



### **B23: Engineering Geology**

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**Preamble:** Geology is the science and study of the solid and liquid matter that constitute the Earth. The field of geology encompasses the study of the composition, structure, physical properties, dynamics, and history of Earth materials, and the processes by which they are formed, moved, and changed. 'Engineering Geology' is the application of the geologic sciences to engineering practice for the purpose of assuring that the geologic factors affecting the location, design, construction, operation and maintenance of engineering works are recognized and adequately provided for. Engineering geologists investigate and provide geologic and geotechnical recommendations, analysis, and design. Engineering geologic studies may be performed during the planning, environmental impact analysis, civil engineering design, value engineering and construction phases of public and private works projects, and during post-construction and forensic phases of projects. Works completed by engineering geologists include; geologic hazards, geotechnical, material properties, landslide and slope stability, erosion, flooding, dewatering, and seismic investigations, etc.

The field work of an engineering geologist is typically culminated in analysis of the data and the preparation of an engineering geologic report, geotechnical report, fault hazard or seismic hazard report, geophysical report, ground water resource report or hydrogeologic report. An engineering geologic report describes the objectives, methodology, references cited, tests performed, findings and recommendations for development. A civil engineer should be able understand an engineering geologic report, and incorporate adequate measures into the design of engineering works he is concerned with.

#### **Program outcomes addressed**

- a. An ability to apply knowledge of engineering, information technology, mathematics, and science
- d. An ability to identify, formulate and solve engineering problems

#### **Competencies:**

1. Explain geological activities (endogenetic and exogenetic) that result in earthquakes, volcanic eruption, formation of mountains and landslides.
2. Explain the impact of gradational forces on civil engineering activities and works.
3. Identify and describe given mineral and rock samples.
4. Assess the engineering properties of rocks and suggest means of strengthening it for civil engineering requirements.



- Determine the geological aspects relevant to the design of civil structures like bridges, tunnels, dams, tall buildings and roads

**Assessment Pattern**

	Cognitive Level	Test 1	Test 2	End-semester examination
1	Remember	20	20	10
2	Understand	40	40	20
3	Apply	20	20	30
4	Analyze	20	20	20
5	Create	0	0	20
6	Evaluate	0	0	0

**Remember**

- List structural components of topography.
- All earthquakes cause liquefaction. True or false?
- List causes of landslides.
- Define weathering.
- Define minerals.
- Which of the following is a metamorphic rock?
  - Granite
  - Basalt
  - Gneiss
- How do you identify clayey minerals from non clayey minerals?
- Name the factors which affect quality of building materials.
- List various methods of grouting for strengthening of rocks.
- What are the complicated regions for roads?

**Understanding**

- Explain how earthquake occurs? What is your inferences about the recent past earthquakes occurred in and around the world?
- What do you understand from the internal constitution of the earth as inferred by the seismologists?
- Summarize types of slides and its triggering factors.
- Discuss the geological activity of river and its impact on topography.
- Write physical properties and uses of the following materials in civil engineering.
  - calcite
  - chromite
  - bauxite
- Explain how textures and structures of sedimentary rocks are formed?



7. Summarize mechanical properties of rocks and strength of materials, with examples.
8. Write classification of folds and its mechanism and causes.
9. Summarize the need of preliminary and detailed geological investigation required for any civil engineering works or activities.
10. Discuss various controlling factors of weathering and its impact on human beings.

**Apply:**

1. How do you identify different types of gradational features in the field?
2. How civil engineering structures could be protected from the hazards like earthquake, slides, volcanic eruptions, tsunami, flooding etc., - ?
3. Comment on role of geotechnical engineer in weathering prone regions?
4. Describe the geological work of sea and add a note on task of civil engineer in these areas.
5. Write step by step procedures to identify minerals in the field.
6. How do you distinguish igneous rocks from sedimentary rocks in the field?
7. On what basis civil engineer should select materials for their works?
8. How do you strengthen weakening rocks (site improvement)? Discuss.
9. Comment on geological consideration in tunneling.
10. Discuss geological investigation to be carried out for construction of bridges.

**Analyze:**

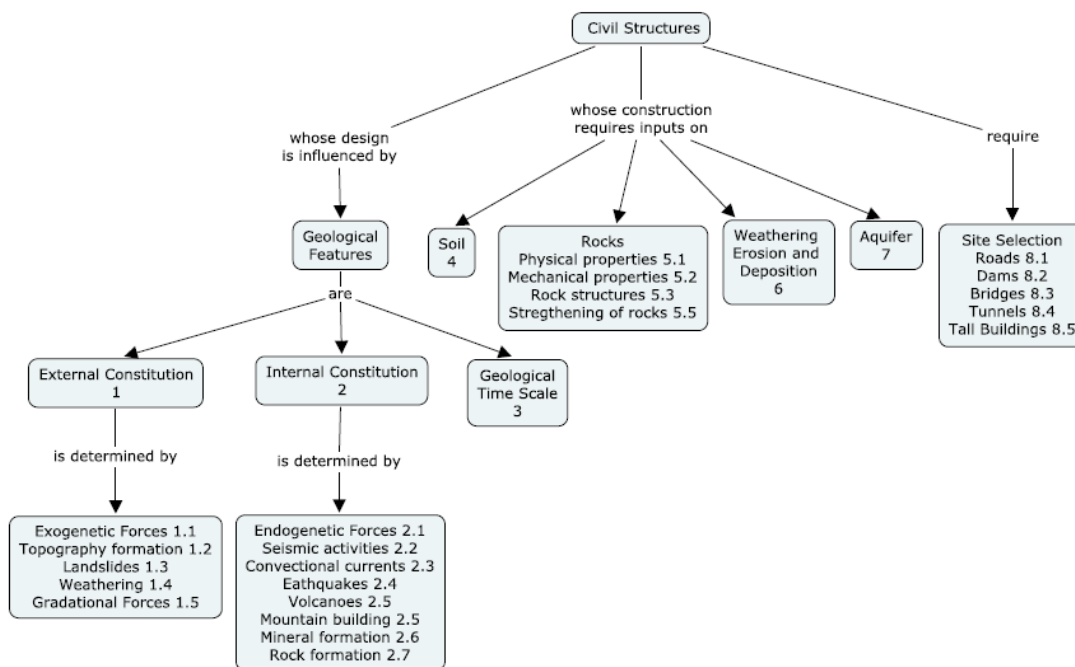
1. Write the mechanism behind the movement of tectonic plates and its causes.
2. How earth has natural magnetic and electrical properties in it?
3. Can we predict earthquake? Analyze.
4. Why civil engineers are always being carefully considered the endogenetic sudden forces for their design works?
5. What type of minerals could be used in civil engineering works? Why?
6. Why sedimentary terrain is not selected by the civil engineer for any major construction works in general? Comment on it.
7. Analyze how properties of rocks limit the work of civil engineer in all his construction works?
8. How rock structures limit the design of structures?
9. Analyze the required geological conditions for construction of dams.
10. What are the preliminary geological investigations to be carried out for construction of tall structures?



### Create

1. How would you change building codes/zoning regulations in regions of earthquake prone regions?
2. How do you find out slope stability and susceptibility factor for an area of landslide prone regions and also preventing methods?
3. Discuss how weathering and tectonic forces impose slides in an area?
4. Comment on interrelationship between plate movements and the distribution of high intensity of earthquake and active volcanic regions.
5. Earth activities starts from M.O.R – comment on it.
6. Write the importance and uses of Minerals – Rocks in civil engineering works.
7. Synthesis how the physical properties of rocks controls the mechanical properties of rocks and in turn how it limits the design and execution works of civil engineer?
8. Explain how rock structures and geological conditions limit the design and execution works of civil engineer?
9. Write essay on Geological Time Scale and the occurrence and distribution of minerals and rocks.
10. What are the criteria's followed by the civil engineer for the site selection and how they overcome the problems encountered if any in the field?

### Concept Map





**Lecture Schedule**

Sl. No.	Topic	Hrs
1.	<b>Geological Features: External Constitution</b>	
1.1	Topography and Exogenous Forces	2
1.2	Topography Formation: Continents and Oceans	1
1.3	Weathering	1
1.4	Landslides	2
1.5	Gradational Forces	2
2.	<b>Geological Features: Internal Constitution</b>	
2.1	Endogenous Forces	2
2.2	Seismic Activities	2
2.3	Convectional Currents	2
2.4	Earthquakes	2
2.5	Volcanoes	1
2.6	Mountain Building	1
2.7	Mineral Formation	3
2.8	Rock Formation	3
3.	<b>Geological Time Scale</b>	1
4.	<b>Soil Characterization</b>	1
5.	<b>Rocks</b>	
5.1	Physical Properties	1
5.2	Mechanical Properties	1
5.3	Rock Structures	3
5.4	Strengthening of Rocks	2
6.	<b>Weathering Erosion and Deposition</b>	1
7.	<b>Aquifer</b>	1



8.	<b>Site Selection</b>	
8.1	Roads	1
8.2	Dams	1
8.3	Bridges	1
8.4	Tunnels	1
8.5	Tall Structures	1

### Syllabus

**Geological Features - External Constitution:** Exogenetic Forces, Topography Formation: Continents and Oceans, Weathering, Landslides, Gradational Forces;

**Geological Features - Internal Constitution:** Endogenetic Forces, Seismic Activities, Convectional Currents, Earthquakes, Volcanoes, Mountain Building, Mineral and Rock Formation; **Geological Time Scale;** **Soil Characterization;**

**Rocks:** Physical Properties, Mechanical Properties, Rock Structures, Strengthening of Rocks **Weathering Erosion and Deposition; Aquifer; Site Selection:** Roads, Dams, Bridges, Tunnels, Tall Structures

### Textbook

Parbin Singh: Engineering and General Geology, Sixth Edition, S.K.Kattaria & Sons, 2001.

### Course Designer:

1. S. Palanivel [spciv@tce.edu](mailto:spciv@tce.edu)