Chapter 7. Foundations

Pile Foundations

Outlines :

- ○ The first problem is to determine whether or not piles must be used for the given site conditions.

- ○ Selection of pile type - classified by material type or by method of placement.

- ○ Computation of the ultimate load for the pile-soil system.

- ○ Settlement analysis (the mechanism of load transfer between pile and soil must be understood)

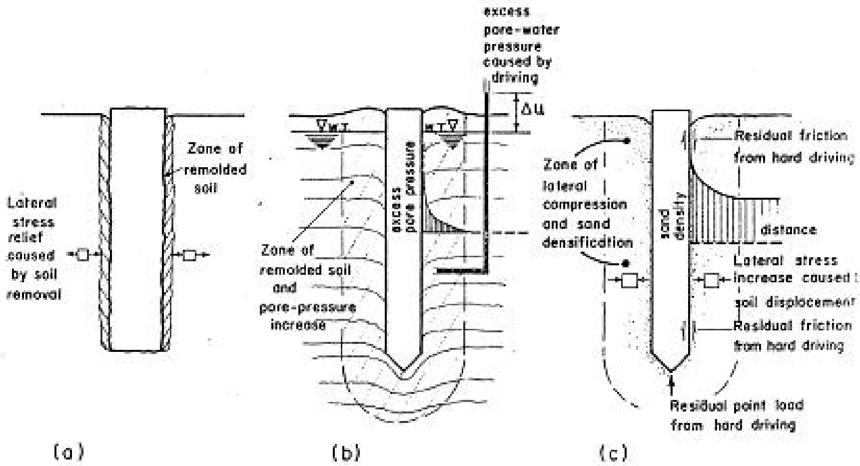
- ○ Behavior of pile groups

- ○ Construction problems - pile driving

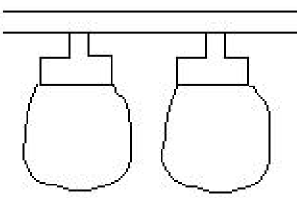
- ○ Test piles - full scale (Appendix #1)

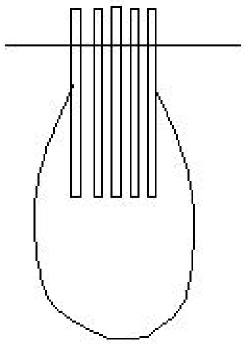
Some distinct differences from shallow foundation :

- The bearing soils, above and below foundation base, is almost always disturbed.

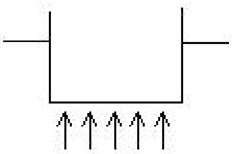


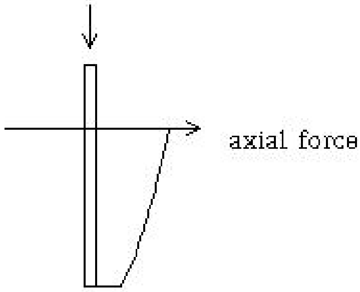
- Piles are often designed in groups.





- Load distribution in soil mass is not easily defined → load transfer problem.

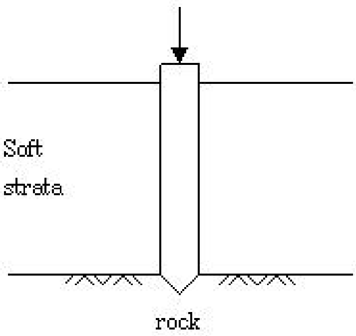




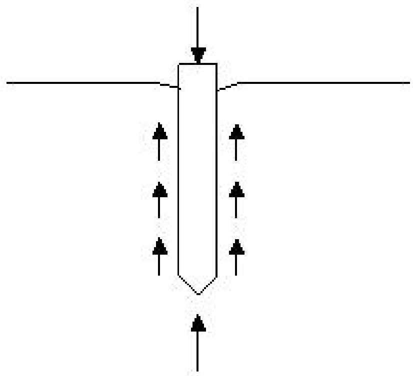
Introduction

◎ When the pile foundations are needed ;

- the upper soil strata are too compressible or too weak to support the structural load

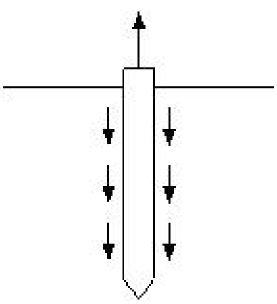


(End-bearing pile)

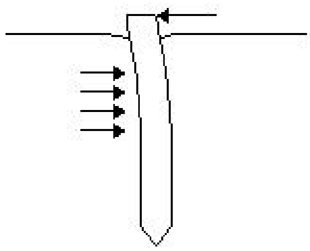


(Friction pile)

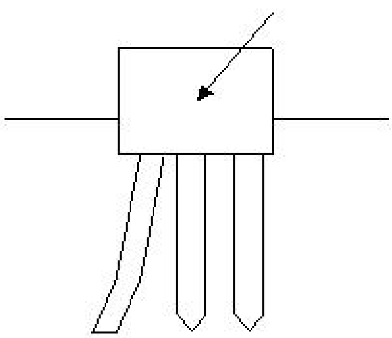
- footings cannot transmit inclined, horizontal, or uplift forces and overturning moments



(uplift)

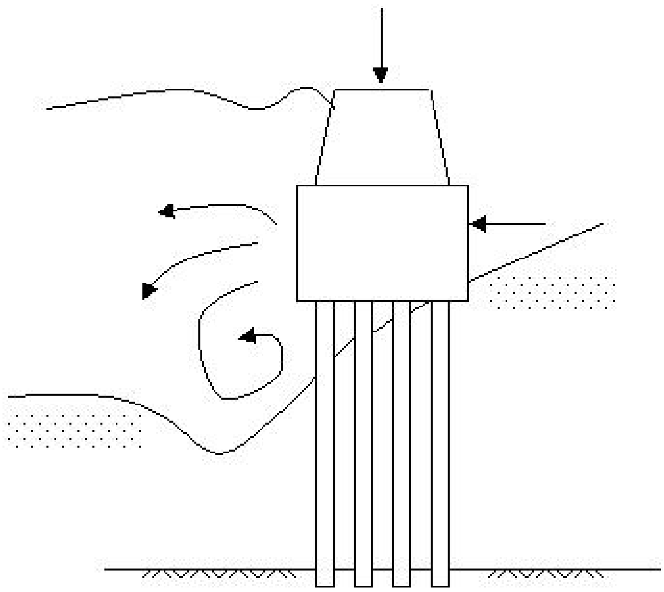


(horizontal)

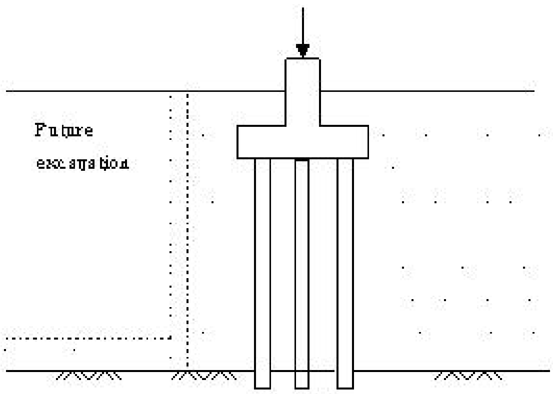


(inclined)

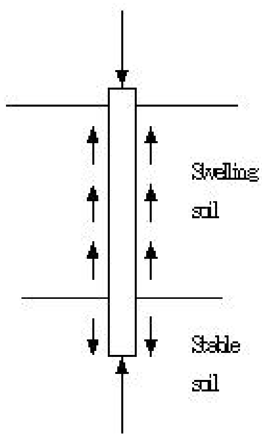
- Scour around footings could cause erosion, in spite of the presence of strong, incompressible strata at shallow depths.



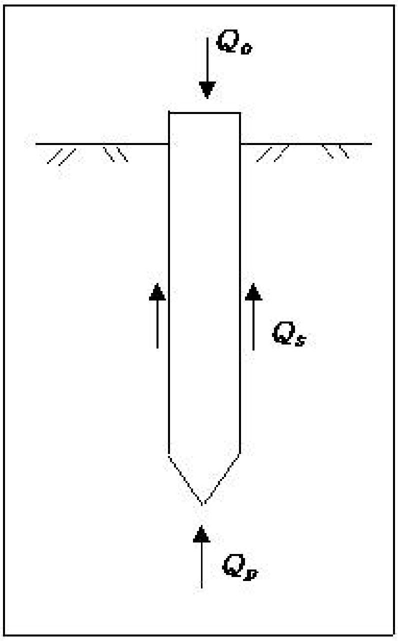
- Future excavation may be adjacent to the structure



- Expansive soils extend to considerable depth



Computation of ultimate load :



$Q_0 = Q_s + Q_p$

여기서,

Q_0, Q_s, Q_p: Ultimate, Shaft, Point resistance

$Q_s = f_s \cdot A_s$, f_s: unit shaft resistance

$Q_p = q_p \cdot A_p$, q_p: unit point resistance

A_s, A_p: Areas of shaft, point

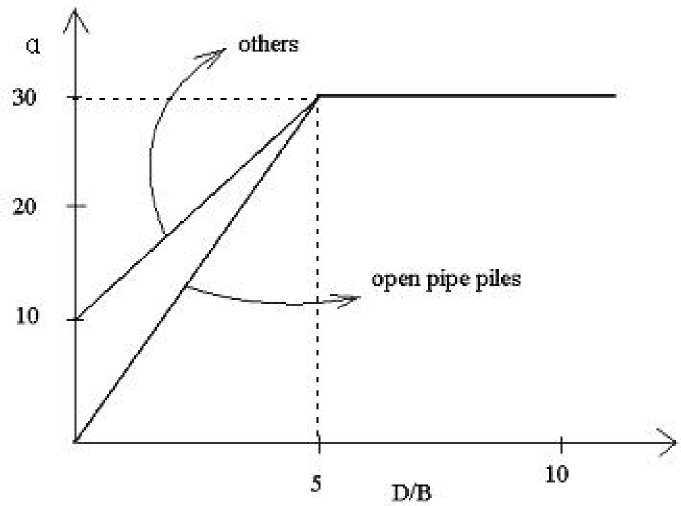
$f_s = K \cdot \gamma z \tan \phi$

$q_p = cN_c^* + qN_q^*$

$$Q_a = \frac{Q_0}{FS}$$

Empirical estimation of ultimate load :

$q_0 = \alpha N$
(t/m^2)



Dynamics of Pile Driving

◎ Dynamic pile formulas (↔ Static formula : $Q_0 = Q_p + Q_s$)

(It was observed that) the greater the resistance of a pile to driving, the greater should be the pile's capacity to support load.

→ All the common dynamic pile formulas equate

$$\left[\text{the energy delivered by the hammer}\right] = \left[\text{the work done by the pile as its tip penetrates a distance S against resistance R}\right]$$

with various allowances for the losses of energy

Engineering News Formula :

$$W_H H = R(S+0.1) \rightarrow R = \frac{2W_H H}{S+0.1}$$

(H in ft, S in in.)

W_H : wt. of the hammer in R unit (Appendix #2)

H : distance of free fall of hammer

R : resistance

S : useful penetration S (set) (Appendix #3)

0.1 : lost penetration due to energy loss

Homework : Summary report of dynamic pile formulas other than ENF