SOIL MECHANICS II
CIVL 311
COURSE NOTES
2012

PART 2
FOUNDATIONS & EARTH RETAINING STRUCTURES

Instructors: Dr. D. Wijewickreme, P. Eng.
Department of Civil Engineering
University of British Columbia

SOIL MECHANICS II
CIVL 311
COURSE NOTES
2012

Module 8 – Segment A
Selection of Deep Foundations

Instructor: Dr. D. Wijewickreme, P. Eng.
Department of Civil Engineering
University of British Columbia
Vancouver, B.C.
Canada

Learning outcomes

When you complete this section, you should be able to:

- Appreciate the wide range of available pile types and know the types most common in the Lower Mainland of BC
- Know the difference between geotechnical and structural capacity
- Estimate the allowable load capacity of single piles and pile groups
- Estimate the settlement of single and group piles

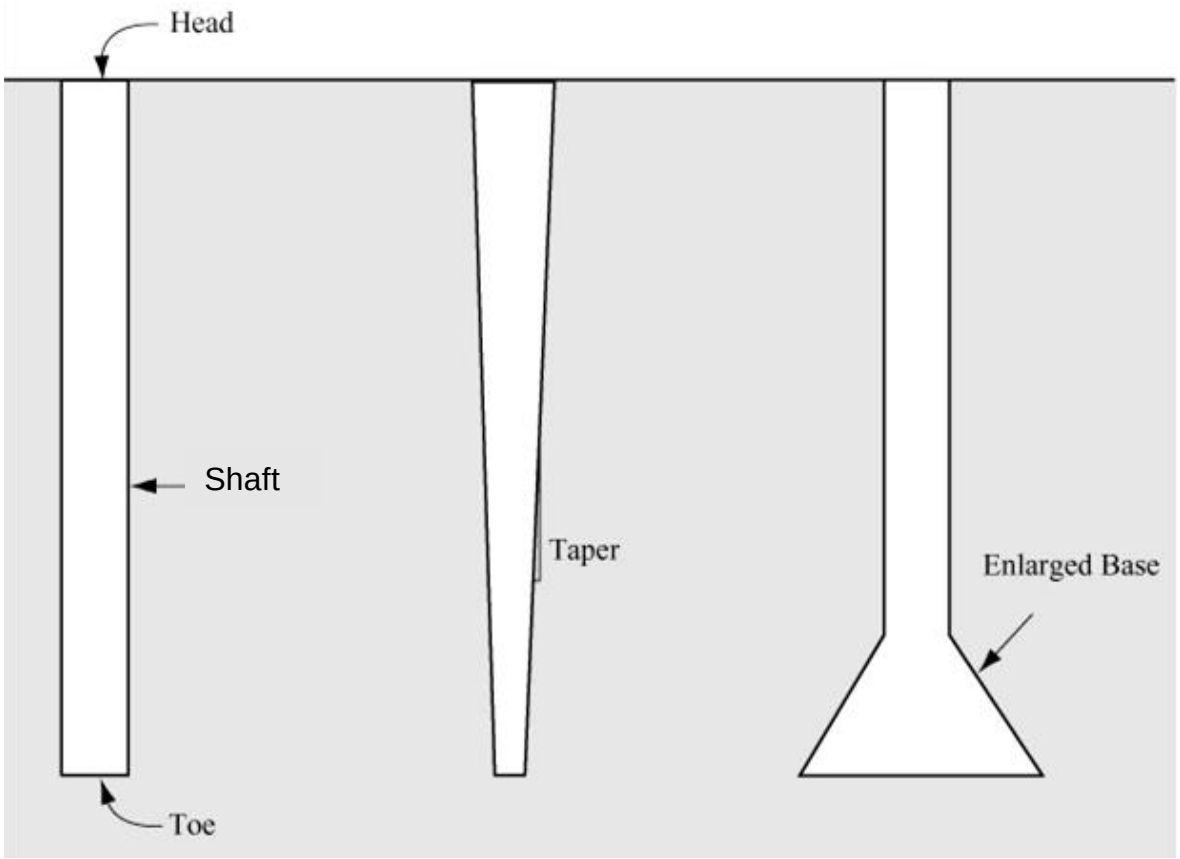
Pile topics

- Capacity of single piles
- Settlement of piles
- Capacity of pile groups
- Settlement of pile groups
- Other issues
  - Lateral loading
  - Downdrag or negative skin friction
  - Uplift

Use of Pile Foundations

- **Pile foundations are used when**
  - the soil near the surface does not have sufficient bearing capacity to support the structural loads
  - the estimated settlement of the soil exceed tolerable limits, i.e., settlement greater than the serviceability limit state
  - differential settlement due to soil variability or non-uniform structural loads is excessive
  - the structural loads consist of lateral loads and/or uplift forces
  - excavations to construct shallow foundation on a firm soil layer are difficult or expensive.

Terminology



Adapted from Coduto Figure 11.2

Parts of a deep foundation
(a) straight foundations;
(b) tapered foundations;
(c) foundations with an enlarged base.

Types of pile

- Driven-
  - large displacement pile if driven closed-ended
  - Low displacement pile if driven open-ended
- Driven and cast-in-place
  - Franki or Pressure Injected Footings
- Jacked
- Bored and cast-in-place
- Composite Piles
- Screw-in Piles – Helical, Auger-cast, etc.

Typical Pile Materials

1. **Timber**
2. **Concrete**
   - **Precast**
   - **Cast-in-Situ**
3. **Steel**
   - **H-Pile**
   - **Pipe (open or closed-end)**

Selection of Pile Type

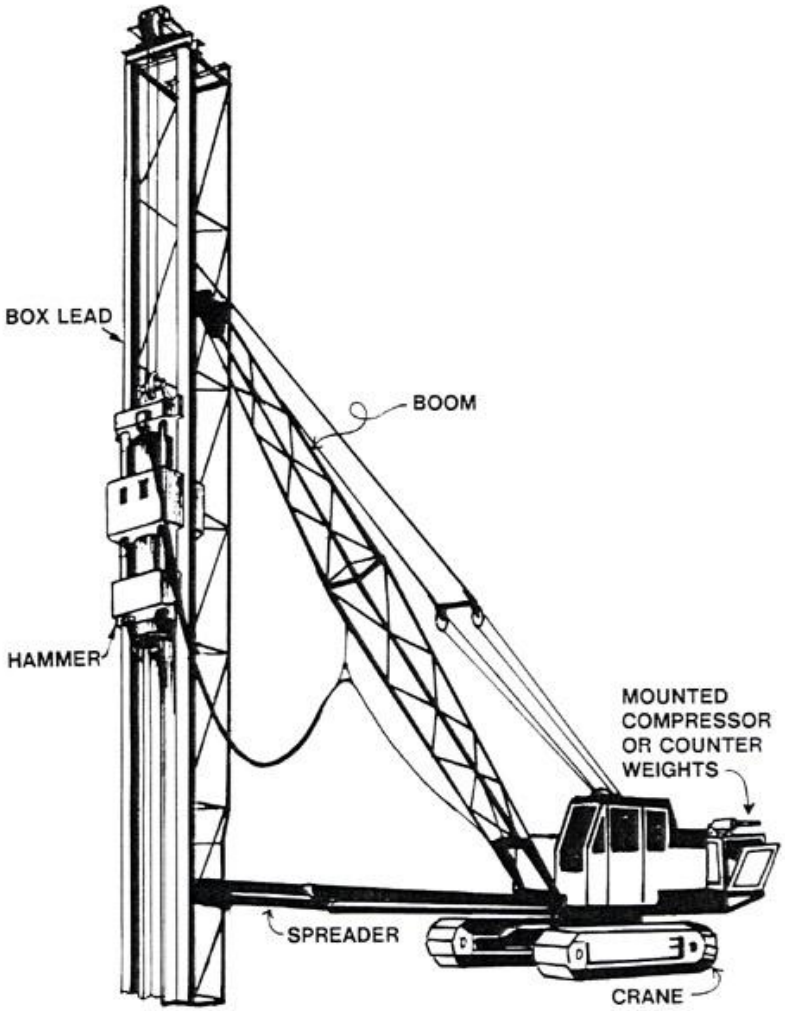
- Applied loads
- Required diameter
- Required length
- Local availability
- Durability in specific environment
- Anticipated driving conditions

Wood Preserving Plant, New Westminster, BC

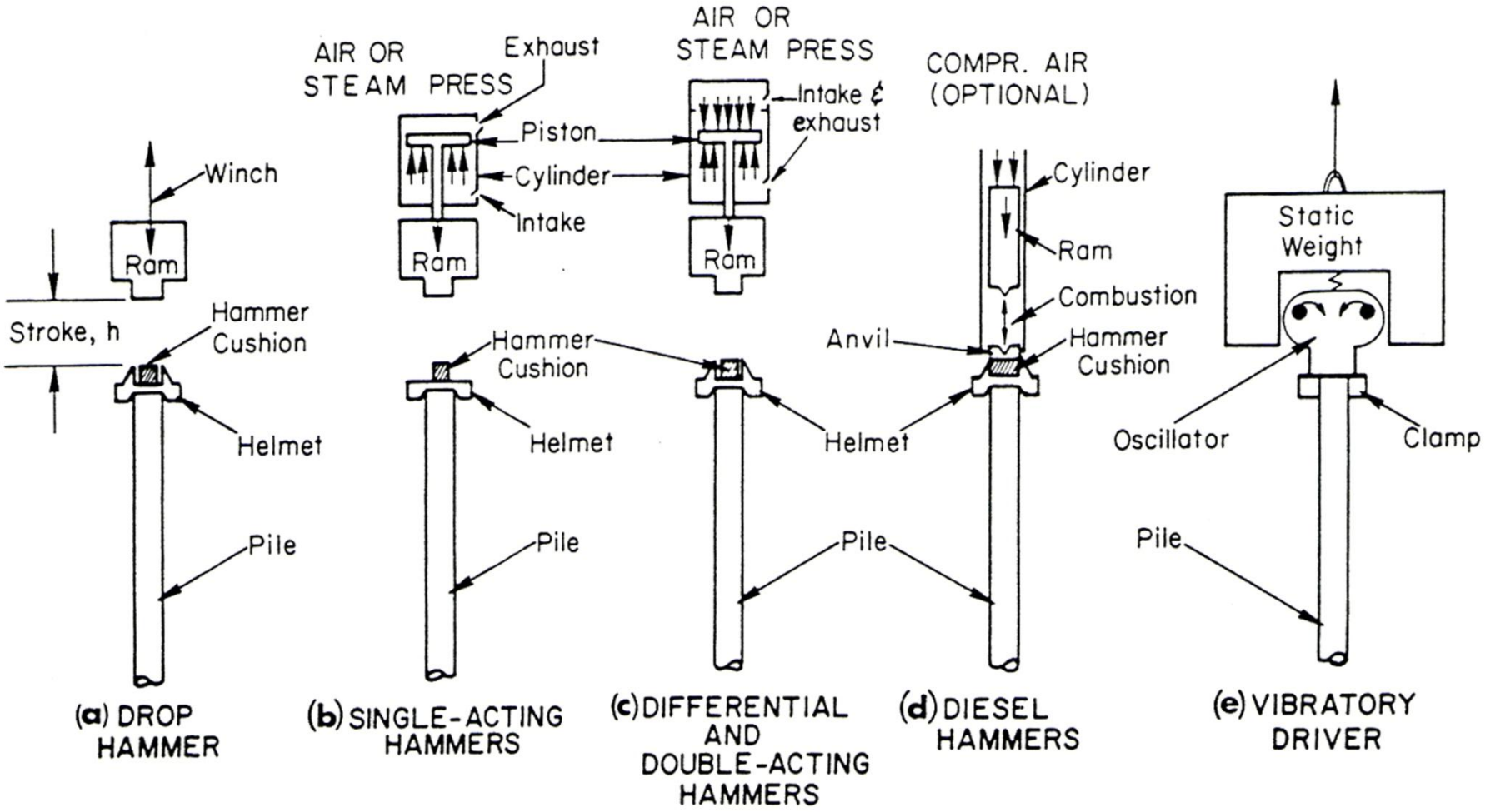
Creosote Treated Timber Piles

Untreated Timber Piles

Pile Driving Rig

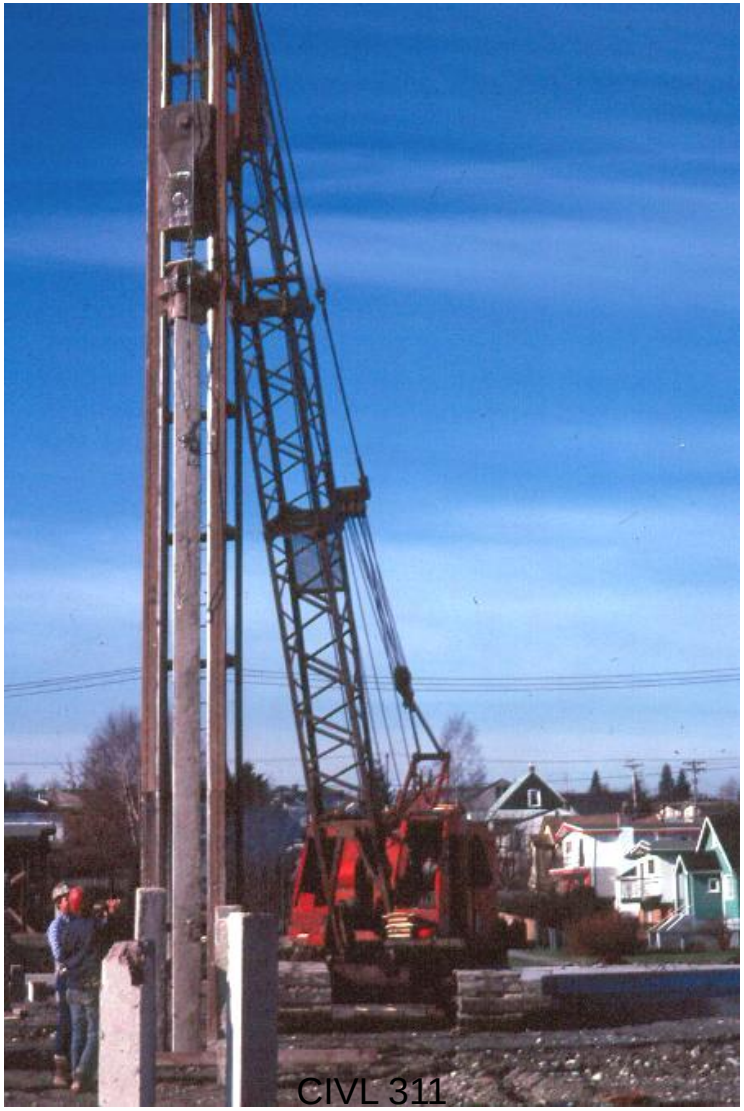


Types of Hammers

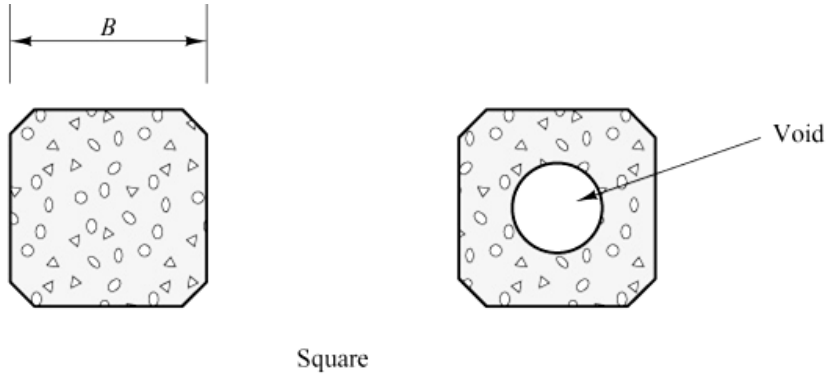


Extracted Timber Piles

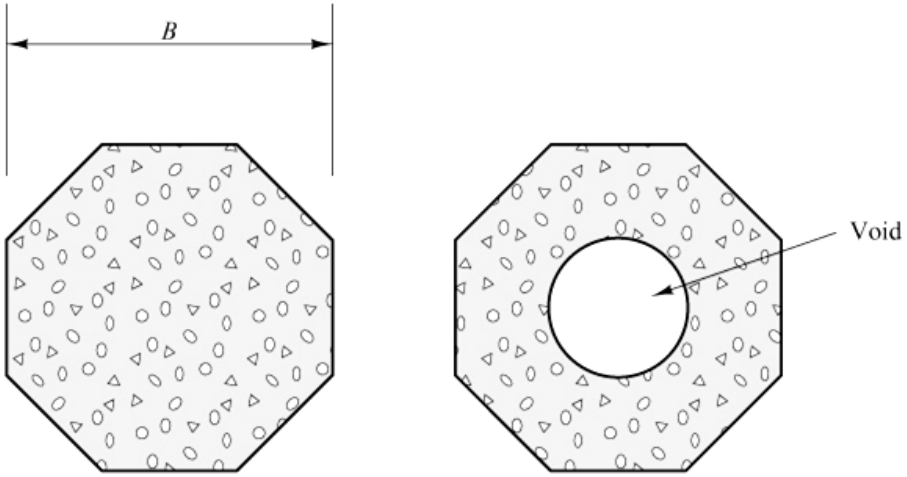
Drop Hammer



Precast Concrete Piles



Square



Octagonal

- Reinforced
- Durable
- Moderate to high capacity
- Moderate cost
- Precast hard to splice
- Cumbersome to handle

0.3 m Square Concrete Pile with Centre-Tube

Prestressed Concrete Pile Driving, Port Alberni, BC

Kobe K25 Diesel Hammer

Cushion and Drive Cap

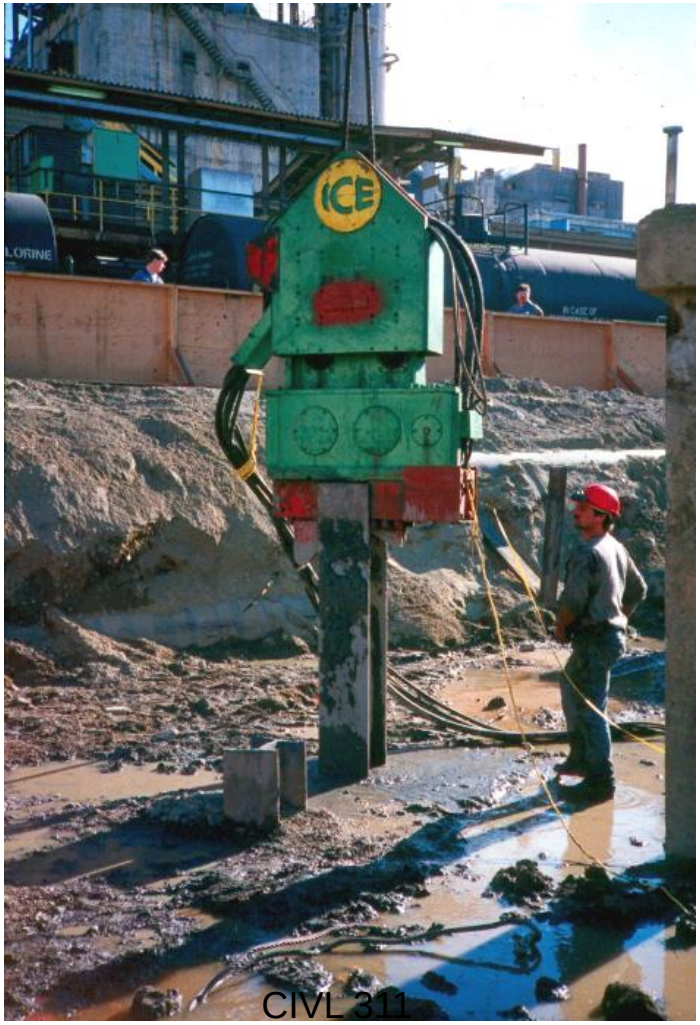
CTMP Plant, Port Alberni, BC

Splicing with Dyn-a-Splice

Ground Heave Due to Pile Driving

Check Pile Heave

Vibratory Hammer Extracting H-Pile



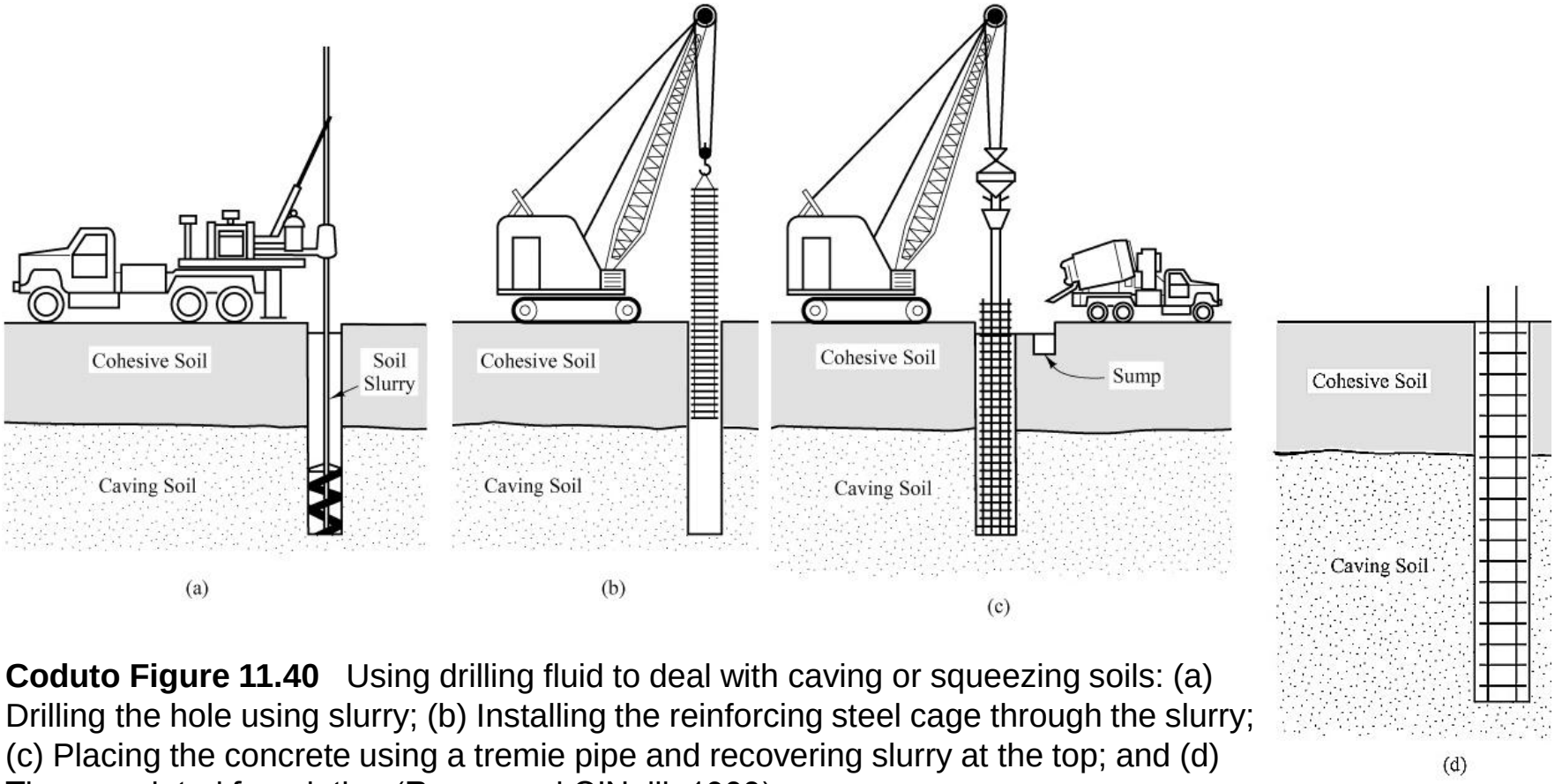
Kobe K25 Diesel Hammer

Steel Pipe Piles, Port Alberni, BC

Steel Pipe Piles, Woodfibre, BC

Damaged Pile Toe Section with Oslo Rock Point

Drilled Shaft – Slurry Method



Coduto Figure 11.40 Using drilling fluid to deal with caving or squeezing soils: (a) Drilling the hole using slurry; (b) Installing the reinforcing steel cage through the slurry; (c) Placing the concrete using a tremie pipe and recovering slurry at the top; and (d) The completed foundation (Reese and O'Neill, 1988).

Static methods

- Different types of deep foundation construction methods induce different changes in the soil
- Different material types interact differently with the soil
- Consequently, we often cannot use design approach developed for one type of pile and installation method to design another type.
- ***It is important to use analysis methods developed specifically for the type of foundation being designed.***