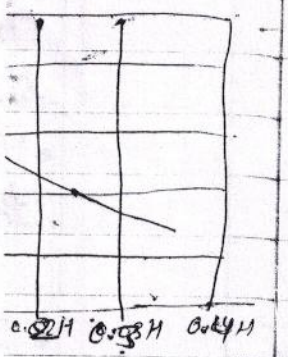
of zero
by the

— (1)

mpute



f x →

t only)

equating
ider forces
for y.

Section - D
Unit-VI (Soil Stabilization)

Stabilisation, in a broad sense, incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance.

Methods of stabilisation may be grouped under two main types:

(a) modification or improvement of a soil property of the existing soil without any admixture.
Eg:- Compaction and drainage

(b) modification of the properties with the help of admixtures.
Eg: Mechanical stabilization, Stabilisation with cement, lime, bitumen and chemical etc.

Mechanical Stabilisation :→

This involves two operations:

(i) changing the composition of soil by addition or removal of certain constituents

(ii) densification or compaction.

This has been largely used in the construction of cheap roads. Guide of specifications have been drawn for gradation requirements of the bases and surfacing.

- For mechanical stabilisation, where the primary purpose is to have a soil resistant to deformation and displacement under loads, soil materials can be divided into two fractions: the granular fraction retained on a 75 micron IS sieve and the fine soil fraction ~~to de~~ passing a 75 micron sieve.

- The granular fraction impart strength and hardness.
- The fine fraction provides cohesion or binding property, water retention capacity, and also acts as a filler for the voids of the coarse fraction.

Notes:-

(i) For bases:- Liquid limit not exceeding 25% and plasticity index not exceeding 6.

(ii) For Surfacing: Liquid limit not exceeding 35% and plasticity index between 4 and 9.

If the soil from one source does not meet the gradation and plasticity requirements of a job, it becomes necessary to mix materials from two or more sources by obtaining the desired mixture.

Proper compaction plays a very important role in stabilisation.

e the
resistant
nder loads,
o two
retained
fine soil
n sieve.

rength

n or
n capacity,
ids of

eeding 25%
6.
eeding 35%
nd 9.

t meet
ments
nix
es by

portant

Cement Stabilisation:→

Soil Cement and its influencing factors:-

The soil stabilised with cement (Portland) is known as soil cement. The cementing action is belived to be the resulting of chemical reaction of cement with the siliciows soil during hydration.

- The binding action of individual particles through cement may be possible only in coarse-grained soils.
- In fine-grained, cohesive soils, only some of the particles can be expected to have cement bonds, and the rest will be bounded through natural cohesion.

The important factors affecting soil cement are: nature of soil, cement content, conditions of mixing, compaction and curing, and admixtures

Construction Methods:

The normal construction sequence for soil-cement bases is as follows:

(i) Shaping the sub-grade and scarifying the soil.
(ii) pulverising the soil
(iii) adding and mixing cement
(iv) adding and mixing water
(v) Compaction

(vi) finishing
(vii) curing, and
(viii) adding ~~water~~ wearing surfacing.

There are three methods of carrying out these operations:
(i) mix-in place method
(ii) travelling plant method
(iii) stationary plant method.

- In the mix-in-place method the subgrade is first shaped to the required grade and is cleared of undesirable materials. It is then scarified to the required depth of treatment and the soil is pulverised, untill at least 80% of the material passes a 4.75 mm sieve. Water is added as required for compaction and the soil cement-water is turned ~~in~~ into an intimate mixture. The wet mixture operation should not last more than 3 hrs after which the compaction should be completed. A bitumen wearing surface is provided. This method is cheaper and more adaptable to different field conditions, but the processing of soil is not so through and accurate as with other methods.

- In the travelling plant method, the pulverised soil is heaped into a window and the cement is spread on the top. The soil and cement are lifted by an elevator to a mixer carried on a travelling plateform where water is added and mixing is done. The mixture is then discharged on to the subgrade. It is spread with a grader and compacted. A uniform mixing and accurate control on added water can be ensured in the method. This method is costly.
- In the stationary plant method, the excavated soil is brought to a stationary mixing plant. At the plant, cement and water are added and mixed with the soil. The mixture is then transported back to the desired location, dumped, spread and compacted. The uniform mixing and accurate control on added water can be ensured. The depth of treatment can be easily controlled. This method is slower and may prove expensive due to additional haulage of soil.

Lime Stabilisation :→ or lime fly ash Stabilisation

Lime has been mainly used for stabilising the road bases and sub-grades.
On addition of lime to a soil, two main types of chemical reactions occur:
(i) alteration in the nature of the absorbed layer through base exchange phenomenon
(ii) cementing or puzzolanic action
Lime reduces the plasticity index of highly plastic soils making them more friable and easy to be handled and pulverised.
Normally 2 to 8% of lime may be required for coarse grained soils, and 5 to 10% for plastic soils. The amount of fly ash as admixture may vary from 8 to 20% of the soil weight (Lambe 1962).

The construction procedures of lime stabilised bases are similar to those soil-cement.
No strict time limitations for completion of the job are however necessary, since the soil-lime cementation reactions are respectively slow.

Bitumen Stabilisation :→

Asphalts and tars are bituminous materials which are used for stabilisation of soil, generally for pavement construction.

fly ash
lisation
bilising

main

bsorbed
omenon
n
of highly
ke and

required
0% for
h as
20% of

e Stabilised
cement.
mpletion
, since
ctions

s materials
t soil,
tion.

Depending upon the actions and the nature of soils, bitumen stabilisation is classified under the following four types:
(i) Sand-bitumen, (ii) Soil-bitumen
(iii) Water-proofed mechanical stabilisation
(iv) Oiled earth

1) Sand Bitumen :-
This term refers to bitumen-stabilized cohesionless soil, such as loose beach, dune, pit or river sand. The primary function of bitumen ~~to~~ is to bind the soil particles. Sand should be free from clay and organic matter.
Hot mix sand asphalt is suitable in area of heavy rainfall, and emulsions are preferable in arid zones. Rapid curing cutbacks are recommended for low temperatures and slow curing for high temperatures.

2) Soil bitumen :-
It refers to a cohesive soil in which the main function of bitumen is to preserve the natural cohesive strength by water-proofing the soil or reducing the water absorption.

3) Oiled Earth :-
Slow and medium curing road oils are spread on the ground surface to make it water and

abrasion resistant. The oil penetrates a short depth into the soil without involving any mechanical mixing.

⊠ Chemical Stabilisation:→

1) Calcium Chloride:-

It is used as a water retentive additive in mechanical stabilised bases and surfacing. Being hydroscopic, the salt absorbs moisture from the atmosphere and retains it. It makes alterations in the characteristics of pure water. The vapour pressure get lowered and the surface tension increased, and thereby the rate of evaporation decreases. Calcium chloride acts as soil flocculent. It facilitates compaction and usually causes a slight increase in the compacted density.

2) Sodium Chloride:→

The stabilising action of sodium chloride is somewhat similar to calcium chloride, but it has not been widely used. It attracts and retains moisture and reduces the rate of evaporation. Another beneficial phenomenon is the crystallisation of the salt in the soil pores near the surface, which retards

trates
ioet
ing.

- additive
and
he salt
nasphere
ations
e water.
and the
d thereby
ses.
'occulent.
ially
compacted

chloride
chloride,
'. 4%
and
m.
is the
he soil
retards

further evaporation and also reduces the formation of shrinkage cracks. The salt is not applied on the surface, but it is mixed into the soil by mix-in-place or plant-mix methods.

3) Sodium Silicates :→

The sodium silicate solution in water, known as water glass, in combination with other chemicals, such as calcium chloride, is used as an injection for stabilising deep deposits of soils. These injections are found to be most successful in fine and medium sands.