NOTES ON ENGINEERING GEOLOGY

INTRODUCTION: After the failure of St. Francis dam in U.S.A. in 1928, with loss of many lives and properties, the importance of proper interpretation of foundation material for proper design of structures was realized. This led to the development of application of geology to engineering structures and a subject called "Engineering geology" was born.

DEFINITION: *"ENGINEETRING GEOLOGY IS THAT BRANCH OF HUMAN KNOWLEDGE THAT USES GEOLOGICAL INFORMATION COMBINED WITH PRACTICE AND EXPERIENCE TO ASSIST THE ENGINEER IN THE SOLUTION OF PROBLEMS IN WHICH SUCH KNOWLEDGE MAY BE APPLICABLE."*
S.C.HOPP'1955

Engineering geology differs from geology primarily in scope. In civil engineering construction depth of 200mts. is seldom exceeded. Hence, the study by engineering geologist is concentrated mostly to a thin layer of earth's crust, compared to deeper layer accessible for geological studies.

Normally the engineer wants to know whether a given constituent of the earth's crust (rock or soil) fits with his construction program. If it does not, how it can be made to fit. An engineering geologist should present in clear and simple terms and not in complex classification such information's.

GEOTECHNIQUES: With the development of soil and rock mechanics as specialized branches of civil engineering, it was felt that a practical knowledge of this branch by engineering geologists is essential for application to practical construction problems. Except some heavy and special engineering structures like dams, large bridges or special underground structures, rest is founded on soil. Understanding of behavior of soils during application of loads is very essential for good design. Thus, the subject of engineering geology reinforced with useful information's from their earth sciences and engineering is being gradually transformed into a new branch of human knowledge known as geotechnique.

FUNCTIONS AND RESPONSIBILITIES: The functions and responsibilities of geologists commence from the planning stage and continue till the completions of the project. At times the investigation is made for attending to post construction problems also.

Broadly the engineering geological investigations can be grouped under the following stages:

(a) Reconnaissance or preliminary planning
(b) Feasibility
(c) Preconstruction
(d) Construction
(e) Post construction

(a) At the reconnaissance or planning stage the various alternative layouts are identified based on general topography and regional geological features. These

are plotted on contour plans and a reconnaissance of the sites are made for a very preliminary appraisal

(b) During feasibility stage based on photo-geological study and ground check, the geological features at site are identified and adverse geological features (if any) are noted. Relocation of site or layout is suggested for detailed contouring. Geological mapping of individual components on 1. 1000 scale or 1:10,000 scale (depending on magnitudes of the project) is carried out on final layout. Sub-surface exploration by drilling and pitting is also undertaken. Geophysical traverses are often undertaken to decipher rock condition. Physical properties of rocks and soils are determined both at site and laboratory. Based on all these data, preliminary designs are made.

(c) At the pre construction stage more detailed mapping, followed by intensive drilling at selected areas for geological defects and more detailed soil and rock analysis are made to provide adequate data for final design. Construction materials are located for quarrying.

(d) During construction stage geologist assists the engineers in solving day-to-day problem faced during construction. He collects geological data from all the sites, map the foundation on large scale (1:500 or 1:1,000), and keep a detailed log of underground excavations. This record is very essential to know details of actual geological condition encountered for comparison and future references.

(e) The post construction studies are at times necessary for assessing the performance of the project or to assist in suggesting remedial measures for any adverse effect in functioning of the project.

SEISMICITY: During the feasibility stage of the investigation of any project, one of the important parameter required to be assessed for incorporation in design is seismic factor. The responsibility of the geologist is to study the seismotectonic set- up of the region where the project is located. The epicenters of past earthquakes are plotted with magnitudes on this seismotectonic map to identify seismogenic fault, if any. The seismic co-efficient to be incorporated in the design is calculated based on this data and other parameters to ensure safety in the event of any large probable earthquakes in future. This is particularly important for dams, powerhouse, tall buildings and underground or over ground nuclear stations.

SEISMIC ZONING MAP: ISI seismic map divides India with five zones 1 to 5. Zone 5 is most susceptible to damage by earthquakes, while zone 1 is the least. A corresponding value of horizontal seismic co- efficient has been indicated for each zone, which is incorporated in the design of civil engineering structure. This is expressed in terms of ‘g’ or 32 ft\sec^2. The values are given below:

ZONE	HORIZONTAL SEISMIC CO-EFFICIENT
I	0.01
II	0.02
III	0.04

IV	0.05
V	0.08

A GEOLOGIST IN PLANNING, DESIGN AND CONSTRUCTION: Geologist play very important role in planning, design and construction of a project. Without proper geological knowledge, it is rather hand to think a safe and economically viable project like big dams, tunnels highways etc:

PLANNING:	Site investigation.
DESIGN:	Type of engineering structure with respect to local geological conditions
	Economic factor
	Safety factor
	Long lasting
	Overall environmental impact
CONSTRUCTION:	Availability of construction material, its source and type
	Cost benefit ratio.
POST CONSTRUCTION MONITORING:	Behavior of different forces acting on structure, their effect on overall safety and life of the structure

SITE INVESTIGATION

OBJECTIVE AND SCOPE: To assess the suitability of a site for a proposed project and to provide information required for the design, planning and economic appraised of the project. **The scope** of an investigation will depend on the type of project, the nature of the site and on the time and funds available.

PHASES OF INVESTIGATION:

(i) Reconnaissance: Involves visiting the site and its surroundings and noting the salient features of the area.

(ii) Desk study: Includes a review of available information from remote sensing aerial photographs, maps and records.

(iii) Ground investigations: Include sinking pits and borings field's tests and observations and laboratory testing.