Subject: Pavement Material Engineering
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Q1(1) Ans:
The given figure refers to a phenomena know as vertical stress phenomena (stresses and strains phenomena) which are mostly found in flexible pavements, where the wheel load is applied over a flexible pavement and this phenomena is produced their.

Q1(2) Ans:
According to the above phenomena the pavement directly under wheel load of vehical is under compression. While most of the surround area is under very little stress. The modulus of elasticity describes the stiffness of a material.
For Example: its capacity to bear and spread load. In ideal road structure the modulus of materials in the pavement layer should decrease from top to bottom. This is just because of closer the material to the surface, the greater will be the stress caused by the whel load. A stiffer/hard material will spread the load better over

the layer below. Behavior for flexible pavement with granular base and Stabilized base are following.

A) For Granular Base:

Typical Asphalt flexible pavement with granular Base Shows the critical stress/Strain locations.

1) compressive Strain it can possibly cause rutting.
2) Tensile Strain can cause fatigue or alligator cracking.
3) compressive Strain which can cause Rutting.
4) compressive Strain which can cause Rutting and depression.

B) For Stabilized Base:

Typical Asphalt flexible pavement with Stabilized Base Showing the critical stress/Strain locations.

1) compressive Strain which results in Rutting.
2) Tensile Strain which results in transverse reflective cracking or fatigue cracking.
3) Compressive Strain it cause Rutting
4) Compressive Strain causes Rutting and Depression.

Q2(1) Ans:
Being a material design expert, in soil investigation we need a complete picture of sub surface condations. Following are the (general procedure) steps to be followed while soil investigation.
1) Collection of Preliminary Data
2) Reconnaissance
3) Site works
4) Laboratory tests
5) Reports

Q2(2) Ans: Alaso elaborate the steps briefly in your own words.
1) Collection of Preliminary Data:
It is the first step for preparation of geotechinal site investigation report. In this step we check the general geology of the site, and any other existing reports about the site and Pavement Detial.
2) Reconnaissance:
In this second step we organized a site visit and examine the gernal topography and genral ground slop of the area. We also check the property in proposed ROW and prsence of water courses and soil stratification from deep cuts and prospect material sources and assure if there is any local problems

(Floods, cracks, subsidence)

3) Site works:

In this thired step we make a field tests pits and take a samples from the which is to be tested in laboratory first. And also measure the in-situ moisture and density of the soil

4) Labortory Test:

In this fourth step we made all laboratory tests like classification analysis (sieve Analysis and Atterberg's limits) and strength test, consolidation and settlement and chemical testing. Reports are prepared which are compiled with the field conditions and then take appropriate decisions based on these results.

5) Reports:

In this final step we made a reports on all the performing tests and all the performing field evaluation and then submits this report to the client.

Q3(1): Ans:

Given figure in this question is from (porter's Paper 1942) shows a typical bearing values (psi) versus penetration in (inch). For various materials ranging from "Very Poor Subgrade" (CBR up to 5) to "good crushed rock bases" (CBR of 100). The CBRs are in terms of percentage (%) Since the bearing value is divided by 1000 Psi (0.1 penetration) or 1,500 Psi (0.2 inch penetration) which represents the bearing value of crushed rock material (refer to " Standard Curve 100% in Figure.)

Further more the figure that soil like clays and adobe have very low CBR values and hence are very Poor Subgrade materials with low bearing values.

As the CBR values increases like in Sandy loam Soils. The bearing values of soil also increases hence are very good for Subgrade.

For a good sub base material the disintegrated granite Shows good CBR value 30 40%. And the hard rocks whose CBR values are maximum are used for the base and wearing coarse.

More over the figure also shows that with the increase in Penetration size, the CBR value Percentage (%) also increases.
We can say that a soil with CBR value 0 is the least suitable or very poor soil and with the increase in the CBR value percentage (%) the suitability of soil also increases. Hence a CBR value more than 30 is good for subgrade and sub base and base.

Q4 (i) Ans:
In given figure starting at low water contents, as the water content increases, the particles develop larger and larger water films around them which tend to "lubricate" the particles and make them easier to be moved about and reoriented into a denser configurgation.

Dry of optimum:
When the soil is drier than optimum compaction of the soil, then it is called dry of compaction. Dry of optimum soils are always flocculated. These soils need more compaction.

Wet of optimum:

when the soil wetter then optimum compaction of the soil then it is called wet of compaction. ~~Dry of~~ In wet optimum fabric becomes more oriented or dispersed. These soil need lesser water supply and compaction.

Q4(2) Ans:

Now we will discuss about effects of compaction on Engineering Properties of soil. The following Properties are effected.

1) Soil Structure
2) Permeability
3) Swelling
4) Pore water Pressure
5) ShrinKage
6) compressibility
7) Stress-Strain Relationship
8) Shear Strength

1) Soil Structure:

The amount of water content at which the soil is compacted Plays an important role in soil structure. soil compacted at water content less than optimum water have flocculated structure. Soils compacted at water content more than

2) Permeability:-

Permeability of soil on voids size. As water content increases, there is an improved orientation of particles resulting in reduction of void size and permeability. Above optimum water content, the permeability slightly increases. If compactive effort is increased, the permeability decreases due to increased dry density.

3) Swelling:-

The effect of compaction is to reduce void space. Hence swelling is enormously reduced. Further soil compacted on wet side because of random orientation and deficiency of water.

4) Pore water Pressure:-

It is defined as pressure of ground water held within a rock or soil in gaps b/w particles (pores). The pore water pressure for soil compacted dry of optimum is therefore less then that for the same soil compacted wet of optimum.

5) Shrinkage:-

Soils compacted dry of optimum shrink less when compared to compacted wet of optimum. The soils compacted wet of optimum shrik more because the soils particles in dispersed structure can pack more efficiently.

6) Compressibility:
The flocculated structure on dry side of optimum offers greater resistance to compression than the dispersed structure on wet side. So, the soils compacted dry of optimum are less compressible.

7) Stress - Strain Relationship:
The soil compacted dry of optimum have steeper stress-strain curve those on wet side. The strength and modulus of elasticity of soil on dry side of optimum will be high. Soil compacted dry of optimum shows brittle failure. And soils compacted on wet side experience increased strain.

8) Shear Strength:
In general the soils compacted dry of optimum have a higher shear strength then wet of optimum at lower strains. However at large strains the flocculated structure of soil is broken, and ultimate strength will be equal for both dry and wet sides.