Pavement Material Engineering

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MS (TE)

Mid Term Exam

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Ans#2

Part1:General procedure for a Geotechnical Report:

1. **Desk Study:**
2. **Field Reconnaissance Survey**
3. **Site Investigation/Field investigation and sampling.**
4. **Seismic site class.**
5. **Laboratory investigatin/Main investigation**
6. **Geotechnical Investigation Report**
7.

Desk Top Study:

Every geotechnical investigation project start with a desk study including ,collecting ,collating and reviewing the following.

- Design drawing of any previous structure at the site.
- Previous investigation report if any including bore hole logs penetrometer results and construction experience
- Hydrological data.
- Geological maps, survey data and records and evaluation of regional geology conditions such as earthquake, faults, formation of soils.
- Climate and weather data
- Aerial photographs.
- • Local knowledge and resources

2- Field Reconnaissance Survey:

Site access and environmental constrains have major influence on cost of site investigation, there for a field reconnaissance survey should be conducted as the first stage of geotechnical investigation. The following information should be obtained.

- Legal and physical aspects of access to site, for example, access for drilling rigs. Availability of any services or supplies of water, electricity, earthworks plant.
- Decision of exploration techniques
- Buried or overhead services.
- Photographs of surface conditions.
- Traffic control requirements.
- On-ground survey details.
- Tide, river level or other natural constraints.

• Notes on any exposed geology, for example the presence of boulders, bedrock exposure, swamps etc.

The field reconnaissance survey must be diligently prepared and conducted to allow for reliable cost estimates to be prepared.

3-SEISMIC SITE CLASS:

Different seismic class such as A,B,C,D and other parameters Si and Sc.

4-SITE INVESTIGATION/FIELD INVESTIGATION AND SAMPLING:

- Planning for man power and equipment's
- Mobilization of technical team and equipment's
- Set out the coordinates and location for boreholes and test pits
- Tanking samples and conduction some site tests

4-LABORATORY INVESTIGATION/MAIN INVESTIGATION

- Conducting detail investigation
- In-situ tests and laboratory tests of different properties of materials

5-GEOTECHNICAL REPORTS:

The report should contain sufficient information for tenders to prepare bids and to manage the risk of any subsequent contractual claims.

It should include the alignment, location, sampling, testing and result of all investigations.

The report should classify the extent, nature and variability of soil types and should draw attention to the following issues.

- The scope of the investigation including a statement that only design issues were considered.
- For most site investigations access and environmental constraints have major influences on cost.:
- Legal and physical aspects of access to site, for example, access for drilling rigs
- Availability of any services or supplies of water, electricity, earthworks plant. • Buried or overhead services.
- Photographs of surface conditions.
- Traffic control requirements.
- On-ground survey details.

- Tide, river level or other natural constraints.
- Notes on any exposed geology, for example the presence of boulders, bedrock exposure, swamps etc.

The report should include the following stages of information.

a) presentation of Information for Tenderers
   The presentation of factual geotechnical information will include, but not be limited to, the following.
   - Purpose and scope of geotechnical investigation
   - Brief description of the project
   - Dates between which field and laboratory work were performed.
   - Detailed description of methods used for the field and the laboratory work.
   - Types of field equipment's used

b) Presentation of Evaluations, Conclusions and Recommendations.
   I. Evaluation of geotechnical information.
   II. Conclusions and Recommendations

There will be two categories of recommendation.

- Surface recommendation
- And Sub surface recommendation will be discussed in part 2

Ans#2 PART2: THE STEPS TO CONDUCT A GEOTECHNICAL REPORT:

As the steps discussed earlier in part one, I as a geotechnical expert will conduct and accomplish my geotechnical investigation of a road project in following steps.

1. **Desk study:**

The very first step to start a geotechnical investigation is to conduct a desk study which require to collect , collate and review different information such as

We will collect the design drawing of any previous structures
Previous investigation report if any is available bore hole logs, hydrological data of site from concerned sources
Geological data etc.
All data as discussed in part one of general procedure will be collected and will forward for further work.

2. **Site reconnaissance survey:**

To know the exact condition of site and to conform the data obtain during desk study.we must gather a site visit.to estimate the exact cost and consider real site condition a site survey is necessary. The team of expert will attain the site survey.

We will collect information about different site feature as discussed in part one about the real picture of site to confirm the initial data and to know about the environmental social or any other constrains.

3-SEISMIC SITE CLASS:

In this part we will determine the site for different seismic classes Such as A, B,C,D and E and also the other parameters will be determined such as Si and Sc.

4-Field investigation and Sampling:

In this parts the details about the about investigated site will be briefly explained Such as site location, bore holes or test pits coordinates site geological layers. seismic condition of entire site and geological map.

To start field investigation, we have to prepare a work plan for the manpower and equipment's with respect to the program.

Mobilization of geotechnical team supervision and other personnel

Survey will be started and setting out bore holes' coordinates

We will collect samples in a proper way and will transport to geotechnical laboratory.

5-Laboratory investigatin/Main investigation

In this section we will perform all laboratory tests that are obtained from boreholes or test pits and the reults will be used to calculate design parameters such as bearing capacity,Earth pressure ,settlement etc.

The samples collected from site will be tested in laboratory for classification and geotechnical requirement of the project, followings are the tests which will be conducted.

Index property tests (determining of soil classification)

- Moisture content - determination of the moisture content of a soil as a percentage of its oven-dried weight.
- Unit weight - determining the total/moist and dry densities - unit weights - of soil specimens.
- Specific gravity -.

- Atterberg limits - determination of the liquid limit, plastic limit, and the plasticity index of soils.
- Particle size distribution -

Engineering properties tests (determining of strength and deformation parameters)

- Unconfined compression strength - determination of the unconfined compressive strength of cohesive soil of the axial load.
- Consolidation test (one-dimensional consolidation properties) –
- Consolidated undrained triaxial compression test
  Rock Strength Properties Tests

- Point load test - determining the point load strength index of rock. This is an index test and is intended to be used to classify rock strength.
- Uniaxial compression strength test –

Chemical Analysis of Groundwater

- pH value, sulphate content and chloride content tests – determining the aggressiveness of groundwater to concrete and steel structures.

6-Geotechnical report:

The final step of geotechnical investigation is to prepare the report which will consist to main parts

This step we will recommend surface and sub surface recommendation which includes site preparation, satisfactory material compaction recommendation for subgrade and sub grade.

This section will aslo include below details.

I. presentation of Information for Tenderers: first part of report will contain preliminary information for tenderer such as alignment, location sampling and results

   Photographs of surface condition there will be many more details included in this section of report which are discussed in part one.

II. In this part we will prepare a presentation of evaluation we have done and what are the conclusion and findings obtained from site and what instruction and technical guidance recommended for tenderers.

Ans#4

Part1: What is dry of optimum and wet of optimum

Dry of Optimum:

If the amount of water added is less the optimum moisture content then it is called dry of optimum compaction.

Or

When the soil is drier than the optimum compaction of the soil, then it is called dry of compaction. These soil need more compaction.

Wet of optimum:

If the amount of water added is is more than the optimum moisture content ,then it is called as wet of optimum compaction.

Or

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

When the amount of water added during the compaction ,the density of the soil would be increased until to achieve the optimum moisture content of the soil required, after the optimum content of the soil it more water added in the soil during the compaction the density would be decreased .As the maximum dry density obtained by the compaction of soil at its optimum moisture content.

Ans#4 Part2:

Compaction means pressing the soil particles close to each other by mechanical methods

With the application of compaction efforts Air is expelled from soil mass and mass density is increased.

The purpose of compaction is to improve the engineering properties such as Strength, stability etc., reduce compressibility and permeability.

STRENGTH: In general, the soil compacted dry of optimum have a higher shear strength than wet of optimum at lower strain

However, at large strains the flocculated structure of soil is broken and ultimate strength will be equal for both dry and wet sides.

The strength of compacted clays is rather complex.

- Samples compacted dry of optimum have higher strengths than those compacted wet of optimum.
- The strength wet of optimum also depends somewhat on the type of compaction because of differences in soil structure.
- If the samples are soaked, the picture changes?

PERMEABILITY:

Permeability of soil depends on voids size, as with increase in water content there is an improved orientation of particles which results reduction in void size and permeability.

Above the level of optimum water content, the permeability slightly increase.

With increase of comp active efforts, the dry density increase and will result the decrease in permeability

The effect of compaction is to decrease the permeability. In the case of fine grained soils it has been found that for the same dry density soil compacted wet of optimum will be less permeable than that of compacted dry of optimum.

COMPRESSIBILITY:

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.

Compressibility of compacted clays is a function of the stress level imposed on the soil mass. At relatively, low stress levels, clays compacted wet of optimum are more compressible.

At high stress levels, the opposite is true. In Fig. it can be seen that a larger change in void ratio (a decrease) takes place in the soil compacted wet of optimum for a given change (increase) in applied pressure.

SWELLING: The effect of compaction is to reduce voide space hence swelling is enormously reduced.

Soil compacted dry of optimum exhibits greater swell than compacted on wet side because of random orientation and deficiency of water.

Swelling of compacted clays is greater for those compacted dry of optimum. They have a relatively greater deficiency of water and therefore have a greater tendency to adsorb water and thus swell more. Soils dry of optimum are in general more sensitive to environmental changes such as changes in water content.

PORE PRESSURE:

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

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

The soils compacted wet of optimum shrink more because the soil particles in dispersed structure can pack more efficiently.

Ans#1

Part1: The phenomena is stress strain behavior of Flexible pavement.

As shown in in the figure the flexible pavement is composed of two layers, granular base and stabilized base.

The stiffness modulus E1 layer 1(granular base) is more than the stiffness of E2 layer 2 (stabilized base.

At the point of contact between tire and surface of layer 1 (granular base) there is compression, this compression forces extends toward bottom and reduce gradually, at a certain point in layer 2 there is a neutral axis with no compression and tension, below that point is tension since E1>>E2.

Most of the layer E2 is under tension.

Ans#1 Part2:

Typical flexible pavement with granular base:

1-compressive strain at the top of asphalt layer used to determine rutting in the asphalt layer

2-Tensile horizontal strain at bottom of the asphalt layer, used to determine fatigue cracking in the

3-Compressive strain at the to of granular base used to determine the rutting.

Compressive strain at the bottom of granular sub base and top of sub grade used for rutting and depression.

Typical flexible pavement Stabilize base:

1-compressive strain at the top of Asphalt concrete layer and describe the rutting in asphalt layer.

2-Tensile strain at the bottom of stabilize base used to determine the transverse reflective cracking or fatigue cracking.

3-Compressive strain developed at the top of stabilize base layer used to know the rutting

4-Compressive strain location at the top of subgrade layer describing rutting and depression.

Ans#3: Load penetration curves for different soils:

The Curve show the division of different soils according to the value of CBR percentage and bearing values below are some divisions.

1. curve 100 % show good crushed and crushed gravel
2. 80 to 100 CBR well graded gravel and crushed gravel bases and minimum specification requirement.
3. 80 % minimum crushed rock base at the bearing value of 1200 lb/in ^2
4. from 1000 to 1500 lb/sq.in is grave base have a value of 50% of standard and good for subase .
5. 30 to 50% there is disintegrated sub base and granite sub base and good for sub base, while at 30 % is sandy loam soil and 20 % to 30% is very good subgrade.
6. from 10 to 20 % is fair to good subgrade below the 500 lb/sq.in
7. 5 to 10 % consist of clayey loam soil and is poor to questionable for sub grade.
8. Below the 5% is adobe and is very poor subgrade.