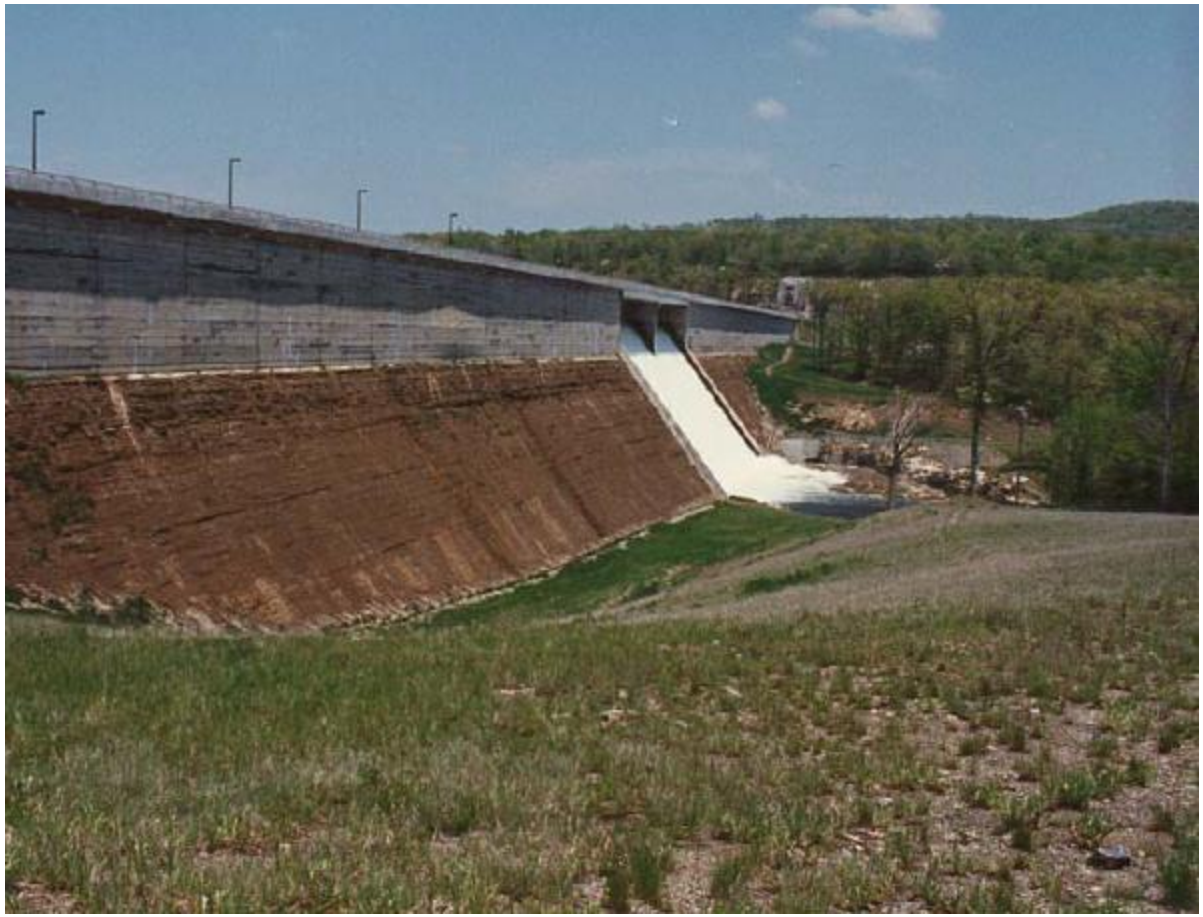
Types

- Gravity Dams
- Arch Dams
- Buttress Dams
- Earth/Rock Fill

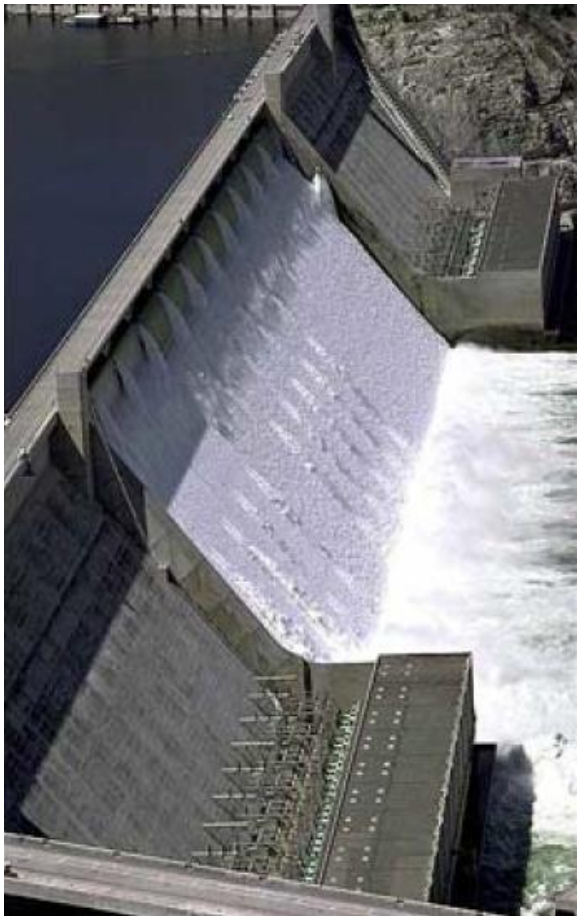
Purposes

- Water supply
- Flood control
- Power production
- Navigation
- Recreation/Asthetic

Gravity Dams

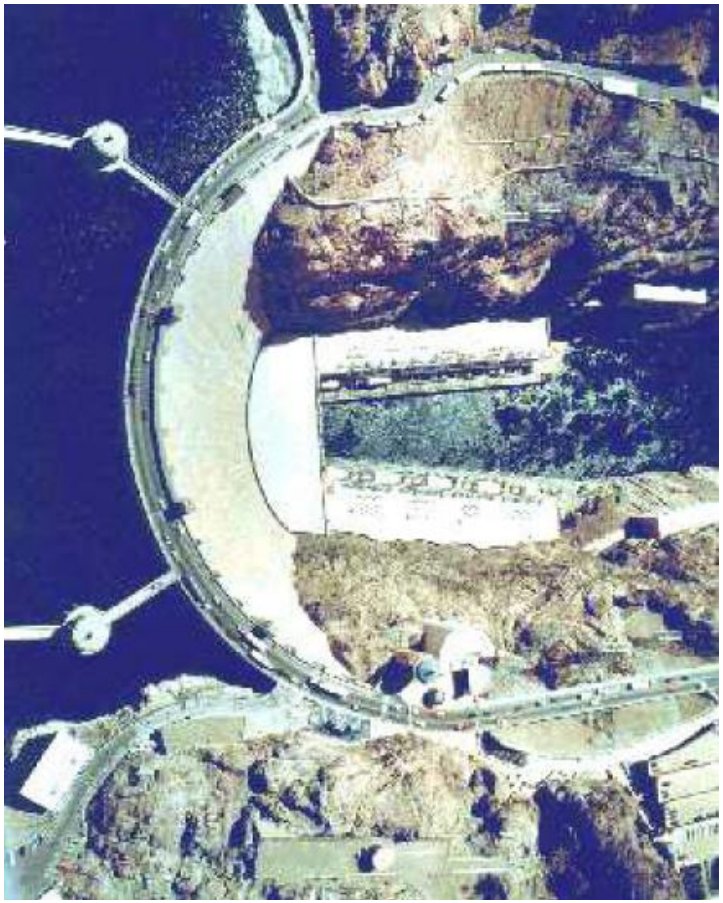


Monksville Dam,
Ringwood Borough, NJ

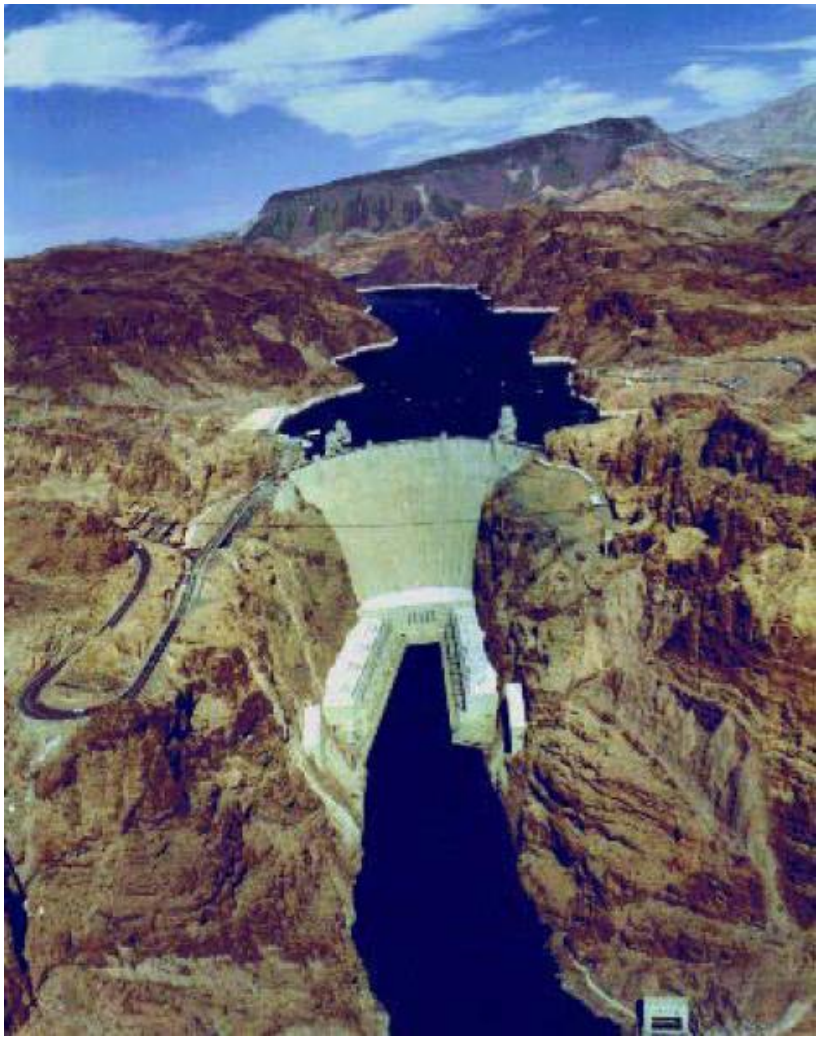


Grand Coulee Dam
Columbia River, WA

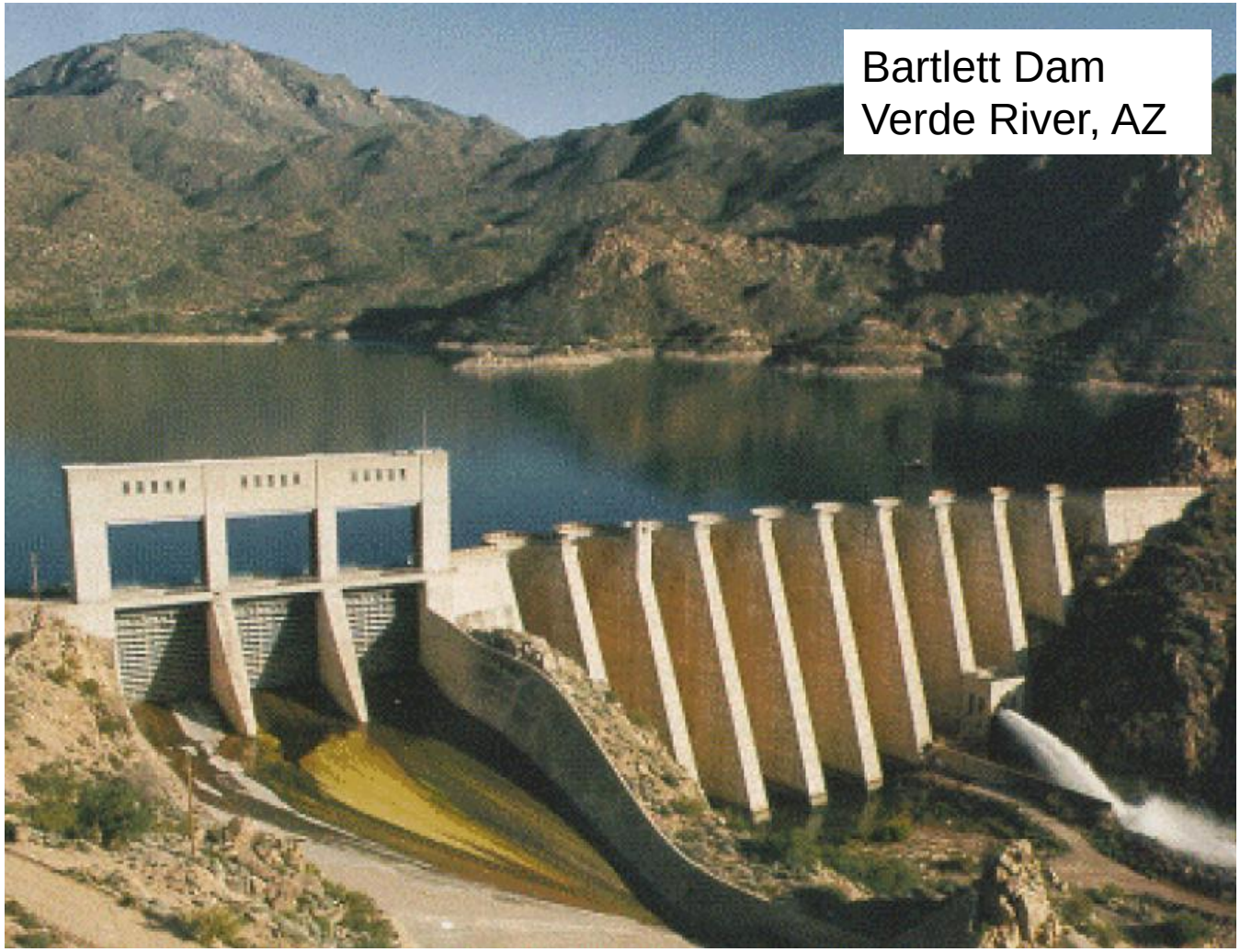
Arch Dams



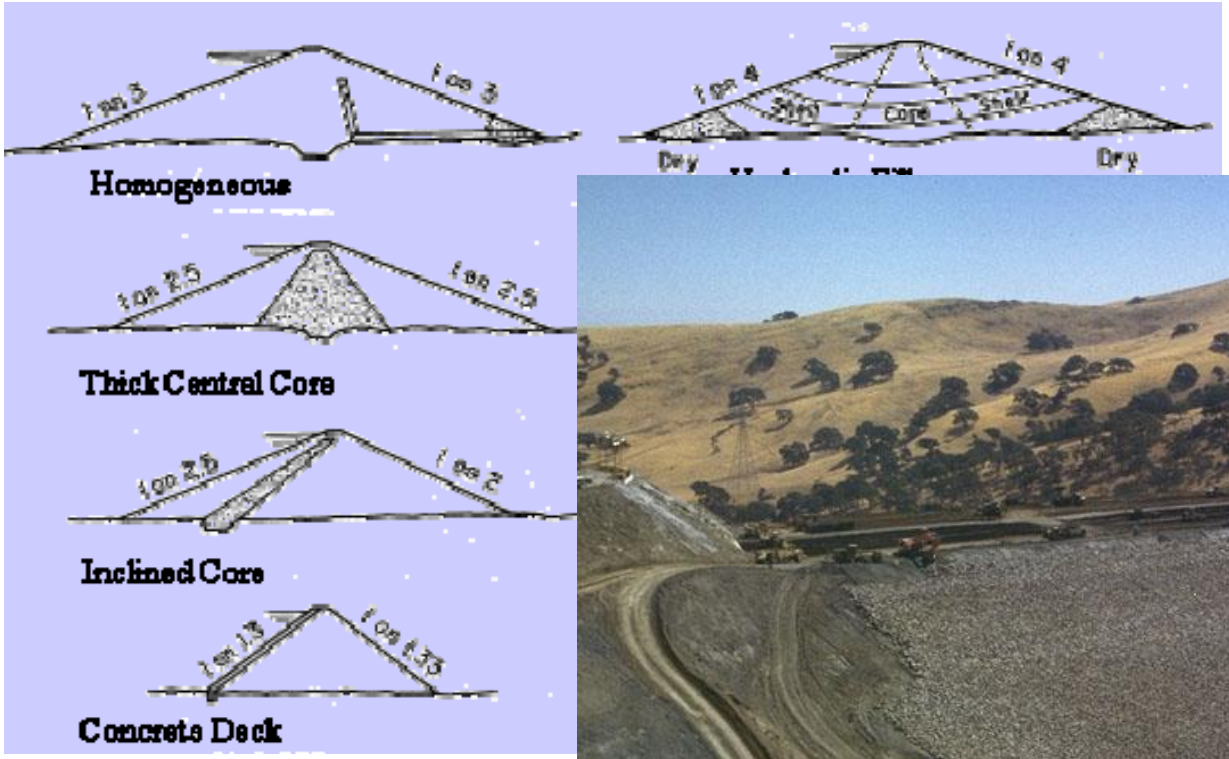
Hoover Dam,
Colorado River

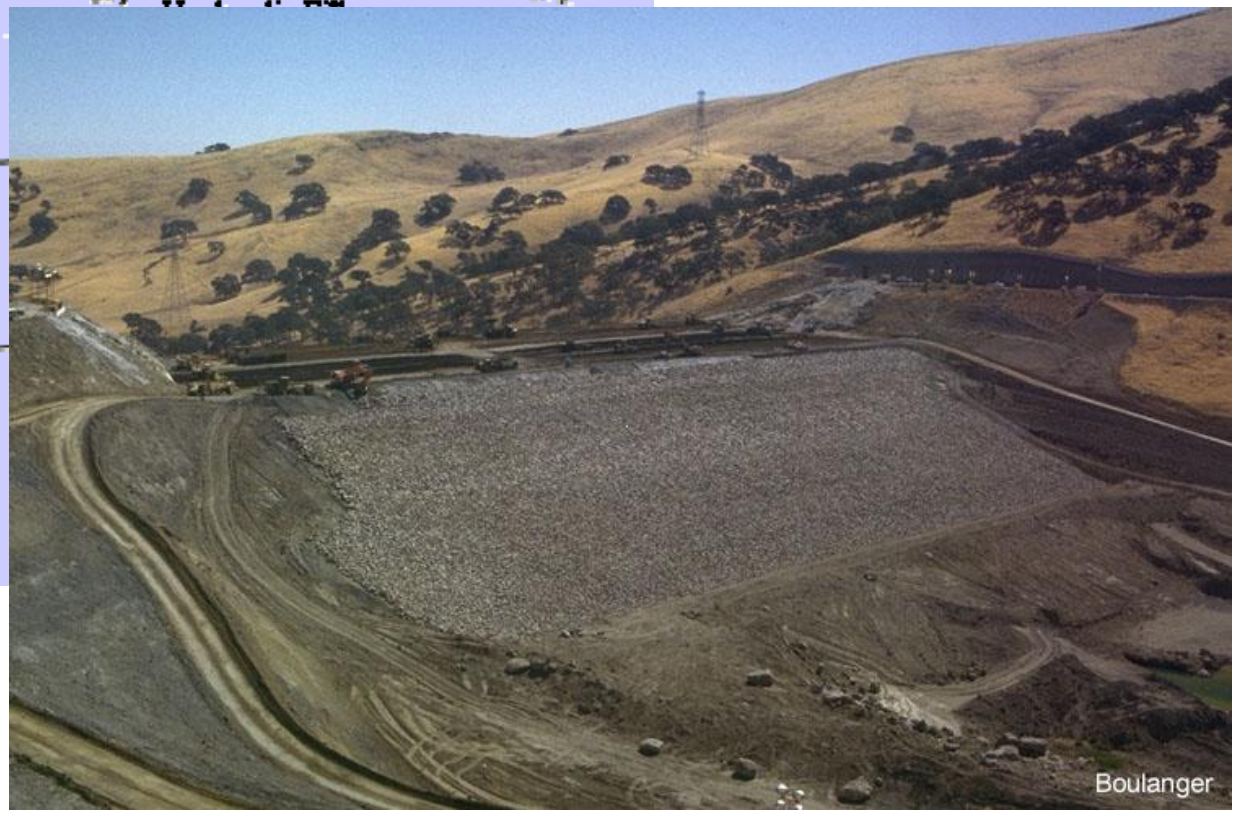


Buttress Dams



Earth Dams





Los Vaqueros Dam, CA, during construction

Natural Hazards

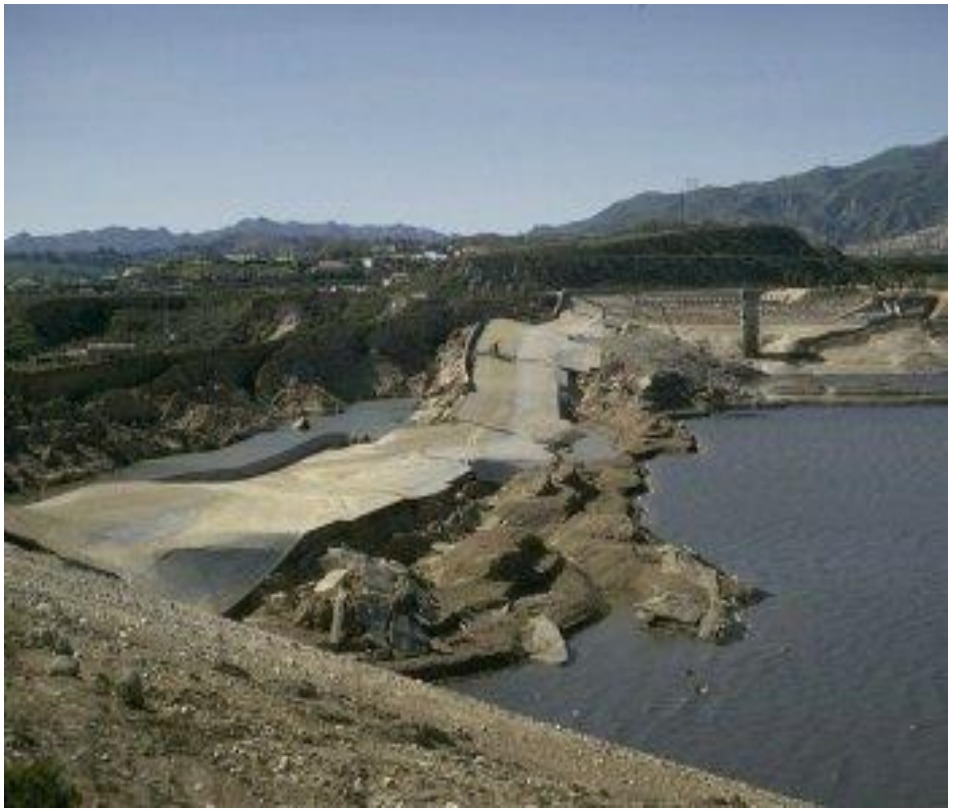
Natural Hazards

- Earthquakes
- Sinkholes
- Landslides

Earthquakes

Earthquakes

The upstream slope of the Lower San Fernando Dam, in California, failed due to liquefaction during the 1971 San Fernando earthquake.



Nishinomiya Bridge - 1995 Kobe Earthquake

Turkey

Boulanger

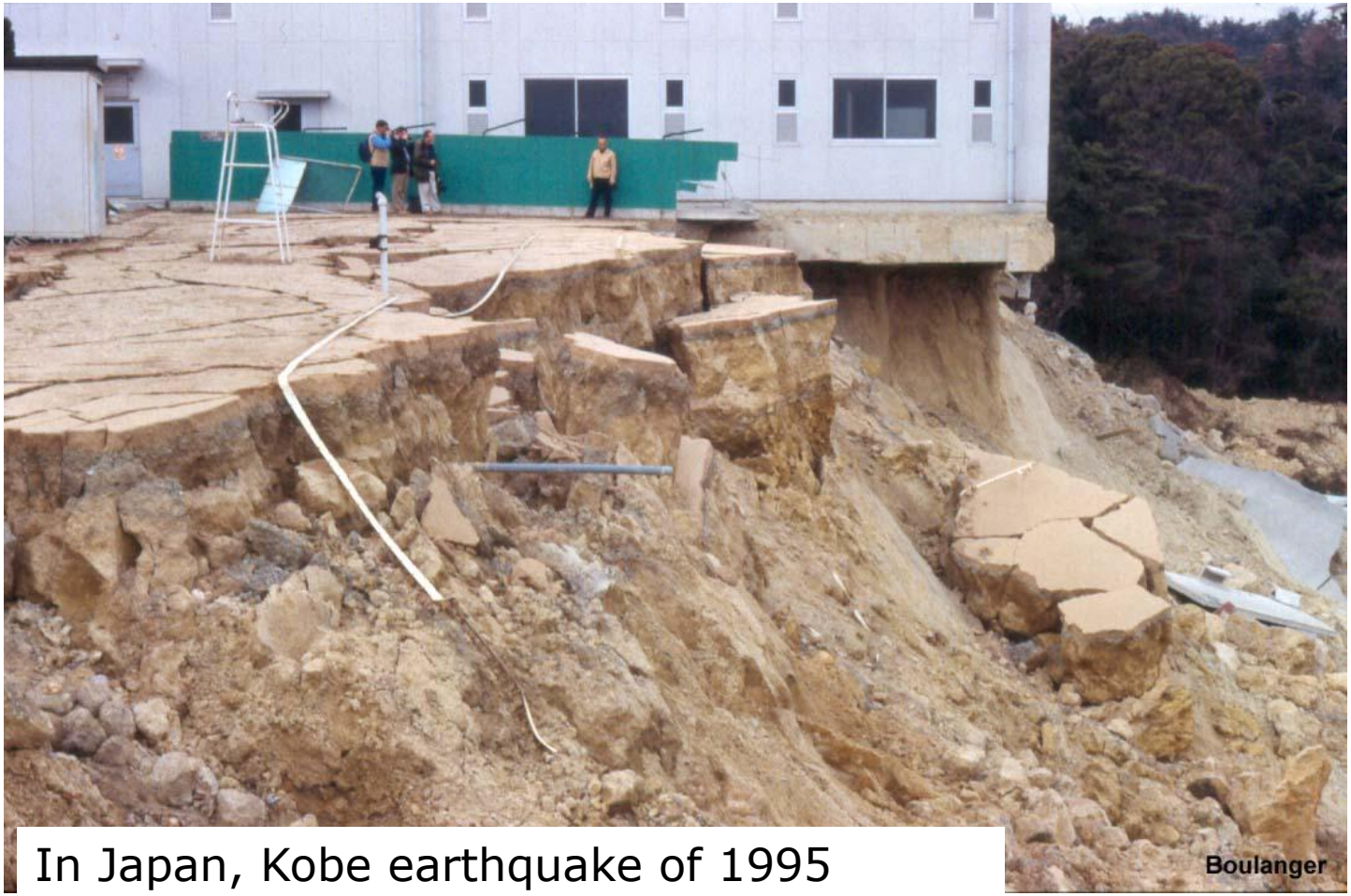
Boulanger

Landslides

Landslides

Courtesy of Prof Jim Duncan, Virginia Tech

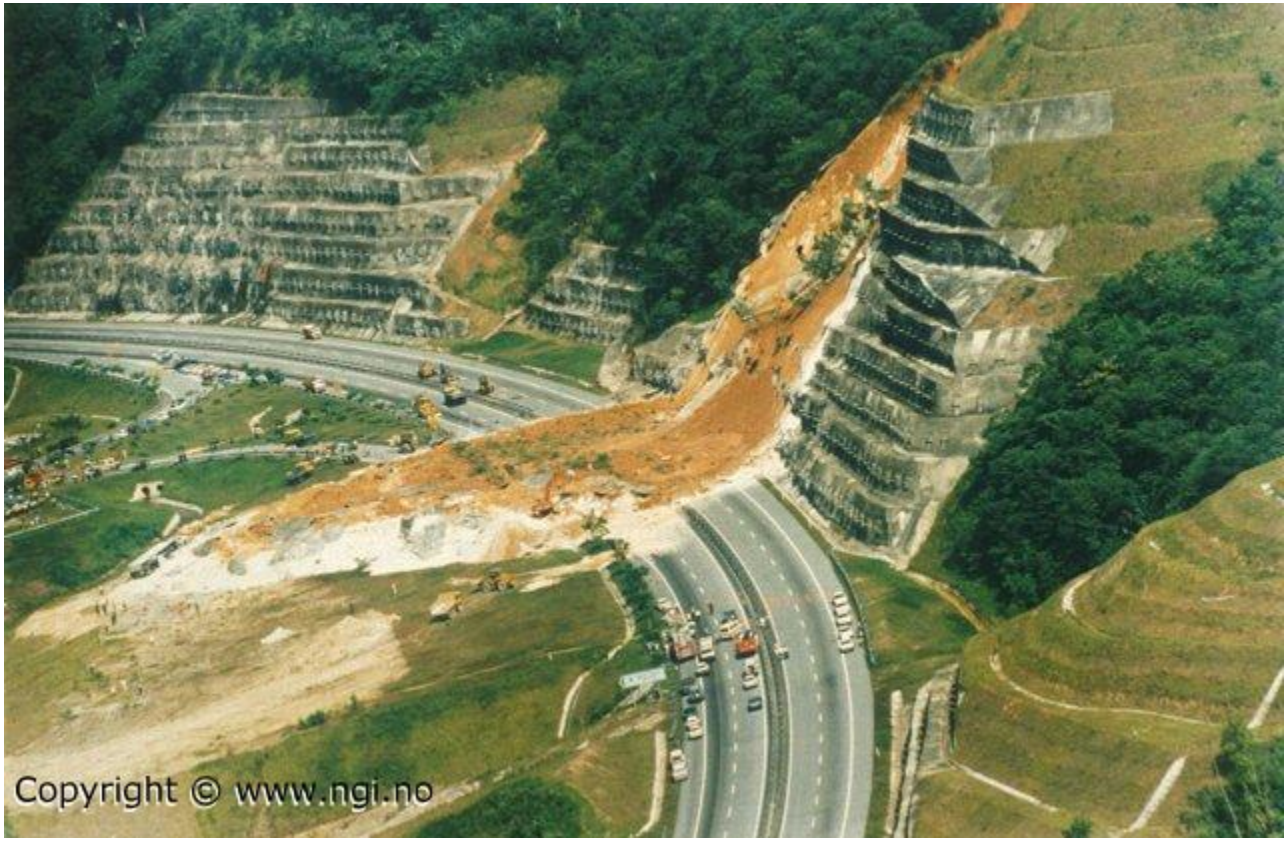
Landslides



In Japan, Kobe earthquake of 1995

Courtesy of Prof Ross Boulanger, UC Davis

Landslides



Sinkholes

Sinkholes

Sinkholes

Sinkholes*!*

Halfway down inside a sinkhole miles away from the Mayan Ruins

YouTube

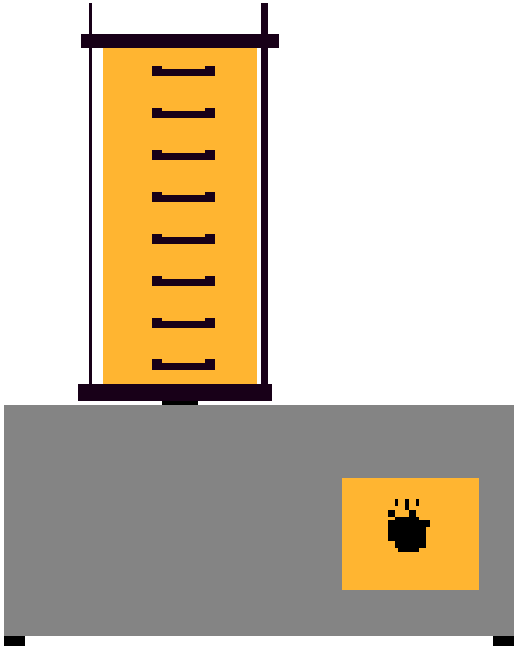
- School Collapse, Earthquake, China (2:32): http://www.youtube.com/watch?v=ndZU2Q3I_o8&NR=1
- Landslide in California (1:04): http://www.youtube.com/watch?v=qEbYpts0Onw&feature=PlayList&p=2A09F6CCDEB47681&playnext=1&playnext_from=PL&index=56

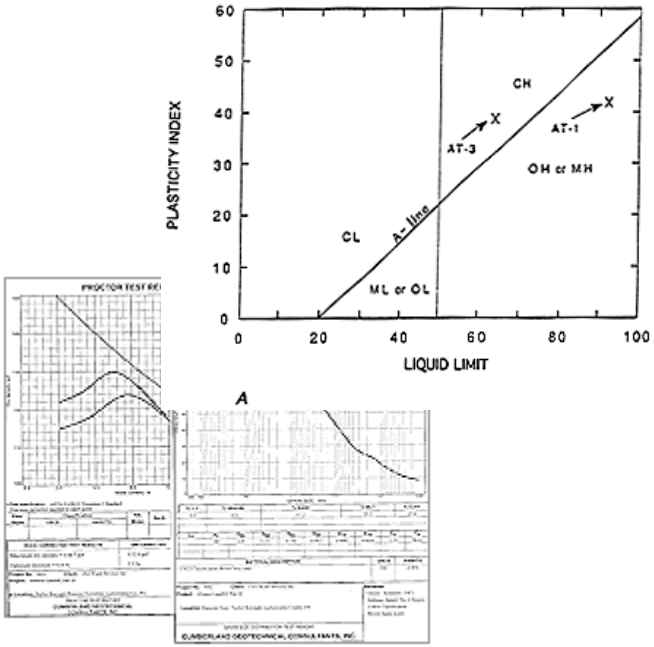
Topics to be Learned

BUT … FIRST

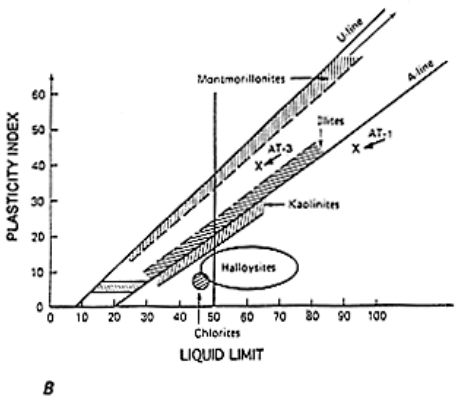
Need to learn the basics

Physical Properties of Soils

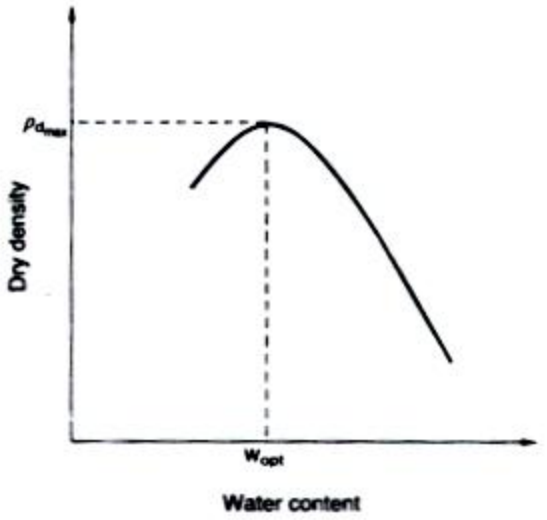




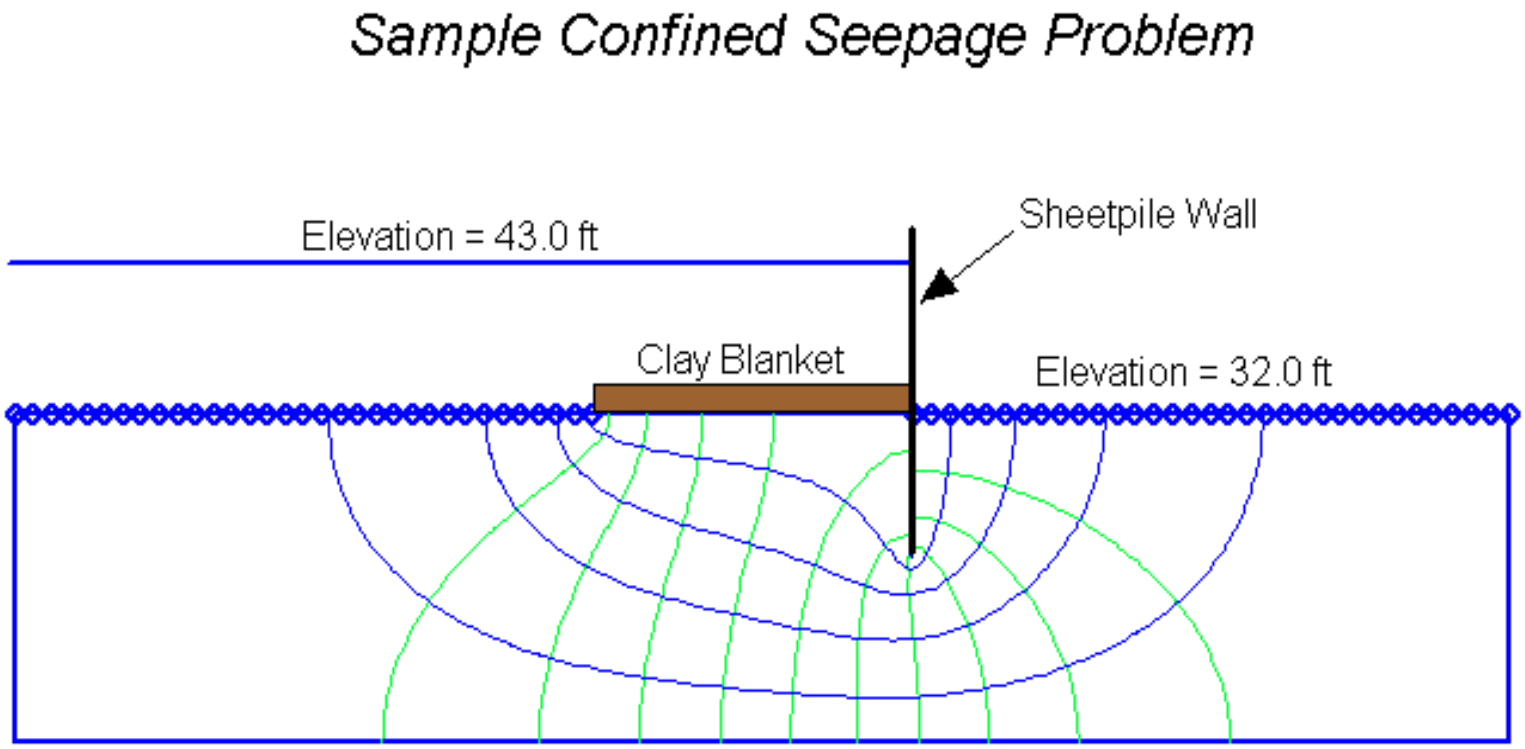
Click to Enlarge



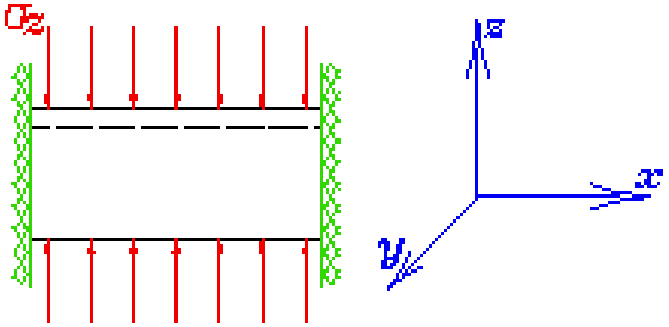
Soil Compaction



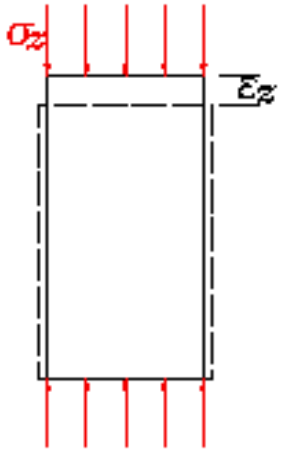
Seepage Analysis

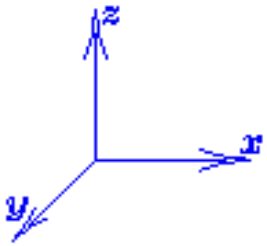


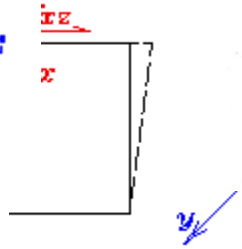
Settlement Calculations

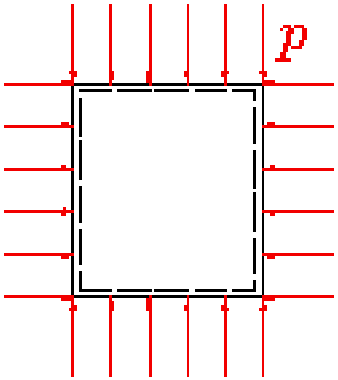


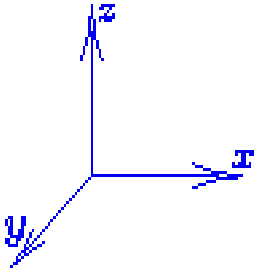
Shear Strength of Soils











Learning Objectives

Learning Objectives

a. Origin of soil and grain size
   - Describe the processes of soil and rock formation and types of soil deposits

b. Weight-volume relationships, plasticity and structure of soil
   - Analyze soil composition based on weight and volume relationships
   - Explain how soil structure, mineralogy, gradation and interaction with water affect its behavior

c. Engineering soil classification
   - Classify soils using AASHTO and Unified soil classification systems

Learning Objectives (Cont.)

d. Soil compaction
   - Evaluate soil compaction characteristics and select compaction methods and equipment for fine and coarse-grained soils
   - Interpret field compaction results with respect to compaction specifications

e. Permeability and seepage
   - Interpret permeability test data to get soil permeability and/or estimate soil permeability from basic soil properties
   - Analyze seepage flow and pressures

Learning Objectives (Cont.)

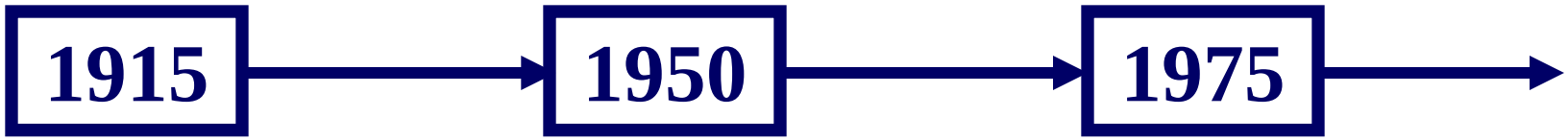
f. Stress analysis
   - Calculate total and effective stresses in soil
   - Calculate stress increase in soil due to vertical loads

g. Compressibility of soil
   - Predict foundation settlement (elastic, consolidation)

h. Shear strength of soil
   - Select appropriate lab and field tests to measure soil strength
   - Interpret shear strength lab and field test data to get design parameters

Evolution of Soil Mechanics

EVOLUTION OF SOIL MECHANICS



Theoretical
- Bearing Capacity
- Consolidation
- Slope Stability

Semi-empirical based on Field Observations

Computer Programs such as Finite Element Method

Questions*?*