Earth Retaining Structures

- Externally Stabilized Systems
  - Gravity Walls
  - Insitu Walls
- Internally Stabilized Systems
  - Reinforced Soils
  - In-situ Reinforcement

Gravity Walls

- Gravity wall
- Cantilever wall
- Counterfort wall

In-situ Walls

- Anchored wall
- Strutted wall
- Cantilever wall

Reinforced Soils

- Assumed failure surface
- Actual failure surface
- Stress distribution
- Metal strips
- Fabric
In-situ Reinforcement

Influence of displacement on lateral earth pressure

Active earth pressure (Rankine) in sand

Lateral earth pressure
Active earth pressure (Rankine)
in clay

Active earth pressure (Coulomb)

Influence of two point loads on soil pressure

Stress distribution below surface load
Effect of compaction on earth pressure

Effect of vibratory roller

Distribution of soil pressure after compaction

Compaction of soil layers
Earth pressure distribution at rigid wall due to compaction

Gravity wall and Cantilever wall

Failure modes

Design of retaining structure for bearing capacity

See Das Example 8.1
Design of retaining wall for inclined load

Design of wall against sliding

Overturning of retaining wall

General stability of retaining wall

\[ q_{max} = \frac{2V}{3(\theta - \epsilon)} \]

\[ q_{max} = \frac{V}{A} + \frac{M}{W} \]

\[ \theta > \frac{5}{6} \]

\[ \theta < \frac{5}{6} \]

\[ F_s = \frac{\Sigma \text{Resisting moment}}{\Sigma \text{Driving moment}} \]

\[ F_s = \frac{\Sigma \text{Resisting forces}}{\Sigma \text{Driving forces}} \geq \begin{cases} 2.0 & \text{(clay)} \\ 1.5 & \text{(sand)} \end{cases} \]

\[ C_a = 0.5 \text{ to } 0.75 C_u \]
Shear keys in sliding wall

Reinforcement in retaining wall

Location of reinforcement

Drainage of wall
Drainage of retaining structure

Reinforce earth wall

Required length of earth reinforcement
Cantilever sheet pile wall

Earth pressure distribution of cantilever wall, friction soil

Factor of safety of retaining wall

Earth pressure distribution of cantilever wall, cohesive soil
Earth pressure distribution of cantilever wall, factor of safety

Design of sheet pile walls

Failure mechanisms

Anchored sheet pile wall (Free earth support)
Moment distribution in sheet pile wall

Earth pressure distributions (design)

Strut forces

Braced excavations
Water flow into excavation in sand

Bottom heave in excavation in clay, effect of wall adhesion

Bottom heave in excavation in clay

Bottom heave in excavation

Bottom heave in excavation

\[ B/L = 1.0 \]

\[ B/L = 0 \]

\[ D/fg < N_b \]

\[ (D+d)/g - 2\sigma_d = f/g < N_cu \]

\[ D/fg - 2\sigma_d < N_cu \]
Settlement adjacent to strutted excavation

Estimate of settlement adjacent to excavation

\[ V_s = V_B + V_L + V_0 \]

Settlement caused by a lowering of the ground water level