Compaction and Stabilization Equipment

OUTLINE

1. Introduction
2. Type of Compacting Equipment
3. Soil Stabilization
4. Compactor Productivity

Introduction (1)

Compaction

Process of increasing the density of a soil by mechanically forcing the soil particles closer together

If performed improperly, settlement of the soil could occur and result in unnecessary maintenance costs or structure failure.

Introduction (2)

What is soil?

Soil is formed in place or deposited by various forces of nature such as glaciers, wind, lakes and rivers, residually or organically.

Following are important elements in soil compaction:

- Soil type
- Soil moisture content
- Compaction effort required

Introduction (3)

- Compaction seeks to improve the Quality (property) of Soil
  - Reduce or prevent settlement
  - Increase strength
  - Improve bearing capacity
  - Control volume changes
  - Lower permeability
- By means of improving (increasing) dry density

Introduction (4)

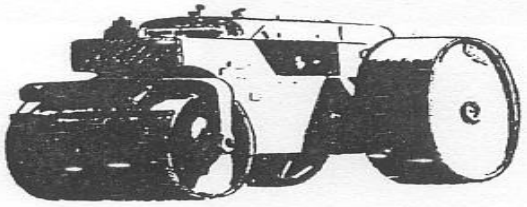
Compaction Actions

- **Kneading**
- **Static Weight**
- **Vibration**
- **Dynamic / Impact**

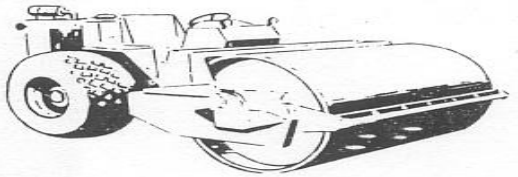
Type of Compacting Equipment (1)

- Tamping Roller
  - Effective on all soil
  - Working speed 8 – 12 mph
- Vibration Compactor
  - Have one or two drums
  - Working speed 2 – 4 mph
- Pneumatic-Tire Rollers
  - Used in compacting asphalt, base and sub-base material

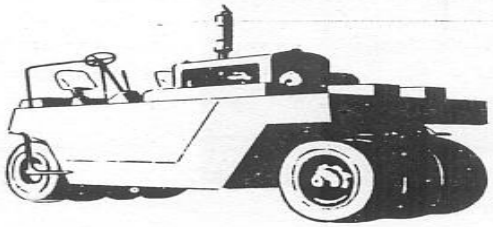
Type of Compacting Equipment (2)



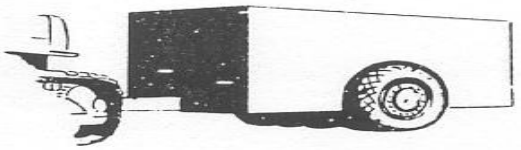
SMOOTH, STEEL WHEEL ROLLER



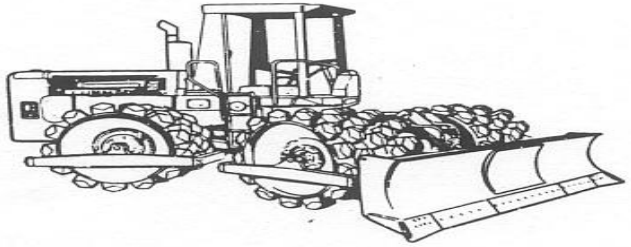
SELF-PROPELLED
VIBRATING ROLLER



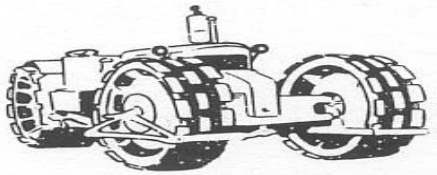
SMALL, MULTITIRED
PNEUMATIC ROLLER



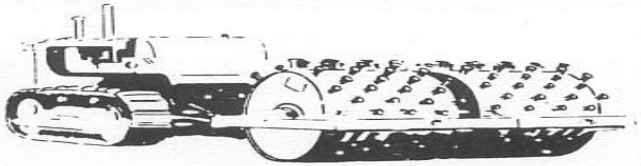
HEAVY PNEUMATIC
ROLLER



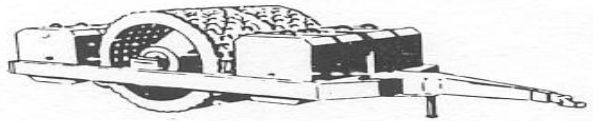
SELF-PROPELLED TAMPING
FOOT ROLLER



SELF-PROPELLED SEGMENTED
STEEL WHEEL ROLLER



TOWED SHEEPSFOOT
ROLLER



GRID ROLLER

Type of Compacting Equipment (3)

Soil Stabilization (1)

- Soil conditions are often unstable,
- They are subject to differential expansion and shrinkage when undergoing changes in moisture content
- Improvement through chemical and/or mechanical stabilization

Soil Stabilization (2)

Soil density tests

To determine if proper soil compaction is achieved for any specific construction application, several methods were developed. The most prominent by far is soil density.

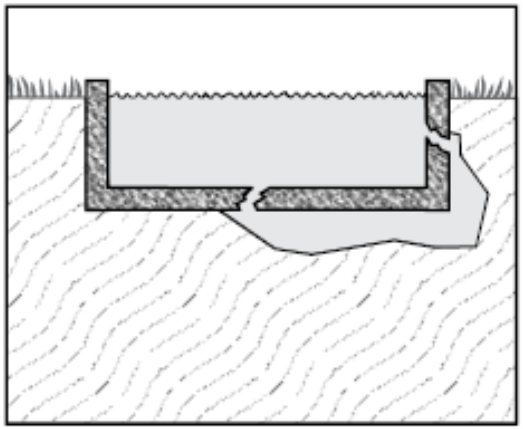
Why test

Soil testing accomplishes the following:

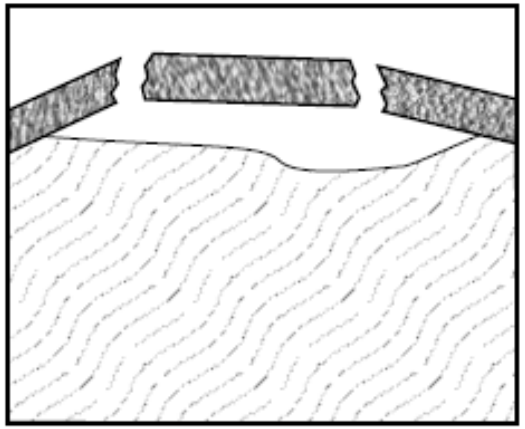
- Measures density of soil for comparing the degree of compaction vs specs
- Measures the effect of moisture on soil density vs specs
- Provides a moisture density curve identifying optimum moisture

Soil Stabilization (3)

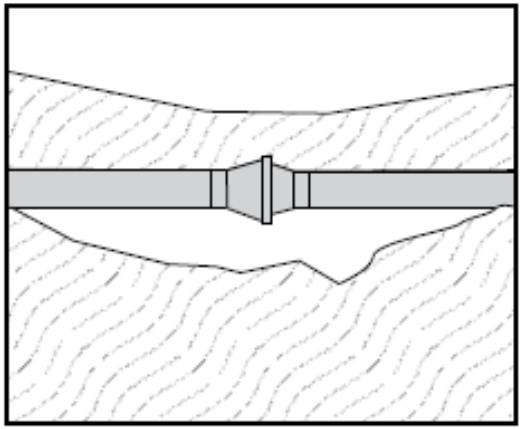
RESULTS OF POOR COMPACTION



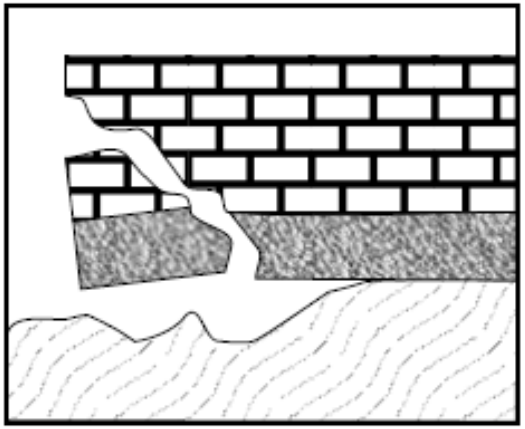
Basement & Pool
Cracks & Leaks



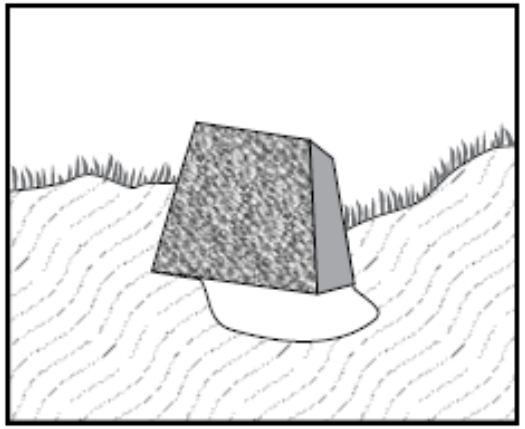
Slab Cracks



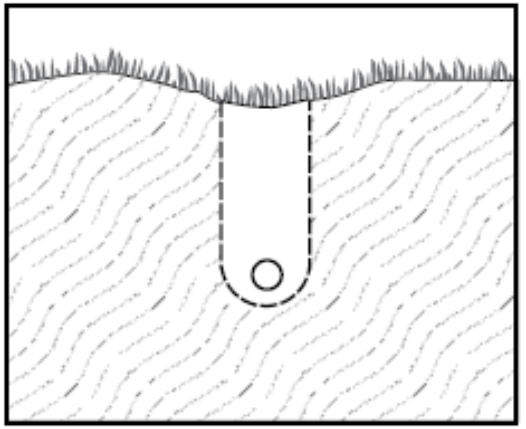
Pipe Leakage
& Breaks



Foundation Erosion

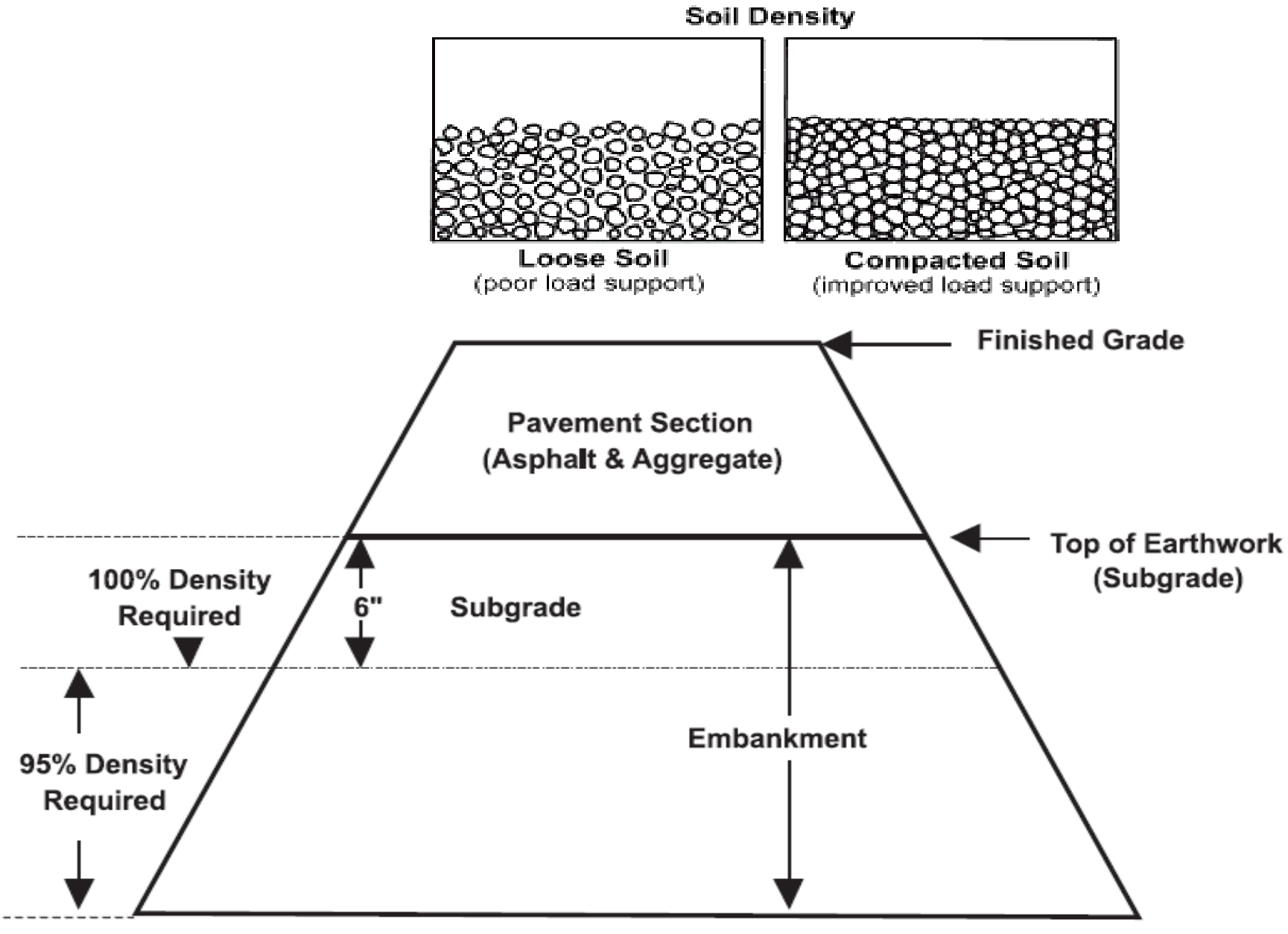


Erosion Gullies
Under Abutments



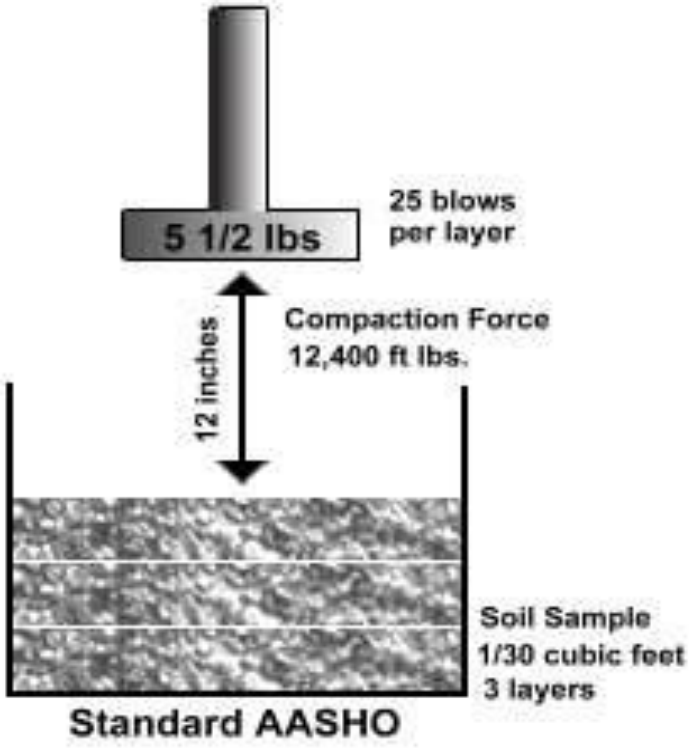
Utility Trench
Settling

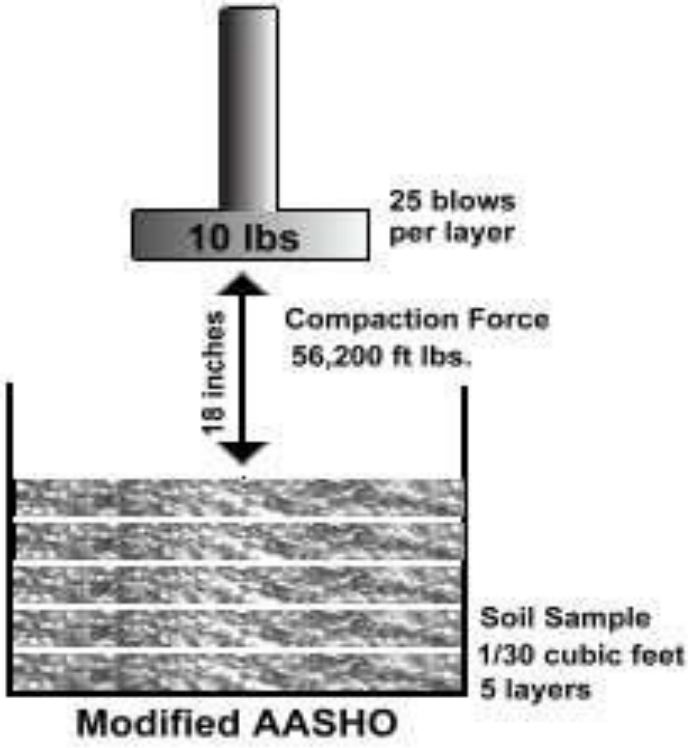
Soil Stabilization (4)



Soil Stabilization (5)

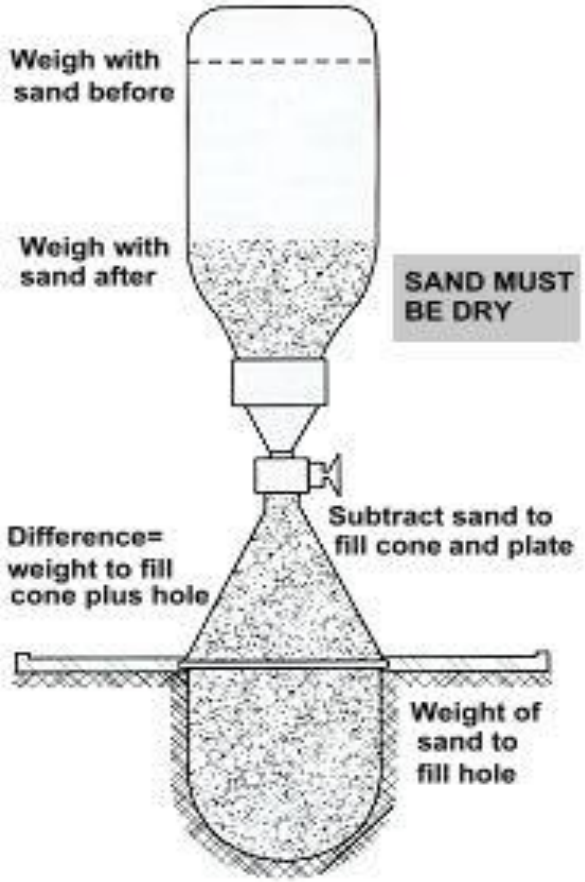
Proctor Test





Soil Stabilization (6)

Sand Cone Test (ASTM D1556-90)



- Dig compacted soil from a hole (6” diam by 6” deep)
- Weighed the soil (wet weight)
- Dry the soil
- Weigh the soil (dry weight)
- Fill the hole with dry sand and measure its volume

Soil Stabilization (6)

Factors Affecting the Effectiveness of Compaction

- Compaction Mechanism (type of equipment)
- Type of Soil
- Thickness of layer (lift)
- Weight of Compactor
- Efficiency

Soil Stabilization (7)

Method of Soil Stabilization

Chemical Stabilization

- Incorporating lime (w/ fly ash) for high clay content soil
- Incorporate Portland cement for granular soil

Soil Stabilization (8)

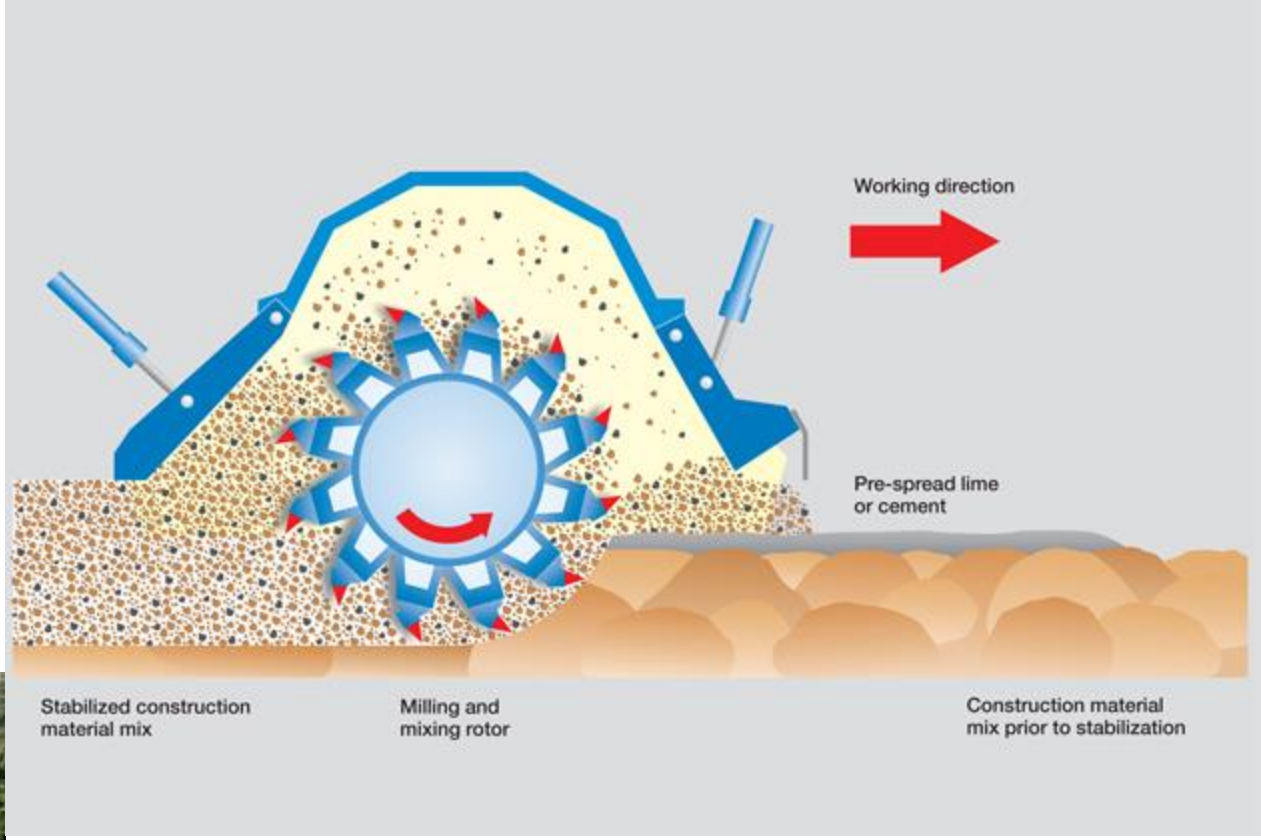
Lime Stabilization Construction Procedure

- Scarification and pulverization
- Lime Spreading
- Preliminary Mixing and additional water
- Preliminary curing (cure 24 to 48 hours)
- Final mixing
- Compaction
- Final Curing (7 days)

Soil Stabilization (9)

Soil Cement Stabilization Construction Procedure

- Spreading
- Mixing
- Compaction
- Final Curing (2 days)



Compactor Productivity

Compacted Quantity / Hour (Productivity)

$$Q = \frac{W \times S \times L \times E}{P}$$

Q = compacted volume / hour (cy/hr or m^3/hr)

W = compacted width, (ft or m)

S = average speed, (mph or km/h)

L = compacted lift, (in or cm)

P = number of passes required to achieve density

E = work efficiency

Compactor Productivity

$$Q = \frac{16.3\ W \times S \times L \times E}{n}$$

Q = compacted cy/hr

W = compacted width, (ft)

S = average speed, (mph)

L = compacted lift, (in)

n = number of passes required to achieve density

E = work efficiency

16,3 is the conversion factor for putting the result in cubic yard

Compactor Productivity (2)

A self-propelled tamping foot compactor will be used to compact a fill being constructed of clay material. Field tests have shown that the required density can be achieved with four passes of the roller operating at an average speed 3 mph. the compacted lift will have a thickness of 6 in. The compacting width of this machine is 7 ft. one bcy equals 0.83 ccy. The scraper production, estimated for the project is 510 bcy/hr. how many roller will be required to maintain this production? Assume a 50 min hour efficiency.

Solution…??

Compactor Productivity (3)

$$\text{Compacted cubic yard per hour} = \frac{16.3\ x\ W\ x\ S\ x\ L\ x\ efficiency}{n}$$

$$= \frac{16.3\ x\ 7\ x\ 3\ x\ 6\ x\ 5/6}{4}$$

$$= 428 \text{ ccy/hr}$$

$$= \frac{428}{0.83}$$

$$= 516 \text{ bcy/hr}$$

$$= \frac{510}{516}$$

$$= 0.99, \text{ only one roller will be required}$$

Homework

- Find article (s) on soil (chemical) stabilization
- Describe and discuss method of work in a paper of at least 5 pages (A4) printed on one side
- Presented in PPT format
- Paper due by Friday, 7th March 2014