Assignment # 01

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Question # 1

Given Figure. 1 refers to which phenomena of the pavement conditions?

2. Find the phenomena and discus that phenomena / behaviour for flexible pavement with granular base and stabilized base.

Answer # 1

From Fig.1 we see that Stress-Strain phenomenon of the Pavement condition. Vertical Stress is acting whose intensity is on the top layer is maximum and reduces with depth and this value of stress comes to lower value when it comes to subgrade E1>E2 means top layer must be of higher quality material.

Question # 2

Being a material design expert, if client department award you the consultancy for preparation of the geotechnical report for the upcoming road project.

1. Which steps (General Procedure) you would consider while soil investigation and preparation of Geotechnical Report ?
2. Also elaborate the steps briefly in your own words.

Answer # 2:

Site Investigation is the gathering of the information about the proposed location of a project e.g highway or buildings. Being a material design expert, if awarded the consultancy services by the client, for preparation of the geotechnical report for the upcoming road project the following steps (General Procedure) would be considered while soil investigation and preparation of Geotechnical Report.

Following are the steps considered soil investigation and preparation of Geotechnical report are:

1. Desk Study
2. Site Reconnaissance
3. Preliminary Investigations
4. Main Investigations
5. Geotechnical Report

1. Desk Study

- Geological Investigation.
- Pavement Details.
- Site History
- Site Location

Benefits of a Desk Study

- Mitigate/minimise risk
- Understanding of potential variations in ground conditions
- Can lead to economical design of foundations / geotechnical structures
- Reduce likelihood of unforeseen ground conditions
- Reduce chances of delays on site
- Quantify / qualify risk
- Accurate forecast of budgets

2. Preliminary Investigations:

Preliminary Investigations includes Preliminary BHs and Preliminary Tests.

3. Site Reconnaissance

It includes

- Site Visit
- Plain or Hilly Area
- ROW
- General Topography
- Local Problems
- Environmental Effects

5. Geotechnical Investigations

It includes Site Tests and Laboratory Tests.

Site Tests are:

- Test Pits
- Boring/ Driling
- Sampling
- In-situ Desnsity Moistur test
- SPT, CPT test

Laboratory Tests are:

- Resilent Modulus
- permeability
- Strength
- Consolidation
- settlement
- Expansion
- Chemical Test
- Classification Tests (Sieve Analysis, Atterberg Limits)

Question # 3

The below Figure. 2-1.7 refers to the CBR results showing penetration of the piston in X-axis and bearing value on Y axis. At y-axis right side of the graph, it shows ranges in percentage from 5% to 100% referring to different degrees of the subgrade (any material) quality in reference to CBR test.

1. Please elaborate the Figure in your own words in detail.

Answer:

The figure in question # 3 it shows the relationship between bearing values and penetration values with respect to CBR values for quality of soil in percentage from 5% to 100%. In the figure the dotted lines shows the standard values of CBR for different soils. Which Starting from Adobe soils, it gives a maximum penetration of 0.5 inch very quickly without any resistance and it is considered very poor subgrade. Clay Loam load penetration curve, it also show little resistance and penetrates quickly to a value of 0.5inch. is considered poor subgrade. Sandy loam soils are considered good subgrade and it gives resistance to penetration and gives 0.5 inch penetration at 800 Ib per sq in. Disintegrated Granite curve comes between 30% and 50% CBR Value, considered fair quality subbase. Gravel base curve indicates that gravel base shows resistance to penetration and at bearing value of 1050 lb per sq inch it gives penetration of 0.Sinch, it is considered poor quality base course. Crushed rock base shows maximum resistance and at maximum bearing value of 2500 lb per inch it gives penetration of 0.45 inch and is considered very good quality material.

Question # 4

1. In the Figure given below what is Dry of optimum and Wet of optimum? Explain?
2. What are effects of compaction on Engineering properties of soil? Details.

Answer:

Optimum Moisture Content refers to the water content of a compacted soil. The water content of a compacted soil is expressed with reference to the Optimum Moisture Content. Thus, soils are said to be compacted dry of optimum or wet of optimum (i.e on the dry side or wet side of OMC).

Explanation:

When the soil is drier than the optimum compaction of the soil, then it is called dry of compaction. These soil need more compaction. When the soil is wetter than the optimum compaction of the soil, then it is called wet of compaction. These soil need lesser water supply and compaction.

For a given compactive effort, soils have a flocculated structure on the dry side (i.e. soil particles are oriented randomly), whereas they have a dispersed structure on the wet side (i.e. particles are more oriented in a parallel arrangement perpendicular to the direction of applied stress). This is due to the well-developed adsorbed water layer (water film) surrounding each particle on the wet side.

Compaction on Engineering properties of soil:

Soil compaction occurs when soil particles are pressed together, reducing pore space between them. Heavily compacted soils contain few large pores, less total pore volume and, consequently, a greater density. A compacted soil has a reduced rate of both water infiltration and drainage. In the construction field, it is an important process as it improves the engineering properties of soil to a great magnitude.

Effects of compaction on engineering properties of soil:

Compaction means pressing of the soil particles close to each other by mechanical methods. Air is expelled from soil mass and mass density is increased. It is done to improve the engineering properties Like shear strength, stability etc… Reduces compressibility and permeability.

The following properties are effected compaction on engineering properties of soil.

1. Shear Strength

- Shear strength of soil compacted to dry of optimum is more than those compacted to wet of optimum at lower strains.
- At higher strain, soil compacted to wet of optimum will have more shear strength.
- Type of compaction, drainage conditions and type of soil also influence the shear strength of compacted soil.

2. Compressibility

- The Compressibility of compacted soil varies according to the amount of pressure applied.
- For low-pressure range, compressibility is more for soils which are compacted to wet of optimum than soil compacted to dry of optimum.
- Similarly, for high-pressure ranges, compressibility is more for soils which are compacted to dry of optimum than soil compacted to wet of optimum.

3. Permeability

- Compaction reduces the voids present in the soil hence permeability also reduces.
- At a particular density, for the same soil sample, permeability is more for soils which are compacted to dry of optimum than those compacted to wet of optimum.

4. Swelling of Soil

- When the soil is compacted to dry of optimum, the soil is in need of water and it swells easily when contacted with water.
- When water is compacted to wet of optimum, the soil particles are oriented in a dispersed manner and swelling does not occur.
- So, to avoid swelling, soils should be compacted to wet of optimum.

5. Pore Water Pressure

- Pore water pressure is high for those soil whose water content is high. Hence, soils compacted to wet of optimum compaction will exhibit more pore water pressure than soil compacted dry of optimum.

6. Shrinkage of Soil

- Shrinkage is more for the soil compacted to wet of optimum than dry of optimum.
- In case of dry of optimum compaction, soil particles are in random orientation and they are in stable condition.
- But in case of wet of optimum, soil particles are in parallel orientation and they are unstable which makes it easy for packing of particles causing shrinkage.

7. Stress-strain Behavior of Soil

- Soils compacted to dry side of optimum will take more stress for little strain hence, stress-strain curve of this type of soil is much steeper and elastic modulus is more. Brittle failure occurs in this case.
- Similarly, soils compacted to wet of optimum will produce more stress even for smaller stress. Hence, Stress-Strain curve, in this case, is much flatter and plastic-type failure occurs at a larger strain. These type of soils have low elastic modulus.