Ground Improvement

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Dynamic Deep Compaction
Dynamic Deep Compaction

- Dynamic Deep Compaction is the dropping of heavy weights on ground surface to densify soils at depth
Dynamic Deep Compaction

Important Terms

- **Effective Depth** -- Maximum depth of ground improvement
- **Zone of Major Densification** -- About upper 2/3 of effective depth
- **Energy Level** -- Energy per blow (weight times drop height)
- **Energy Intensity Factor** -- Involves energy level, spacing, and number of blows
Dynamic Deep Compaction Applications

- Reduce foundation settlements
- Reduce seismic subsidence
- Permit construction on fills
- Densify garbage dumps
- Improve mine spoils
- Induce settlements in collapsible soils
Dynamic Deep Compaction
Depth of Influence

\[ D = C \sqrt{wh} \]

- \( w \): Weight of drop (Tons)
- \( h \): Height of drop (m)
- \( D \): Depth of influence (m)
- \( C \): Factor = 0.3 - 0.7 Depends on soil type
Dynamic Deep Compaction
Typical Program Involves

- Weights of 10 to 30 tons
- Drop heights of 50 to 100 ft
- Impact grids of 7 x 7 ft to 20 x 20 ft
Dynamic Deep Compaction

Important Geotechnical Parameters

- Soil conditions
- Groundwater level
- Relative density
- Degree of saturation
- Permeability
Dynamic Deep Compaction
Important Construction Conditions

- Minimum 100-150 ft clearance from any structure
- Review site for vibration sensitivity
Dynamic Deep Compaction Design Steps

1. Perform site investigation
2. Develop settlement influence diagrams
3. Develop initial DDC program
4. Develop numerical performance prediction
5. Develop QA/QC plans
Dynamic Deep Compaction
Quality Control

- Crater depths (map)
- Surface elevation monitoring
- Decrease in depth of weight penetration with successive drops
- Pore pressures
- Geophysical monitoring
The End
Vibro Compaction

Equipment Used
Vibro-Compaction

- A site improvement technique for granular material
- Vibro-Compaction uses company-designed probe-type vibrators to densify soils to depths of up to 120 feet.
Vibro-Compaction

- Vibro-Compaction increases bearing capacity for shallow-footing construction, reduces settlements and also mitigates liquefaction potential in seismic areas.
Vibro Compaction
Step 1

1. At full water pressure, the vibrator penetrates to design depth and is surged up and down as necessary to agitate sand, remove fines and form an annular gap around the vibrator.
Vibro Compaction

Step 2

2. Once at depth the water pressure is reduced and with the vibrator remaining in the ground, sand infill is added from ground level and compacted at the base of the vibrator.
Vibro-Compaction
Step 3

• 3. When the required compaction resistance is achieved the vibrator is raised and more sand infill added and compacted as before. This procedure is repeated until compaction point is built up to ground level.
Vibro-Compaction

• Check your book for Figures 4.11 & 4.12
The End
Vibro-Replacement

- Related to Vibro-Compaction,
- Vibro-Replacement is used in clays, silts, and mixed or stratified soils.
- Stone backfill is compacted in lifts to construct columns that improve and reinforce the soil strata and aid in the dissipation of excess pore water pressures.
Vibro-Replacement

- Vibro-Replacement is well suited for stabilization of bridge approach soils, for shallow footing construction, and for liquefaction mitigation.
The End
Chemical Grouting

- The permeation of very low-viscosity chemical grout into granular soil improves the strength and rigidity of the soil to limit ground movement during construction.
Chemical Grouting

- Chemical grouting is used extensively to aid soft ground tunneling and to control groundwater intrusion. As a remedial tool, chemical grouting is effective in waterproofing leaking subterranean structures.
Cement Grouting

- Primarily used for water control in fissured rock, Portland and microfine cement grouts play an important role in dam rehabilitation, not only sealing water passages but also strengthening the rock mass.
The End
Jet Grouting

- Jet grouting is an erosion/replacement system that creates an engineered, in situ soil/cement product known as Soilcrete℠.
Jet Grouting

- Effective across the widest range of soil types, and capable of being performed around subsurface obstructions and in confined spaces, jet grouting is a versatile and valuable tool for soft soil stabilization, underpinning, excavation support and groundwater control.
The End