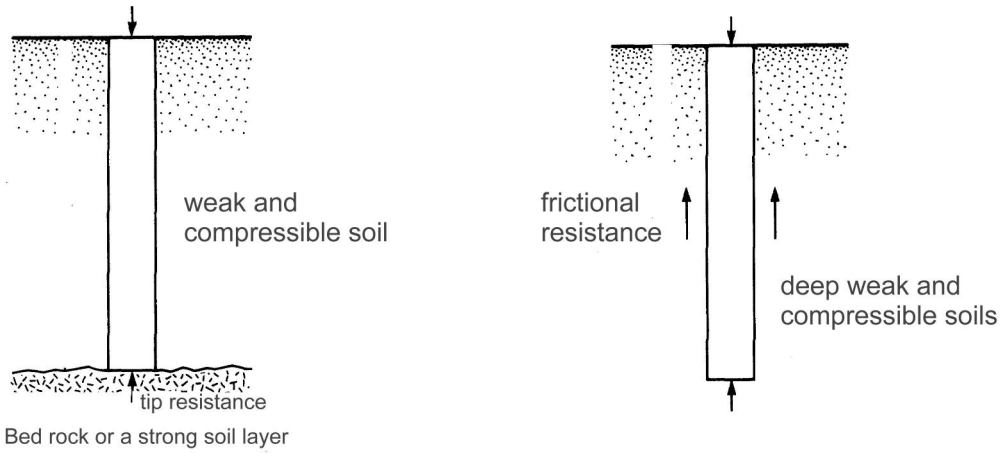
2. Deep Foundations

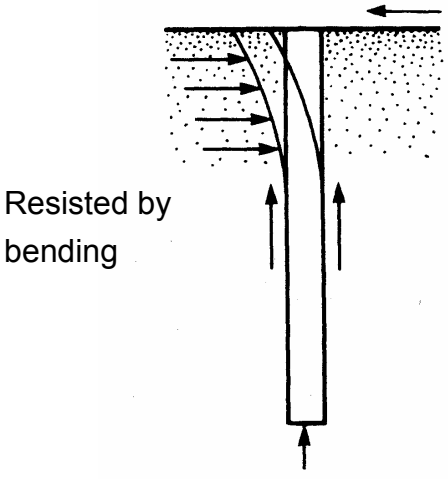
1) General

- Conditions for Pile Foundations

a) When the upper soil layer(s) is(are) highly compressible and too weak,

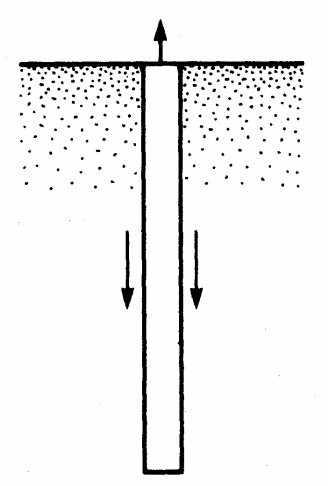


b) When subjected horizontal forces (earth-retaining structures and tall structures that are subjected to high wind or earthquakes)

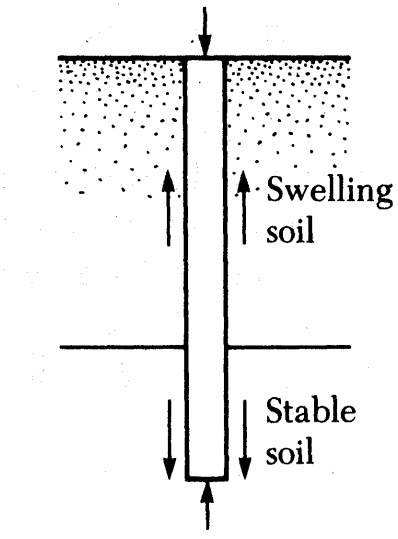


c) When subjected to uplift pressures

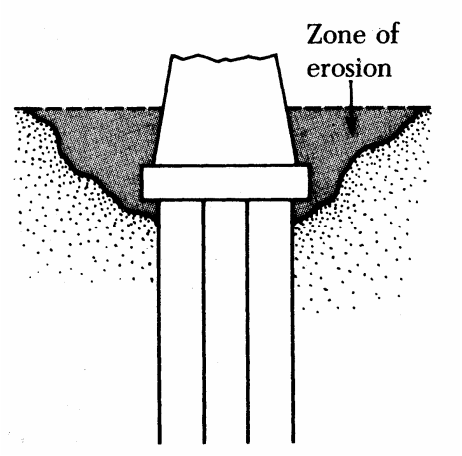
- For structures such as offshore platforms and basements mats below water table



d) In cases of expansive and collapsible soils



e) To avoid the possible loss of bearing capacity due to soil erosion at the ground surface (bridge abutments and piers)



2) Types of Piles

a) Material type

i) Steel Piles ┬ Pipe Piles(can be filled with concrete after driving)
└ H-section Piles

ii) Concrete Piles ┬ Precast Piles ⇐ can be reinforced and prestressed
└ Cast-in-situ Piles ⇐ making a hole in the ground and filling it with concrete

iii) Timber Piles

iv) Composite piles

steel + cast-in-place concrete, concrete + timber
(lower) (upper) (upper) (lower)

b) The Bearing Mechanism

- End bearing pile :

- Friction pile :

3) Installation of Piles

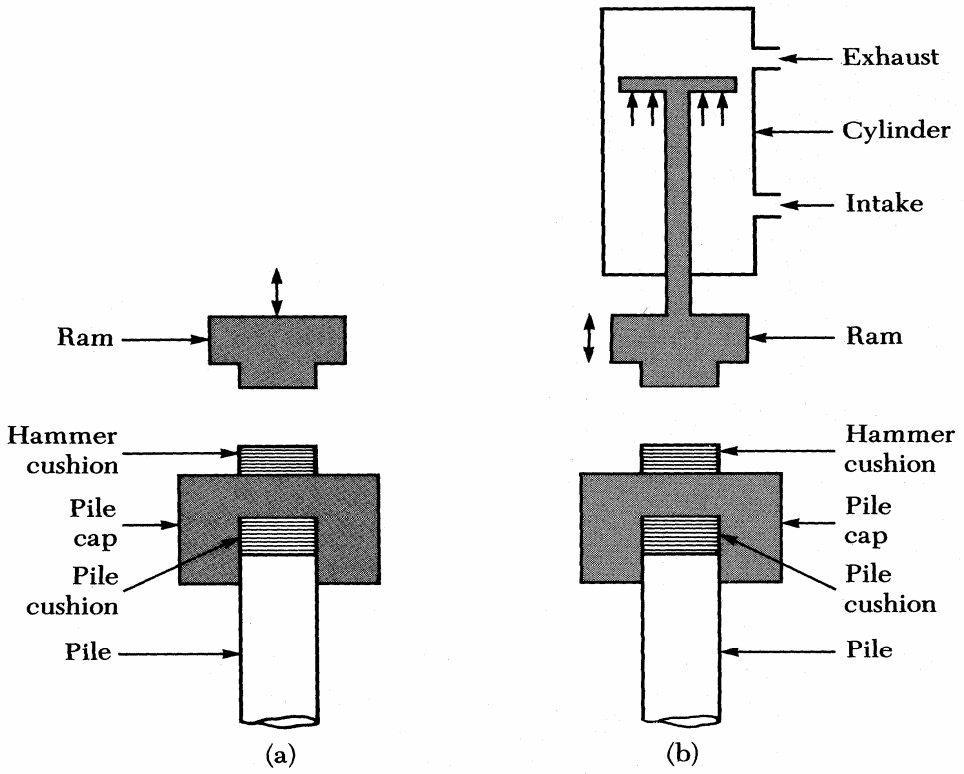
a) Bored Piles

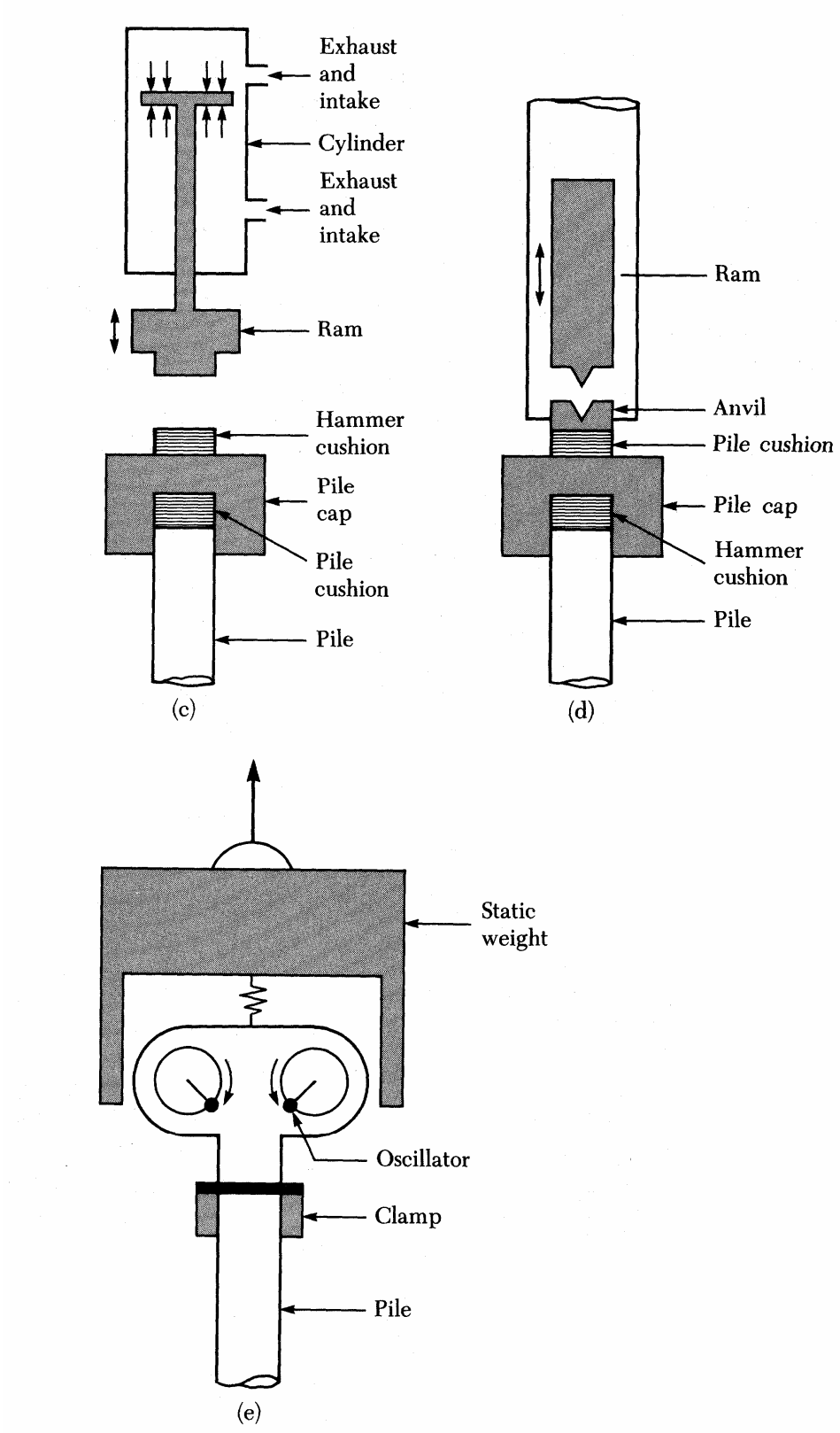
- Cast-in-situ or cast-in-place piles are built by making a hole in the ground and then filling it with concrete.
- Cased piles, Uncased piles

b) Driven Piles

- Mostly installed by means of hammers or vibratory drivers for driven piles

i) drop hammer
ii) single acting air or steam hammer
iii) double acting and differential air or steam hammer
iv) diesel hammer
v) vibratory pile driver
vi) jetting





c) Others

SIP pile (soil cement injected precast pile), OMEGA pile

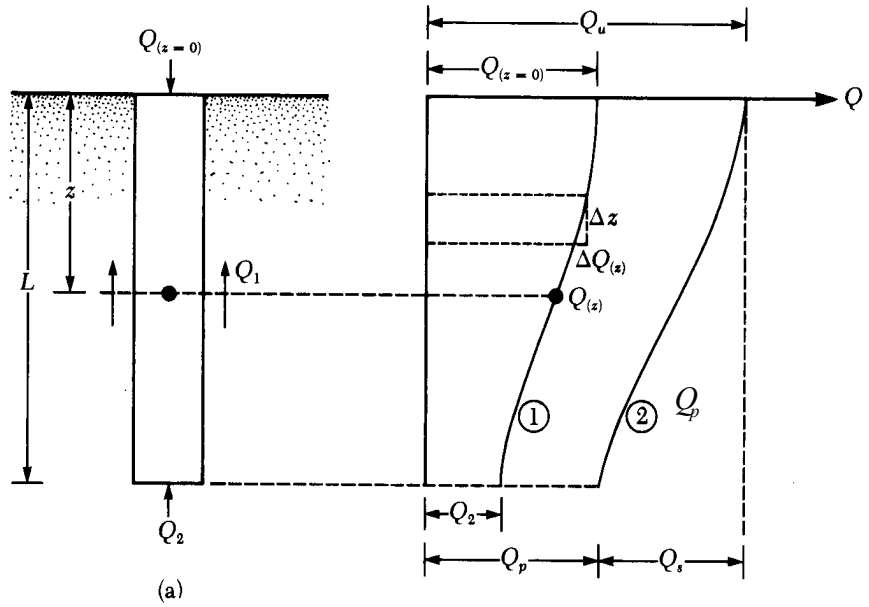
4) Load transfer Mechanism

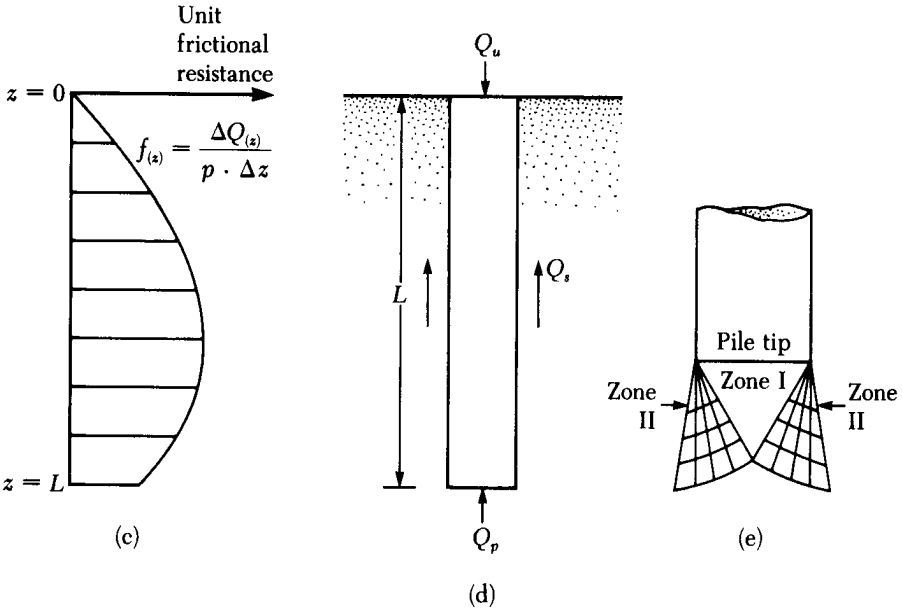
The load on the pile is given as

$$Q_{(z=0)} = Q_1 + Q_2$$

where Q_1 : side friction resistance along the shaft

Q_2 : point resistance





$Q_{(z)}$ will be decreased with depth and can be given as Fig (b).

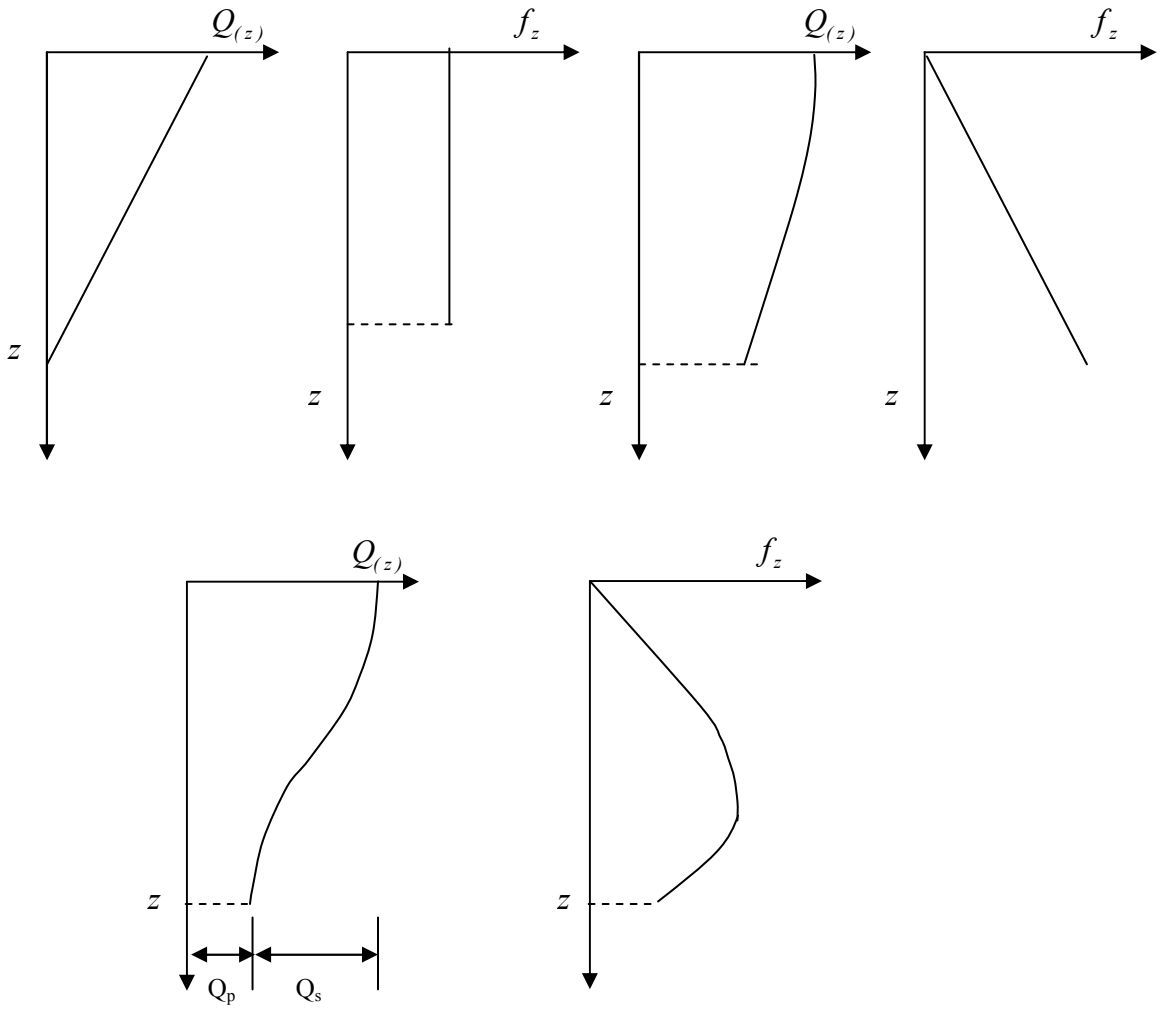
The frictional resistance per unit area, f(z)

$$f(z) = \frac{\Delta Q_{(z)}}{p\Delta z}$$

Where, Q_z = frictional resistance at certain depth

p = perimeter of pile cross section

- Typical $Q_{(z)}$-f_z distributions



- Movements for generating the resistance

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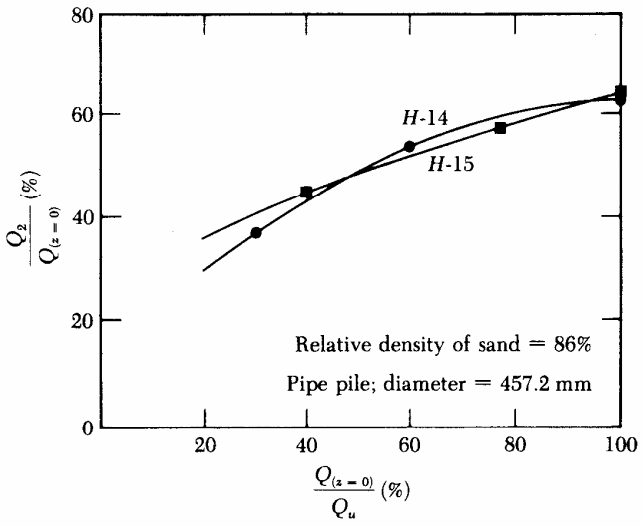

<Relative magnitude of point load transferred
at various stages of pile loading (redrawn after Vesic, 1970)>

⇒ Proportion of point resistance is increased with increasing total load or settlement.