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MID TERM ASSIGNMENT

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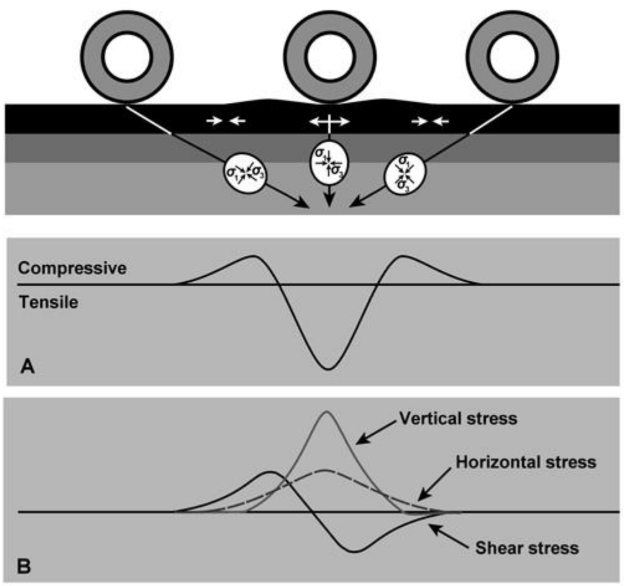
Answer#1

1. Vertical stress under wheel load

The phenomena shown in figure 1 is Vertical stress under wheel load.

The pavement right under the load is under compression,

While maximum of the nearby pavement is under very slight stress.



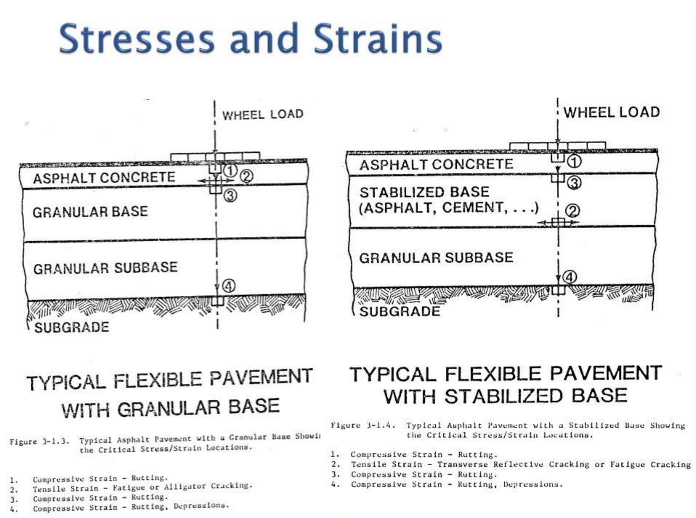
There are many manners in which the pavement fails. Cracking of the surface layer and permanent deformation of the pavement system which shows as rutting on the pavement surface. Larger and more intensive loads produce greater stresses and strains.

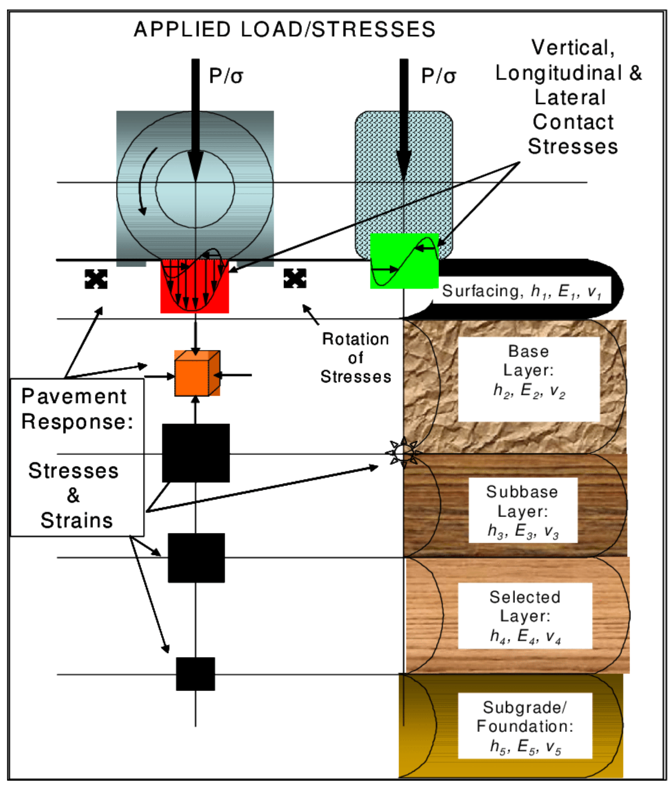
2. Flexible pavement with granular base and stabilized base

Stresses and strains under tire load

Tire load causes a more complex dynamic loading phenomenon and this is normally considered

1. The stresses in the pavement structure caused by the moving wheel load,
2. The time dependent response of the road materials and
3. The stresses induced by impact loads.





Typical Flexible pavement with granular base

Introduction

Aggregates are used in granular base and subbase layers below the driving surface layer(s) in both asphalt concrete and Portland cement concrete pavement structures. The aggregate base layers serve a variety of purposes, including reducing the stress applied to the subgrade layer and providing drainage for the pavement structure

Materials

Aggregates used in granular base and subbase applications generally consist of sand and gravel, crushed stone or quarry rock, slag, or other hard, durable material of mineral origin. The graduation requirements vary with type (base or subbase).

Material Properties and Testing Methods

The granular base and subbase generally make up the greatest thickness of the pavement structure, and provide both bearing strength and drainage for the pavement structure.

Some of the more important properties of aggregates for granular base and subbase include:

Gradation

Particle Shape

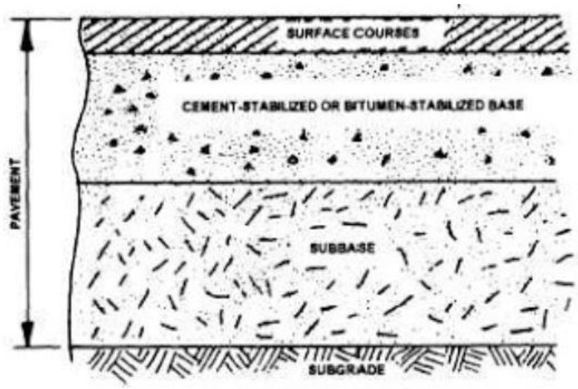
Base Stability

Permeability

Plasticity

Abrasion Resistance

Typical Flexible pavement with Stabilized base



STABILIZED BASE SECTION

INTRODUCTION

The term stabilized base, presented in this section, refers to a class of paving materials that are mixtures of one or more sources of aggregate and cementitious material(s) blended with a sufficient amount of water, that result in a mixture having a moist, nonplastic consistency that can be compacted to form a dense mass and gain strength. This class of base or subbase materials is not meant to include the stabilization of soils or aggregates using asphalt cement or emulsified asphalt.

MATERIALS

The components of a stabilized base or subbase mixture include aggregate, cementitious materials, and water.

Aggregates

Aggregates comprise the major portion of stabilized base. Normally, between 80 to 95 percent by weight of a stabilized base or subbase mix may consist of aggregates. A wide range of different types and gradations of aggregates have been used in stabilized base and subbase mixtures.

Cementitious Materials

The key to strength development in stabilized base or subbase mixtures is in the matrix that binds the aggregate particles together. The strength of the matrix is affected by the cementitious material used in the mixture. The amount of cementitious material in a stabilized base or subbase mix usually ranges from 5 to 10 percent by weight of the mix, but may in some cases comprise as much as up to 20 percent by weight if a lighter weight aggregate is used.

MATERIAL PROPERTIES AND TESTING METHODS

Aggregates used in stabilized base and subbase mixtures play a major role in determining the quality and performance of stabilized base and subbase mixtures. Aggregate materials used in these types of mixtures must be properly graded and possess good to adequate particle shape, strength, and integrity

Gradation

Abrasion Resistance

Durability

Unit Weight

Deleterious Substances

Plasticity

Cementitious Materials

Cementitious materials used in stabilized base and subbase mixes must be capable of reacting to bind the particles of aggregate together into a stable mass that is able to support imposed wheel loadings and resist the deteriorating effects of climate and water. Some of the more important properties of cementitious materials used in a stabilized base application include:

Fineness – the fineness of the cement or supplementary cementitious materials affects heat release and rate of hydration. Finer materials react faster, with a corresponding increase in early strength development. Fineness also influences workability, since the finer the material, the greater the surface area and frictional resistance of the plastic mixture.

Setting Time – the setting time for the cement paste is an indication of the rate at which hydration reactions are occurring and strength is developing.

Compressive Strength – compressive strength is influenced by cement composition and fineness. Compressive strengths for different cements or cement blends are established by compressive strength testing of mortar cubes.

Specific Gravity – specific gravity is not an indication of the quality of the cement, but is required for concrete mix design calculations.

Answer#2

Soil Investigations

Field Reconnaissance Survey

For most site investigations access and environmental constraints have major influences on cost. It is therefore necessary for a field reconnaissance survey to be conducted as the first stage of a geotechnical investigation.

Desk Top Study

Every site investigation should commence with a desk study directed towards collecting, collating and reviewing the following:

- Design drawings from any previous structure at the site.
- Previous site investigation reports, borehole logs, penetrometer results and construction experience.
- Geological maps, survey data and records.
- Aerial photographs.
- Local knowledge and resources. Where possible, collection and collation of the above information should be undertaken during the field reconnaissance survey stage. However, further work to fully explore the extent of information available may be required.

Site Investigation

A comprehensive geotechnical investigation of the project site should be carried out in order to characterize the materials and conditions which will be encountered during the construction and operation of the project, their nature, variability, extent and any special requirements to be observed. The investigation should be undertaken in a systematic manner to minimize the likelihood of contract variations arising from unexpected conditions. The detail of the investigation should be commensurate with the potential risks, hazards and complexity of the project.

Soil investigations involve the following steps:

1. Planning the details and sequence of operations
2. Collection of soil samples from the field
3. Conducting all field tests for determining the strength and compressibility characteristics of the soil
4. Study of ground water level conditions and collection of water samples for chemical analysis
5. Geophysical exploration if necessary
6. Testing in the laboratory of all samples of soil, rock, and water
7. Preparation of drawings and charts
8. Analysis of the results of the tests
9. Preparation of report

Methods of Soil Investigations

The normal methods of soil investigations are:

- Inspection
- Test pits
- Probing
- Boring

Inspection

The first step in this connection is the inspection of the site and its vicinity to get a preliminary idea of the site conditions. This includes the study of the existing buildings in the neighborhood and if possible, the type of their foundations. The cuts made in the nearby areas should also be looked into. The subject can be discussed with those persons who were associated in constructing buildings in the surroundings with regard to their experiences and difficulties encountered by them

Test Pits

Test pits are dug by hand or by excavating machines. The size of the pit should be such that a person can easily enter the pit and have a visual inspection. Both disturbed and undisturbed soil samples are collected from the pit for detailed analysis.

Probing

This will give a rough idea of the underlying soil. In this, a steel bar of 25 to 40 mm (1 inch to 1.5 inch) in diameter is driven into the ground until a hard stratum is met with. The bar is driven by a hammer. The bar is then drawn out at intervals and the soil sticking to the bar is examined to get an idea of the type of the soil. An experienced workman can assess the nature of the soil by observing the way the rod is penetrated into the soil.

Boring

In this process, bore holes are made in the ground and the soil samples collected. Boring helps in obtaining 1) extent of each strata of soil/rock 2) nature of each stratum and the engineering properties of the soils 3) location of ground water table. The depth and number of boreholes will depend upon the type of the structure and nature of the soil as obtained from preliminary examination. The depth of boreholes is governed by the depth of the soil affected by the loading. As a rough estimate, it is advisable to investigate the subsoil to a depth of at least twice the width of the anticipated largest size of the foundation. In case of a pile foundation, the depth of boring should extend into the bearing stratum.

Bearing Capacity

The bearing capacity of a soil is defined as the capacity of the subsoil to support the load of the structure without yielding. The bearing capacity of the soil depends upon the characteristics such as cohesion, friction, and unit weight. The bearing capacity can be determined in the field and also from the results of tests conducted in the laboratory on the soil samples.

Field and Laboratory Testing

Field Tests

The commonly adopted field tests are:

Standard penetration test, Dynamic cone penetration test, Static cone penetration test, Plate load test, Vane shear test, and Pressure meter test.

Laboratory Tests

A set of laboratory tests are required to be done to obtain the soil parameters for the design of foundation. These tests are: Shear strength, Compressibility, Permeability, Chemical and Mineralogical Composition, and Soil Classification.

Synopsis

The foundation is that part of the building which serves as a base and transmits the load to the soil. Before a foundation is designed, it is necessary to investigate the characteristics of the underlying soil. There are different methods to assess these characteristics

Geotechnical Report Contents:

Introduction.

Project Description.

Field Exploration and Testing.

Site Conditions.

Design Recommendations.

General Construction Procedures and Recommendations.

Introduction:

Identify the project by location and name.

Briefly outline the scope of the investigation.

Project Description:

- Location including the beginning and ending station.
- Overview of the structures.

Field Exploration and Testing:

Methods and equipment used to bore the soils.

- Soil Boring Logs contain:
- Soil Densities
- Stiffness
- Blow Counts
- Recovery
- Water Content
- Atterberg Limits
- Unconf. Comp.
- Groundwater
- Methods and equipment used to test the soils

Site Conditions:

- Regional and Site Geology.
- Subsurface Conditions.
- Ground Water Conditions.
- Landslides and other Concerns such as Sink Hole or Fracturing Problems.
- Seismic Classification
- Subsurface Conditions.

Design Recommendations:

- Foundations.
- Modification of Existing Subsurface Materials.
- Retaining Walls.
- Site Grading and Earthwork.
- Pavements.
- Pavement Subsurface Drainage

Foundations:

- Spread Footings
- Driven Piles
- Drilled Shafts
- Micropiles

Retaining Walls:

- MSE Walls
- Modular Block Wall
- Conventional Cantilever Walls
- Soldier Pile and Lagging Walls

General Construction Procedures and Recommendations:

- Pile Installation.
- Site Preparation.
- Fill Compaction.
- Foundation Excavations.
- Erosion Protection.
- Construction Dewatering.

Evaluation Factor:

- How much time do I have?
- How much money do I have?
- What is the likelihood that this site has been previously developed?
- Can I save money later by spending it now?

Answer#3

From the figure it shows that

When the bearing capacity of the soil were below 250 lb. per square inch at the penetration resistance of 0.5 inch it gives us the CBR value 5% which identifies very poor condition of the sub grade.

And when the bearing capacity of the soil were just above 250lb per square inch at the penetration resistance equal to 0.5in it gives us 10% CBR value which give us poor to questionable subgrade

When the bearing capacity were just 500lb per square inch on the penetration resistance of 0.5in it gives us 20% CBR value which shows fairs to good subgrade.

This figure shows typical bearing values (psi) verses penetration (inch) for various materials ranging from very poor subgrade (cbr up to 5) to good crushed rock basis (cbr of 100) .

The cbrs are in term of percentages since the bearing value is divided by 100 psi (.1 % penetration) are 1500 psi (.2 inch penetration) which represent the bearing value of a crush rock material (refer to standard curve 100 %) .

It also shows the thickness design curves from 12 years of cbr test with both failed and good performance pavements on the California highway system. Curves A and B show the minimum pavement thickness for light and medium heavy traffic the additional curves were added us army corps of engineer for the design of air field pavements during ww2.

The tire infiltration pressure for the traffic was 400 kpa the design curves also embody the assumption of the pavement structure lying on compacted soils at least (300mm of compacted subgrade).

Answer#4

1. When the moister content of the soil is less than optimum moister content of the soil, then it is called dry of optimum These soils need more compaction.

When the moister content of the soil is greater than optimum moister content of the soil, then it is called wet of optimum These soils need lesser water supply and compaction.

The dry density of the soil in both cases is less than the maximum dry density which is at optimum moister content OMC.

2. Effect 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.

Now we will discuss about effects of compaction on the 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 a) Shear strength at moulded water content b) Shear strength after saturation

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

Permeability of soil depends on void size. As water content increases, there is an improved orientation of particles resulting in reduction of void size and permeability.

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

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

Soils compacted dry of optimum shrink less when compared to compacted wet of optimum.

The flocculated structure on the 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.

The soil compacted dry of optimum have steeper stress-strain curve than those on wet side. The strength and modulus of elasticity of soil on dry side of optimum will be high.

In general, the soils compacted dry of optimum have a higher shear strength than wet of optimum at lower strains.