

GOVERNMENT POLYTECHNIC, BHUBANESWAR



DEPARTMENT OF CIVIL ENGINEERING

LECTURE NOTE

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Introduction of Geology

Geology (in Greek, Geo means Earth, Logos means Science) IS a branch f science dealing with the study of the Earth. It is also known as earth science. The study of the earth comprises of the whole earth, its origin, structure, composition and history (including the development of life).

Branches of Geology

The key branches of geology relevant to civil engineering are Engineering Geology, Geotechnical Engineering, Hydrogeology, Structural Geology, Geomorphology, Petrology, and Geophysics.

Engineering Geology: This is a fundamental branch that applies geological principles to engineering problems, focusing on the relationship between geological factors and the design and construction of civil works.

Geotechnical Engineering: A specialized branch of civil engineering, but it heavily relies on geological principles to understand the mechanical behaviour of soil and rock. It's crucial for:

Soil Mechanics: The study of soil properties and behaviour to ensure stability in foundations and embankments.

Rock Mechanics: The study of the mechanical behaviour of rock masses, essential for understanding tunnel stability and excavation.

Hydrogeology: Focuses on the distribution and movement of groundwater. This is vital for: Managing water resources for construction projects.

Preventing groundwater issues that could impact foundations.

Structural Geology: Deals with rock deformation and structures like faults and folds. This helps engineers identify potentially unstable geological features that could compromise the safety of a structure.

Geomorphology: The study of landforms and the processes that create them. It helps engineers understand:

The existing surface topography and its evolution.

The potential impact of erosion or deposition on a construction site.

Petrology: The study of rocks, their composition, structure, and origin. This branch provides information on the properties of rock as a construction material and its potential for weathering.

Geophysics: Uses physical processes to investigate Earth's subsurface properties. This is applied in civil engineering for:

Investigating ground conditions without extensive excavation.

Locating subsurface features like bedrock or underground cavities the nature of the 1 processes.

Importance of engineering geology in Civil engineering structures

. To recognise potential difficult ground conditions prior to detailed design and construction

- It helps to identify areas susceptible to failure due to geological hazards To establish design specifications
- To have best selection of site for engineering purposes
- To have best selection of engineering materials for construction.

Composition of earth.

* The planet earth is commonly differentiated into three parts: (a) Atmosphere, (b) Lithosphere, and (c) Hydrosphere.

* The outer gaseous part of the earth starting from the surface and extending as far as 700 km and even beyond is termed as atmosphere.

* Lithosphere is the Stoney part of Earth (litho= stone) and in a broader sense includes all the solid materials composing the earth from surface downwards.

* Hydrosphere is a collective name for all the natural water bodies occurring on or below the surface of the earth.

ROCK:

A rock is a natural, solid collection of minerals, or other mineral-like matter, that forms part of the Earth's crust. It is a large, non-living mass composed of one or more types of minerals, which are naturally occurring inorganic substances.

Classification based on their genesis (mode of origin):

1) Igneous Rocks: Formed from the cooling and solidification of molten rock (magma or lava). Examples include granite (plutonic) and basalt (volcanic).

2) Sedimentary Rocks: Created from the weathering, erosion, transportation, and deposition of pre-existing rocks, which are then cemented together.

3)Metamorphic Rocks: Formed when existing igneous or sedimentary rocks are transformed by intense heat and pressure deep within the Earth, causing a change in their texture and mineral composition.

Igneous rocks like granite and basalt are used in construction, countertops, and for making tools and abrasives like pumice.

Sedimentary rocks such as limestone and sandstone are crucial for construction, cement, glass, and energy (e.g., coal), while others, like shale, are used to make cement and bricks.

Metamorphic rocks like marble and quartzite serve as building materials, sculptures, and decorative items, with marble also used in toothpaste, paper, and plastics.

Stability: Soil provides the essential load-bearing support for a structure's foundation

Roads and Pavements: Soil, especially when stabilized, forms the subgrade for roads and pavement

Construction material:soil is also a component in manufacturing materials like bricks

Slope Stability: Understanding soil properties, engineers design preventing landslides and ensuring the safety of structures built on them.

Retaining Structures: Soil properties helps in design of retaining walls which are essential for preventing soil erosion and structural failure.

Field Application of geotechnical engineering for foundation design.

1. Site Investigation:

Literature Review: Investigating the site's history and surrounding geological data.

2. Field Testing:

Boring and Sampling: Drilling boreholes to get soil samples for laboratory testing and to determine soil layers.

In-Situ Tests: Performing tests like the vane shear test (to measure soil shear strength) or the plate load test directly on-site.

Monitoring Devices: Installing instruments like piezometers to measure groundwater levels or inclinometers to track ground movement.

3. Data Analysis:

Soil Characterization: Using field and laboratory data to classify the soil and determine its engineering properties, such as shear strength, density, and compressibility.

Hazard Assessment: Identifying potential geotechnical risks like landslides, sinkholes, or seismic activity.

4. Foundation Design:

Foundation Type Selection: Choosing between shallow foundations (e.g., spread footings) or deep foundations (e.g., piles) based on soil properties and structural loads.

Field Application of geotechnical engineering for Pavement design.

Geotechnical engineering's field applications in pavement design include

1. Site investigations to understand soil properties.

2. Subgrade and foundation design to ensure stability under traffic loads, and the determination of layer thickness for flexible pavements using methods like the California Bearing Ratio (CBR) test.

3. It also encompasses ground improvement techniques for weak soils, drainage design to prevent moisture issues, and analysis of slope stability for road embankments.

Field Application of geotechnical engineering for Retaining Structure.

1. Site Investigation & Soil Characterization

Purpose: To understand the soil and rock conditions at the proposed sit

2.Stability Analysis & Load Determination

Purpose: To assess the forces acting on the retaining wall and the stability of the soil mass it retains.

3. Design & Material Selection

Purpose: To design a safe and cost-effective retaining wall that resists soil pressure and potential failure modes.

4. Construction & Monitoring

Purpose: To ensure the retaining structure is built according to the design and to monitor performance over time.

Field Application of Geotechnical Engineering in Earthen Dam Design

1. Site Investigation and Soil Exploration

2. Soil Testing and Material Selection

3. Stability and Slope Analysis.

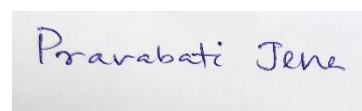
4.Seepage Control

5. Compaction and Construction Control

6. 6. Instrumentation and Monitoring

7. . Earthquake and Seismic Considerations

8. . Environmental and Hydrological Factors



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