UNIT-5

GEOLOGICAL INVESTIGATIONS IN CIVIL ENGINEERING

1. Define remote sensing.

Every object on earth emits its own internal energy according to its molecular and atomic structure, in addition to reflecting sun light during the day time. This radiations can be registered by sensors in several wavelengths, including those in the infrared and microwave regions of the spectrum. When such sensors are installed on aircrafts or on satellites they can record the earth's objects from for off distances. Such distant (Remote) acquisition of information about the objects on the earth's surface is known as remote sensing.

2. What is meant by aerial photography & Imageries?

The photographs of the earth taken from aircrafts are called the aerial photographs, while the pictures taken from the satellites are called the imageries.

3. Define aerial photographs.

Aerial photographs of the region are taken by cameras placed in the aircrafts. Aerial photos give three dimension of the photographed area. These photos contain a detailed record of the ground at the time exposure.

4. Define satellite imageries.

The satellite imageries can either be read manually like aerial photographs, or with the help of computers.

5. What is meant by geographic information system?

The modern computers can process maps and data with suitable computer programmer. The process of integrating and analyzing various types of data with the help of computer is known as geographic information system.

6. What are applications of remote sensing?

General geological mapping, mineral prospecting, petroleum exploration, ground water exploration, engineering .uses of site rocks, disaster studies, coastal geological studies.

7. What are geological considerations involved in the construction of buildings?

Basic requirements of a building foundation, building foundation on soils, building foundation carried to the deep hard rocks, building founded on surface bed rocks, types of settlement in buildings.

8. What are the characteristics of air photos?

Shape and size, flight and photo data, scale.

9. What are the kinds of air photos?

Vertical air photos, oblique air photos, amnesiacs, photo strips, stereoprain.

10. Define stereo meter

The instrument is used under a mirror stereoscope for measuring heights and areas of objects from air photos.

11. What is mean by measuring dots?

A stereo meter consists of two small Tran's parent glass or plastic plates attached to a long metallic bar. A clear dot is etched on earth of the plates called "measuring dots".

12. Define land slide.

A land slide is a slow or sudden downhill movement of slope forming rock and soil materials under the force of gravity.

13. Places in which land slide occur.

They occur in hill valley slopes, sea coasts, river banks and bends, on the slopes of volcanic cones and in earth quake prone areas. They also occur under water as on lake or sea floor.

14. What are the classifications of landslides?

Presence or absence of a definite slip plane, materials involved and their water content, kind and rate of movement.

15. What are the parts of typical slides?

Crown, scrap, head, slip plane, flanks, transverse ridges, fool, toe, length, width, height, depth.

16. What are the types of landslides?

(1) Slides:

Translational, Rotational

(2) Falls

(3) Flows

Slow, Soil creep, Rock creep

(4) Complex slides.

17. What are the characteristics of land slide?

1, Steep scraps in their upper parts and irregular ridges and furrows at lower parts.

2, Landslides vary in extent from several square meters to several kilometers. It is thickness may several meters.

3, Land slide velocities ranges from very small movement to more than 100 km/h.

18. What are the causes of land sides?

a) Natural causes.

1, Internal factors.

2, External factors.

b) Man induced causes.

19. What are the Geological considerations involved in Road cutting?

a. Topography

b. Lithological characters

c. Structural features of the rocks

d. Ground water conditions

20. What are the structural features of tunnel sites?

a. Dip and strike

b. Folds

c. Faults

d. Joints.

UNIT V
APPLICATION OF GEOLOGICAL INVESTIGATIONS

(1) Explain the geological Factors Affecting Construction of Roads

(1) Topography, (2) Lithological characters, and (3) structural features of the rocks, and (4) ground water conditions of the area.

(1) The Topography of the Region

It is a very important factor that controls the route or alignment of a road. The topographic maps will reveal the existence of various land features, such as valleys, hills, plains, slopes, etc.

In hilly regions, it may sometimes become difficult to obtain necessary topographic details in the specified time. In such cases, aerial surveys will have to be conducted, and from that, contour maps prepared, prior to starting the alignment work.

(2) The Lithological Characters of the Rocks

The Lithological characters of the rocks existing along the proposed road alignment, will uniform the engineer about the type and nature of the rocks and sediments of the area, and will thus assist him in knowing as to on what particular type of rocks or soils he has to design the foundations of his roadway or railway, and what type of construction material will be available in the vicinity, so as to transport it with ease and economy.

The rock types available for laying roads may be divided into (a) massive consolidated types; and (b) loose unconsolidated types.

(3) The structural Features of the Rocks

The structural features of the rocks, i.e., the geological structures present in the area, especially of sedimentary origin; do have a very important bearing on the design of the cuts as well as on the stability of a road as a whole.

(4) The Ground Water Conditions of the Area

The ground water conditions of the area will also need to be investigated along the proposed alignment of the roadway. These include determining the position of water table, as well as water bearing properties (i.e., the porosity and permeability) of the various rocks occurring along the proposed route.

(2) Explain the geological investigations of landslide, causes, types and mitigation.

Definition

A landslide is a slow or sudden downhill movement of slope forming rock and soil materials under the force of gravity.

Classification and types of landslides:

Landslides are of many types and broadly classified according to their characteristic parameters.

(a) Presence or absence of a definite slip plane.
(b) Materials involved any their water content.
(c) Kind and rate of movement.

Causes of Landslides:

1.Natural Causes:

These involve topographic meteorologic and seismic factors and are divided by Terzaghi (1950) into (a) internal factors and (b) external factors.(a)Internal Factors : Mechanisms within

the slope material which reduce its hear strength below the magnitude of the external forces that lead to sliding without any change in the surface conditions such as:

2**. Man Induced causes (Human Activity):**

(1) Mining, quarrying, irrigation and Urban regional and recreational programmes involving hillside cuttings, foothill excavations, drilling and blasting operations.

Landslide Hazard Mitigation:

(1)Grading (2) Blasting (3) Drainage (4) Vegetation Turning (5) Asphalt –Mulching (6) Stabilization (7) wire –meshing

Classification and types of subsidence:

(i) **Natural Subsidence:**

Example: Volcanic lava cavity subsidence.

(ii) **Man Induced Subsidence:**

Example: Mining Subsidence (shallow Subsidence) and Hydro-compaction subsidence.

Control and remedial measures

Some of the remedial measures are:

1. Regulated withdrawal of ground water particularly in urban areas.
2. Development of spreading grounds nearby for adequate ground water recharge.
3. Ground water reservoir pressurization by injecting water under pressure into the zone of depletion.
4. Well designed foundations to prevent or minimize settlement of structures.

3.) Explain the geological considerations involved in the selection of a dam site

The geological factors which govern the selection of a dam site can be grouped into the following four heads:

1. Existence of a narrow river valley.
2. Occurrence of the bed rocks at a shallow depth.
3. Occurrence of competent rocks, to offer stable and strong foundation.
4. Presence of proper geological structure.

Geological Consideration for a Successful Reservoir

Reservoir must fulfill, the following geological requirements

(i) It should be water – tight.
(ii) It should be of adequate capacity
(iii) it should have a long life; and
(iv) It should not produce harmful after effects, like landslides, earthquakes, etc. in the adjoining region.

Presence of Geological Structures in Bed Rocks at the Reservoir Site

The presence of geological structures like folds, faults, and joints in the bed rocks of a reservoir basin may affect the leakage from the reservoir to a large extent. Even non porous and impermeable rocks like Granites, may become porous due to the presence of faults and joints, if traverse badly through the rocks.

Position of Water-table at the Reservoir Site

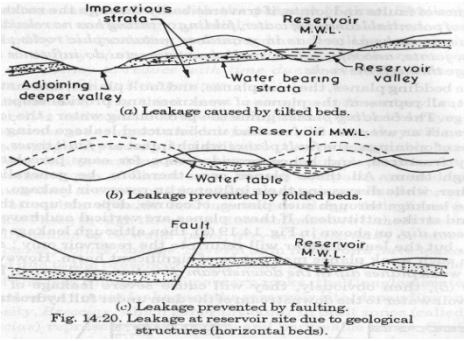

Fig. 14.20. Leakage at reservoir site due to geological structures (horizontal beds).

Prevention of Leakage of Reservoirs

The leakage of a reservoir is partly controlled by natural deposition of impervious fine clayey materials, coming with the river flow and settling down on the reservoir bed to cover and suppress the openings and weaker zones.

Silting of Reservoirs

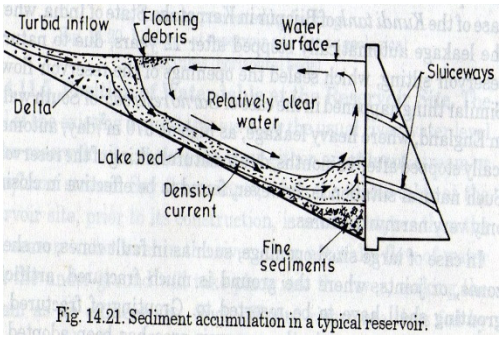

Fig. 14.21. Sediment accumulation in a typical reservoir.

Density Currents

In a reservoir, the coarser sediment settles down along the bottom of the reservoir, as the muddy flow approaches the reservoir; while the finer sediment usually remains is suspension, and moves in a separate layer than the clear reservoir water,.

Silting Control in Reservoirs

(1) Pre-constructing measures ; and
(2) Post – constructing measures.

4) Explain the geological conditions necessary for construction of tunnels

Tunnels may be defined as the under – ground routes or passages, excavated through the rocks or soft ground, without disturbing the overlying rocks or soil covers.

Objects of Geological Investigations

Various geological investigations are carried out while planning, designing and executing a tunnel project, in order to find satisfactory solutions to the following problems:

(i) Selection of Tunnel Route (ii) Selection of Excavation method (iii) Designing the tunnel section. (iv) Assessment of Cost and Stability

Methods of Geological Investigations

The stages are:

1. Preliminary surveys, conducted well before the actual planning of the project;
2. Detailed surveys, conducted almost simultaneously with planning and plotting the geological profile; and
3. Concurrent explorations conducted during the execution of the project.

GEOLOGICAL CONSIDERATIONS INVOLVED IN TUNNELING

Rocks may be broadly divided into two categories in relation to tunneling; i.e. (i) consolidated rocks; (ii) and unconsolidated rocks or soft ground.

Tunneling in Consolidated Rocks

1. litho logical characters;
2. geological structures; and
3. Ground water conditions.

Litho logical Characters at tunnelling site

It is quite obvious that the information regarding mineralogical composition, and texture of the rocks, through which the proposed tunnel is to pass, is of great importance in deciding

Geological Structures at Tunnelling Site

The design and cost of tunnel depend not only on the type of the rock but also on the structures existing in these rocks.

Joint systems in rocks at tunneling site

Joints are cracks developed in rocks due to a variety of causes. Although all types of joints tend to close with depth, their presence and orientation has to be investigated. Joints must be suspected when the rocks are folded and faulted.

Ground water conditions at tunneling site

Determination of ground water conditions in the region of tunnel project is not to be under – estimated at any cost. In fact, ground water is a major governing factor in computation of overhead loads on tunnel excavations and also in the choice of method of tunnel construction. The tunnel axis may be located below the water – table.

5.) Explain the geophysical methods.

Seismic Method of Geophysical Prospecting

The seismic method is highly developed, and most of the sub-surface details are obtained correctly. Since the rocks do posses different elastic properties and densities, the elastic waves get propagated through them with different velocities. In other words, the seismic waves move through the different types of rocks at different velocities.

Electrical resistivity Method.

The electrical resistivity method, as said above, is based upon the principle that electrical resistance, offered by different types of rocks in the sub-surface, is different. This electrical

resistivity (which is the reciprocal of conductivity) of different rock formations, infact largely depends upon the amount of the concentration of the dissolved salts (electrolytes) in the pore water present in the rocks and also upon the volume of the pore water , because the solid soil grains are poor conductors of electricity.

$$P = 2\pi x\left(\frac{E}{I}\right)$$

Where p = apparent resistivity in ohm-m
X = electrode spacing in m
E = potential drop in volts
I = circuit current in amperes.