

Soil Compaction

- #### 4.1 • Compaction theory Proctor

- properties
 - physical : γ , w
 - engineering: compression, permeability, flow, strength

- Compaction effort : $CE = \frac{W.H.N}{V_{soil}}$

- ≡ acts as a lubricant

$$g_m = \frac{M + \Delta M}{V - \Delta V}$$

$$\gamma_d = \frac{g_m}{1 + w}$$

$$w_{\text{opt}} = \text{PL} - \text{few \%} \quad \equiv 80\% S_r$$

$$g_d = \frac{g_w G_s}{1 + w G_s / S_r}$$

$$\text{for } S_r = 1 \quad \rightarrow \quad \gamma_d = \frac{g_w G_s}{1 + w G_s}$$

$$30 < \text{LL} < 70$$

others $\rightarrow$ irregular

4.2 Properties of compacted soils

static impact	- compacted effort	$\rightarrow$ soil behavior
Kneading vibratory	- type of compaction	
	- moisture content	

Water content at compaction/molding $\rightarrow$ soil properties / performance

unaffected by <u>method</u> of compaction	depends on method of compaction
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field

- Proctor test
 - standard
 - modified
- Fig. 4.4 - γ_d
- Fig. 4.5 - permeability (sandy clay)
 - volume change
- Fig. 4.6 - strength loss when remolding sensitive clays
- Fig. 4.7 - shrinkage & swelling

4.3 Field Compaction

4.3.1 General

- Soil
- natural
 - fill
 - cohesionless
 - cohesive
 - difficult to compact
 - time-dependent

- Field compaction & ground improvement
- vibroflotation
 - chemical stabilization
 - grouting
 - ground freezing
 - biological transformation
 - dynamic compaction

- involves → Area, depth, vol. of soil
- labor vs. material cost
 - properties & type of soils
 - intended use
 - equip. available
 - type of exist. str.
 - quality
 - eng. & constr. confidence level

4.3.2; 4.3.3; 4.3.4; 4.3.5 (OMIT)

Field Compaction

1. Spreading the material → using bulldozers, front end loader & blades in layers of 6-18 in. thick depending of comp. equipment.
2. Compaction equipment type --- smooth-wheel & drum rollers

size	100% coverage
	upto p = 380 KPa
	= 55 psi

Type	Coverage	P	Usage
1) Smooth-wheel & drum rollers	100%	Upto 380 KPa (55 psi)	Asphalt pavement & subgrade
2) Pneumatic or rubber-tire roller	80%	Upto 700 KPa (100 psi)	Highway fills embankments earth dams
3) Sheeps-foot roller	8-12%	7000 KPa (1000 psi)	Cohesive soils
4) Loaded trucks			
5) Hand-operated tampers			Around foundations (smaller areas)

4.4 In-Place Determination of Soil Density

Specify Field

→ $\gamma_{d, f} = 95 \text{ to } 98\%$

$w_{\text{field}} = \text{----- range ----- fig. 4.14}$

$$\% \text{ compaction} = \frac{g_{d, f}}{g_{d, o}} \times 100$$

- Lift thickness
- # of roller passes
- Depth of influence
- Field density ----- experiments 18, 19, 20

H.W. 4.3, 4.6, 4.11