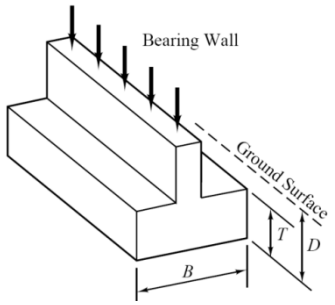
FOUNDATION ENGINEERING

Types of Foundations

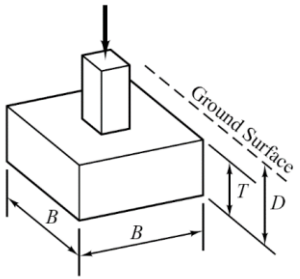
Types of Foundations

Shallow foundations – Transmit load to near surface soils

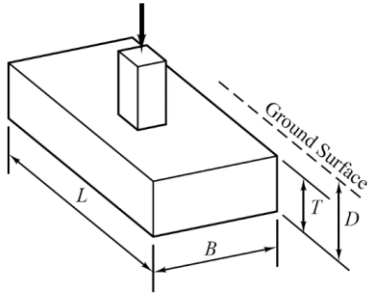


Strip (or wall) footing

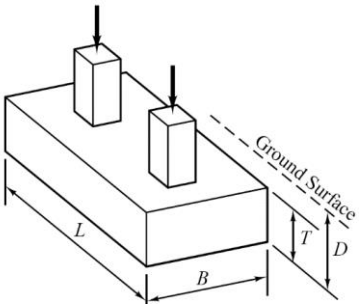
Spread footing



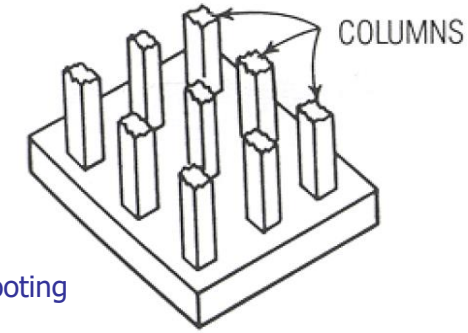
Square



Rectangular

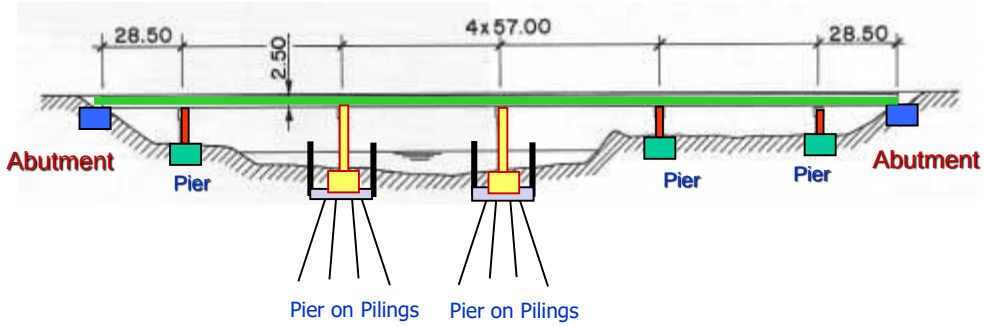


combined footing



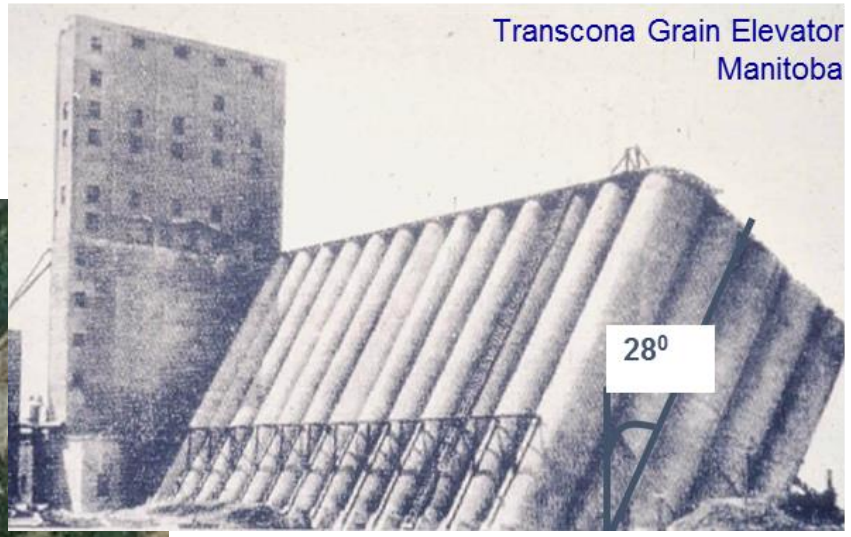
Mat (or raft) footing

Project Management in Context of Foundation Engineering and Process for *a Bridge*



What do We Design for?

Stability – Bearing capacity



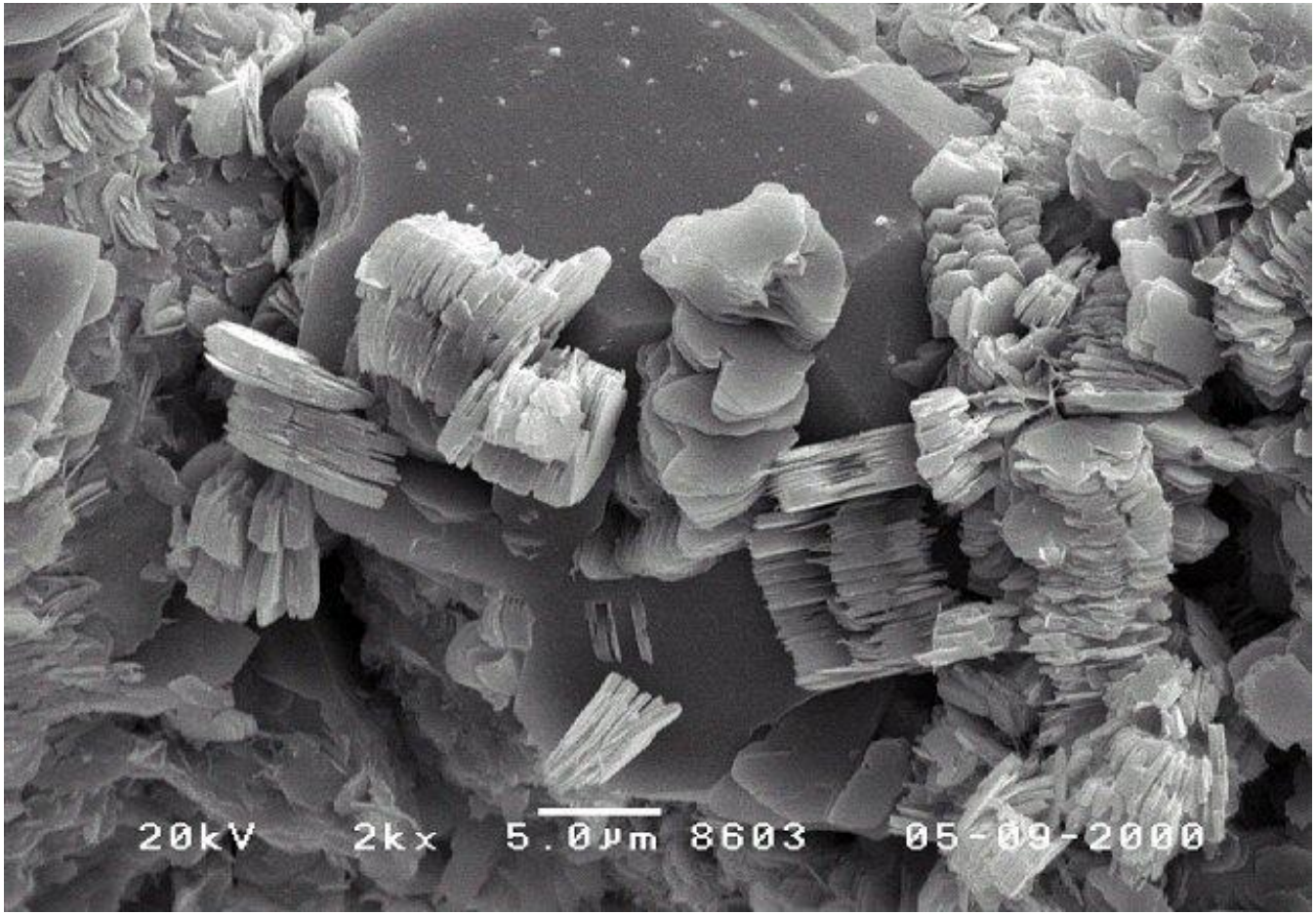
Some effects of liquefaction during the 1964 Niigata earthquake

What do We Design for?

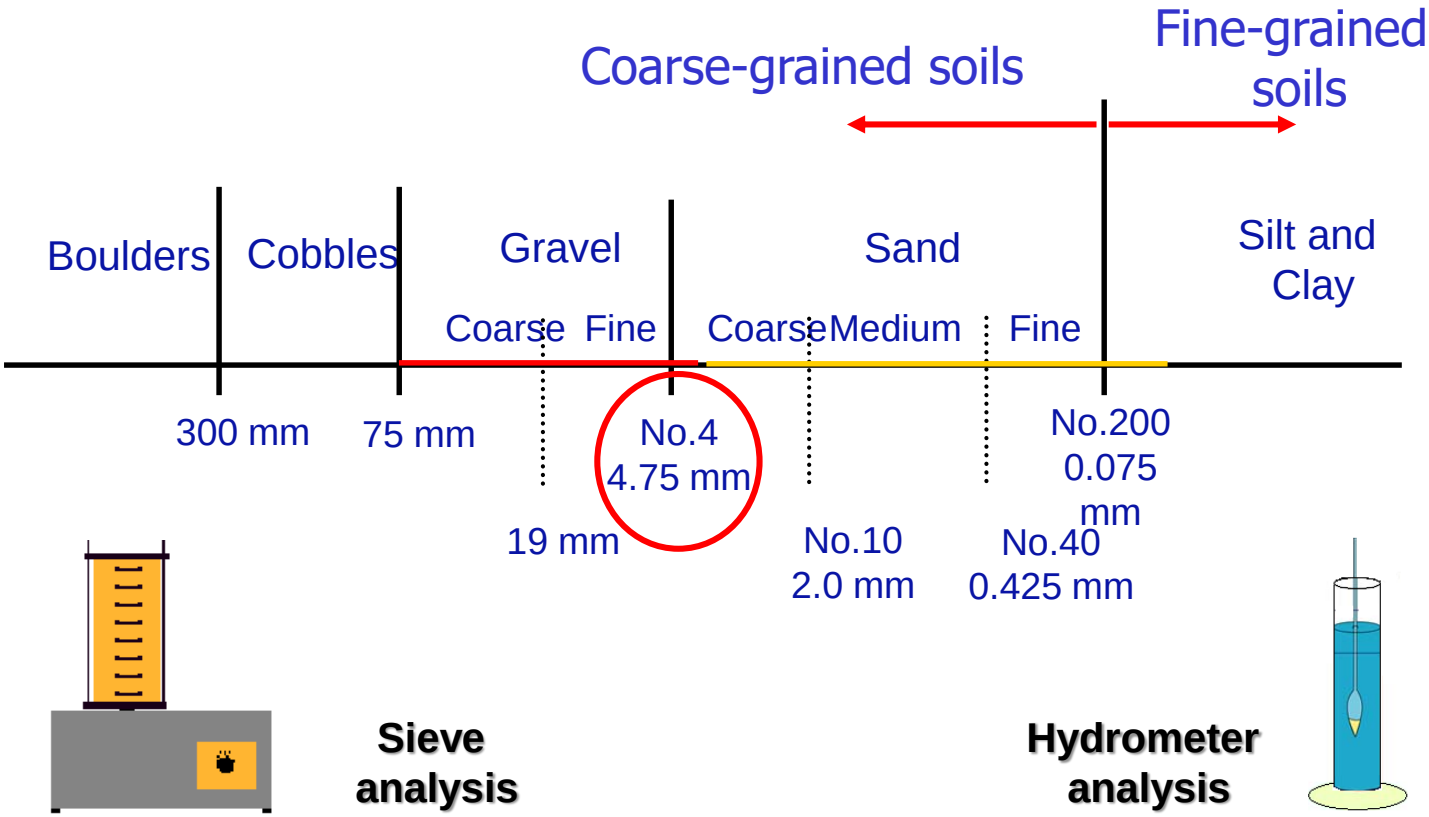
Serviceability – Limit settlements

Soil Types: Coarse-Grained

Soil Types: Fine-Grained



Grain Size Classification (USCS)



Body Forces Important

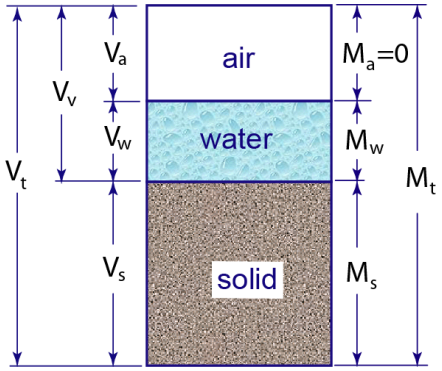
Surface Forces Important

Review – Soil Mechanics

Phase Relations – Typically three phases

Void ratio: $e = \frac{V_v}{V_s}$

Porosity: $n = \frac{V_v}{V_t} = \frac{e}{1+e}$



Degree of saturation: $S_r = \frac{V_w}{V_v} \times 100\%$

Water content: $w = \frac{M_w}{M_s} \times 100\%$ (Moisture content)

Specific Gravity of soil grains: $G_s = \frac{\rho_s}{\rho_w} = \frac{\rho_s \times g}{\rho_w \times g} = \frac{\gamma_s}{\gamma_w}$

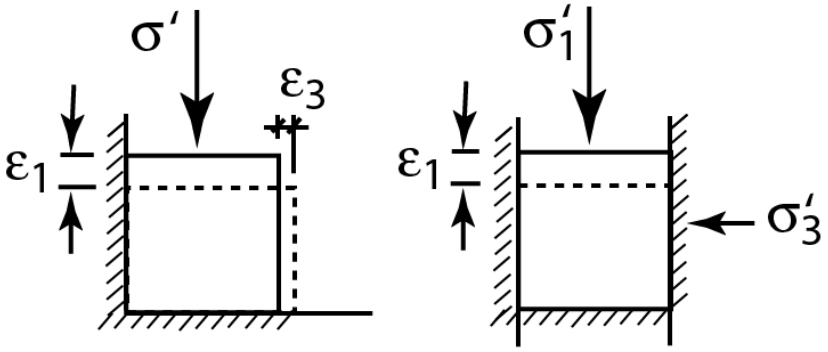
Bulk unit weight: $\gamma = \frac{W}{V} = \frac{G_s(1+w)\gamma_w}{1+e}$

Definitions of Geotechnical Terms

- Saturated unit weight (γ_{sat}) is the unit weight of the soil when the voids are filled with water.
- Submerged (buoyant) unit weight (γ') is the effective unit weight of soil when it is submerged.
- Dry unit weight (γ_d) is the unit weight of soil in dry state

Elastic Coefficients

Settlements occur due to the deformation of the soil



$$\varepsilon_1 = \frac{\sigma_1}{E}$$

$$\varepsilon_3 = -\mu\varepsilon_1$$

E = elastic modulus

μ = Poisson's ratio

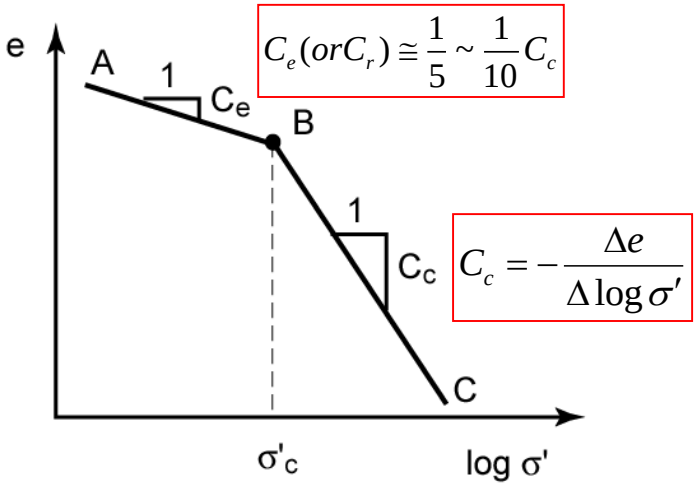
$$\varepsilon_1 = \frac{\sigma_1}{M}$$

$$\sigma_3' = K_0\sigma_1'$$

M = compression modulus

K_0 = coefficient of earth pressure at rest

K_o – Compression – Compressibility:



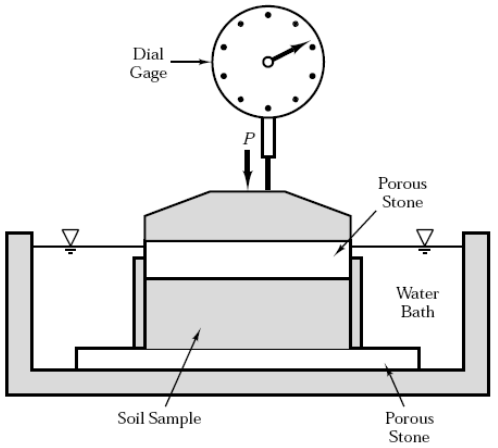
$$C_e(or C_r) \cong \frac{1}{5} \sim \frac{1}{10} C_c$$

$$C_c = -\frac{\Delta e}{\Delta \log \sigma'}$$

$$\Delta\varepsilon_z = \frac{\Delta H}{H} \rightarrow \Delta\varepsilon_z = \frac{\Delta V}{V} = \frac{\Delta e}{1+e}$$

Compression/recompression Index

$$C_c = -\frac{\Delta e}{\Delta \log \sigma'} \qquad C_r = -\frac{\Delta e}{\Delta \log \sigma'}$$



Geostatic Vertical Stress

$$\sigma = \sigma' + u_w \Rightarrow \sigma = \gamma_{sat} z,\ u_w = \gamma_w z,$$
$$\sigma' = (\gamma_{sat} - \gamma_w) z = \gamma' z$$