ENGINEERING GEOLOGY LABORATORY

LAB MANUAL

Academic Year : 2018 - 2019
Course Code : ACE103
Regulations : IARE - R16
Semester : III Branch: (CE)

Prepared By

Y. Ravi Kumar

K. Tarun Kumar

Assistant Professor

DEPARTMENT OF CIVIL ENGINEERING
INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
DUNDIGAL, HYDERABAD-500 043, TELANGANA STATE

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

DEPARTMENT OF CIVIL ENGINEERING

Program: Bachelor of Technology (B. Tech)

VISION OF THE DEPARTMENT

To produce eminent, competitive and dedicated civil engineers by imparting latest technical skills and ethical values to empower the students to play a key role in the planning and execution of infrastructural & developmental activities of the nation.

MISSION OF THE DEPARTMENT

To provide exceptional education in civil engineering through quality teaching, state-of-the-art facilities and dynamic guidance to produce civil engineering graduates, who are professionally excellent to face complex technical challenges with creativity, leadership, ethics and social consciousness.

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

DEPARTMENT OF CIVIL ENGINEERING

Program: Bachelor of Technology (B. Tech)

PROGRAM OUTCOMES (PO's)	
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

DEPARTMENT OF CIVIL ENGINEERING

Program: Bachelor of Technology (B. Tech)

The Program Specific outcomes (PSO's) listed below were developed specifically to meet the Program Educational Objectives (PEO's). The focus of these PSO's is consistent with the set of required PO's identified in the NBA accreditation guidelines.

The Civil Engineering PSO's require that graduates receiving a Bachelor of Technology in Civil Engineering degree from IARE demonstrate the following.

PROGRAM SPECIFIC OUTCOMES (PSO'S)	
PSO1.	**ENGINEERING KNOWLEDGE** Graduates shall demonstrate sound knowledge in analysis, design, laboratory investigations and construction aspects of civil engineering infrastructure, along with good foundation in mathematics, basic sciences and technical communication.
PSO2.	**BROADNESS AND DIVERSITY** Graduates will have a broad understanding of economical, environmental, societal, health and safety factors involved in infrastructural development, and shall demonstrate ability to function within multidisciplinary teams with competence in modern tool usage.
PSO3.	**SELF-LEARNING AND SERVICE** Graduates will be motivated for continuous self-learning in engineering practice and/or pursue research in advanced areas of civil engineering in order to offer engineering services to the society, ethically and responsibly.

Engineering Geology Laboratory – Syllabus

Exp. No.	Name of the Experiment
1.	Study of Minerals
2.	Laboratory Study and Observations of Physical Properties of Minerals
3.	Study of Rocks Referred under theory
4.	Observations and Identification of Rocks
5.	Interpretation and Drawing of Sections for Geological Maps
6.	Simple Structural Geology Problems

ATTAINMENT OF PROGRAM OUTCOMES (PO's) & PROGRAM SPECIFIC OUTCOMES (PSO's)

Exp. No	Name of the Experiment	Program Outcomes attained	Program Specific Outcomes attained
1	Study of physical properties and identification of minerals referred under theory.	PO1,PO2,PO4, PO6,PO10	PSO1,PSO2
2	Megascopic and microscopic identification of minerals.	PO1,PO2,PO4, PO6,PO10	PSO1,PSO2
3	Megascopic and microscopic description and study of rocks referred under theory.	PO1,PO2,PO4, PO10	PSO1,PSO2
4	Megascopic and microscopic identification of rocks.	PO1,PO2,PO4, PO6,PO10	PSO1,PSO2
5	Interpretation and drawing of sections for geological maps showing titled beds, faults, uniformities, etc.,	PO1,PO2,PO4, PO6,PO10	PSO1,PSO2
6	Simple structural geology problems.	PO1,PO2,PO4, PO6,PO10	PSO1,PSO2

MANDATORY INSTRUCTIONS

1. Students should report to the labs concerned as per the timetable.
2. Record should be updated from time to time and the previous experiment must be signed by the faculty in charge concerned before attending the lab.
3. Students who turn up late to the labs will in no case be permitted to perform the experiment scheduled for the day.
4. After completion of the experiment, certification of the staff in-charge concerned in the observation book is necessary.
5. Students should bring a notebook of about 100 pages and should enter the readings/observations/results into the notebook while performing the experiment.
6. The record of observations along with the detailed experimental procedure of the experiment performed in the immediate previous session should be submitted and certified by the staff member in-charge.
7. Not more than FIVE students in a group are permitted to perform the experiment on a set up.
8. The group-wise division made in the beginning should be adhered to, and no mix up of student among different groups will be permitted later.
9. The components required pertaining to the experiment should be collected from Lab-in-charge after duly filling in the requisition form.
10. When the experiment is completed, students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.
11. Any damage of the equipment or burnout of components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year.
12. Students should be present in the labs for the total scheduled duration.
13. Students are expected to prepare thoroughly to perform the experiment before coming to Laboratory.
14. Procedure sheets/data sheets provided to the students groups should be maintained neatly and are to be returned after the experiment.

15. DRESS CODE:

1. Boys - Formal dress with tuck in and shoes.
2. Girls - Formal dress (salwar kameez).
3. Wearing of jeans is strictly prohibited

CONTENTS

MINERALS

STUDY OF PHYSICAL PROPERTIES AND IDENTIFICATION OF MINERALS

STUDY OF MINERALS

Mineral

A mineral may be defined as a natural, inorganic, homogenous, solid substance having a definite chemical composition and regular atomic structure.

Common methods of study for the identification of minerals

Method	Principle
X-ray analysis	Based on the study of atomic structure, distinctive for every mineral. Its limitation is expensive, time consuming.
Chemical analysis	Based on the study of chemical composition. Its limitation is expensive, time consuming and not suitable for minerals exhibiting polymorphism (two or more minerals exhibit different physical properties in spite of possessing the same chemical composition).
Optical study	Based on the net effect of chemical composition and atomic structure. Its limitation is expensive.
Study of physical properties	Based on the consistency in physical properties which are due to the definite chemical composition and regular atomic structure. Its limitation is liable for erroneous inference, sometimes.

LABORATORY STUDY

In laboratories minerals are identified preferably by the method of study of physical properties.

Advantages

- The unique advantage is that the minerals can be studied in the field itself.
- It does not require any additional requirements, chemicals or equipment.
- It involves no loss or wastage of minerals. Hence repetitive study is possible.
- Immediate inference is possible.
- It is the cheapest and simplest method.

The following are the physical properties identified in the laboratory

1. Form

The form represents the common mode of occurrence of a mineral in nature.

Form	Description	Example
Lamellar form	Mineral appears as thin separable layers.	Different varieties of Mica
Tabular form	Mineral appears as slabs of uniform thickness.	Feldspars, Gypsum
Fibrous form	Mineral appears to be made up of fine threads.	Asbestos
Pisolitic form	Mineral appears to be made up of small spherical grains.	Bauxite
Oolitic form	Similar to Pisolitic form but rains are of still smaller size.	Lime stones

Rhombic form	Rhombic shape	Calcite
Bladed form	Mineral appears as cluster or as independent rectangular grains.	Kyanite
Granular form	Mineral appears to be made up of innumerable equidimensional grains of coarse or medium or fine size.	Chromite, Magnetite
Columnar form	Mineral appears as long slender prism.	Topaz
Prismatic form	As elongated	Apatite, quartz
Spongy form	Porous	Pyrolusite
Crystal form	Polyhedral, Geometrical shapes.	Garnets, Galena
Massive form	No definite shape for mineral.	Jasper, Graphite
Concretionary Form	Porous and appears due to accretion of small irregularly shaped masses.	Laterite
Nodular form	Irregularly shaped compact bodies with curved surfaces.	Flint

2. Colour

It is the usual body colour of mineral.

Name of the Mineral	Colour
Olivine	Olivine green
Biotite, Graphite, Magnetite	Black
Chlorite	Green
Garnet	Red
Kyanite	Blue
Amethyst	Violet
Quartz	Colorless, White, Green, Violet, Grey, yellow, Pink, etc..

Feldspar	White, Grey, Shades of Red, Green, Dirty white, etc
Calcite	Colorless, white, shades of Red, Grey, Yellow, etc

3. Streak

The colour of the mineral powder is called the streak of a mineral. This is tested by rubbing the mineral on streak plate (An unglazed white porcelain plate).

Name of the Mineral	Body Colour	Streak
Hematite	Steel Grey	Cherry Red
Chromite	Black	Dark Brown
Magnetite	Black	Black
Graphite	Black	Black
Molybdenite	Black	Greenish Black

4. Lustre

Lustre is the nature of shining on the surface of the mineral.

Lustre	Description	Example
Metallic Lustre	It is the type of shining that appears on the surface of a metal.	Galena, Gold, Pyrite
Sub metallic Lustre	lf the amount of shining is less when compared to metallic luster.	Hematite, Chromite, Magnetite
Vitreous Lustre	Shining like a glass sheet.	Quartz, Feldspar
Sub Vitreous Lustre	Less shining when compared to vitreous lustre.	Pyroxenes
Pearly Lustre	Shining like a pearl	Talc, Muscovite mica

Silky Lustre	Shining like silk	Asbestos
Resinous Lustre	Shining like a resin	Opal, Agate
Greasy Lustre	Shining like grease	Graphite
Adamantine Lustre	Shining like a diamond	Garnet, Diamond
Earthy or Dull Lustre	No Shining	Bauxite, Magnesite

5. Fracture

Fracture is the nature of the randomly broken surface of a mineral.

Fracture	Description	Example
Even fracture	If the broken surface is plain and smooth.	Magnesite, Chalk
Uneven fracture	If the broken surface is rough or irregular.	Hornblende, Bauxite
Hackly fracture	If the broken surface is very irregular like end of a broken stick.	Asbestos, Kyanite
Conchoidal fracture	If the broken surface is smooth and curved	Opal
Sub Conchoidal fracture	If the curved nature is less prominent.	Agate, Flint, Jasper

1. **Cleavage**

The definite direction or plane along which a mineral tends to break easily is called cleavage of that mineral. It occurs as innumerable parallel planes along which the mineral is equally weak. Such parallel planes of weakness are referred to as a set.

Cleavage	Example
One set of cleavage	Mica, Chlorite, Talc
Two sets of cleavages	Feldspars, Pyroxenes, Amphiboles
Three sets of cleavages	Calcite, Dolomite, Galena
Four sets of cleavages	Fluorite

Six sets of cleavages	Sphalerite
No cleavage	Quartz, Olivine, Garnet

7. Hardness

Hardness may be defined as the resistance offered by the mineral to abrasion or scratching. It is determined with the help pH Moh's scale of hardness which consists of ten reference minerals arranged in increasing order of hardness and numbered accordingly.

Name of the Mineral	Hardness
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Feldspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

2. Specific gravity or Density

Specific gravity or Density of minerals depends on their chemical composition and atomic structure.

Density	Range	Example
Low density	Specific gravity less than 2.5	Gypsum (2.3), Graphite (2-2.3)
Medium density	Specific gravity between 2.5 and 3.5	Quartz (2.7), Feldspar(2.5)
High density	Specific gravity greater than 3.5	Chromite (4.5- 4.8)

9. Degree of transparency

Degree of transparency is tested along the thin sharp edges of mineral keeping it against a powerful source of light. Depending upon the resistance offered by the minerals to the passage of light through them the transparency is classified.

Degree of Transparency	Example
Transparent	Thin layers of Muscovite, rock crystal
Translucent	Agate, Calcite
Opaque	Galena, Pyrite

10. Special properties

Some minerals exhibit unique characters which enable them to be identified easily.

Name of the Mineral	Special property
Talc	smooth touch or soapy feel
Graphite	Marks on a paper easily
Pyrolusite	Soils the fingers
Halite	Saline taste
Magnetite	Strongly attracted by any ordinary magnet
Chalk	Rough feeling of touch, adheres strongly to the tongue

Moh's Scale of Hardness

NAME OF MATERIAL	HARDNESS
Talc	1
Gypsum	2
Calcite	3
Fluorite	4
Apatite	5
Feldspar	6
Quartz	7
Topaz	8
Corundum	9
Diamond	10

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical composition :
2. Crystal system :
3. Nature of origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

PHYSICAL PROPERTIES OF MINERALS

OBSERVATIONS

1. Form :
2. Colour :
3. Streak :
4. Lustre :
5. Fracture :
6. Cleavage :
7. Hardness :
8. Specific Gravity :
9. Degree of Transparency :
10. Special Property :

INFERENCE

THEORITICAL PROPERTIES

1. Chemical Composition :
2. Crystal System :
3. Nature of Origin :
4. Occurrence :
5. Uses :
6. Remarks :

ROCKS

MEGASCOPIC AND MICROSCOPIC DESCRIPTION AND IDENTIFICATION OF ROCKS REFERRED UNDER THEORY

STUDY OF ROCKS

A rock is defined as an aggregate of minerals. It is also described as unit of earth's crust. Based on their origin, geologically rocks are classified into igneous rocks, Sedimentary rocks, metamorphic rocks.

Igneous rocks:

These are characterized by vesicular structure, amygdaloidal structure and Aphanitic structure if they are volcanic. If they are Hypabyssal or plutonic, they are dense, compact and exhibit interlocking texture.

Sedimentary rocks:

Occurrence of normal or cross bedding, cementing material, fossils, ripple marks, mud cracks, tracks and trails and peculiar forms such as modular, concretionary, Pisolitic, Oolitic, etc indicate that the rocks under study of sedimentary rocks.

Metamorphic rocks:

Occurrence of alignment of minerals (lineation, foliation) and metamorphic minerals indicate the rocks under the study of metamorphic group.

IGNEOUS ROCKS

Terminology related for the description of igneous rocks

1. Texture

Phaneric	If minerals are visible to naked eye by virtue of their size.
Aphanitic	If minerals are too fine to be seen by naked eye.
Phaneric coarse	If minerals are greater than 5mm in size.
Phaneric medium	If minerals are 2mm to 5mm in size.
Phaneric tine	If minerals are less than 2mm in size.
Equigranular	If minerals are nearly of same size.
Inequigranular	If some minerals are distinctly larger than others.
Porphyritic	If larger minerals are surrounded by smaller minerals.
Interlocking	If minerals are closely interlinked and cannot be separate without damaging surrounding minerals.
Graphic	If angular quartz grains occur with some orientation in feldspars.

2. Colour

Leucocratic	If the rock looks pale coloured or white coloured, it indicates that the rock may be acidic.
Melanocratic	If the rock looks dark coloured or black coloured, it indicates that the rock may be basic or ultra basic.
Mesocratic	If the rock is neither dark coloured nor pale coloured.

3. Structure

Vesicular	If the rock is having empty cavities
Amygdaloidal	If the rock has cavities filled with amygdales

4. Minerals

Primary	If the minerals are present from the beginning of formation of rock.
Secondary	If the minerals are present after the formation of rock.
Essential	If they are major constituents and decide the name of the rock.
Accessory	If they occur in small quantities and their presence or absence has nothing to do in naming a rock.

5. Silica Saturation

Oversaturated	If a rock has free quartz.
Under saturated	If a rock has unsaturated minerals like Olivine.
Saturated	If a rock has neither free quartz nor unsaturated minerals.

6. Depth of Formation

Plutonic/Hypabyssal	If a rock is Phaneric and has interlocking texture.
Volcanic	If a rock is vesicular or amygdaloidal and Aphanitic.

IGNEOUS ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

IGNEOUS ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

IGNEOUS ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

IGNEOUS ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

IGNEOUS ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

SEDIMENTARY ROCKS

Details relevant for the study of sedimentary rocks

1. Bedding or stratification

a) Different beds can be recognized based on colour, grain size, texture, hardness and other physical properties.
b) In case of cross bedding sets of layers will not be parallel but mutually inclined.

2. Cementing Material

Calcareous	It imparts white colour and pale colour to sand stones and can be known by acid test.
Feriginous	Imparts shades of brown, red, or yellow colour to sand stone
Argillaceous	It provides only weak cohesion for sand particles, which fall of rubbing the sand stone
Siliceous	Resembles calcareous cementing material but provides competence and durability to sand stone.
Glaucontic	It provides green colour to sand stone.

3. Fossils

May be plant (leaf) fossils or shells (complete or broken) - common in shales and lime stones.

4. Ripple Marks

Rare, may appear in sandstones, shales and lime stones. These appear as ware undulations on rock surface.

5. Peculiar forms

Concretionary, nodular	Laterites, Lime stones
Pisolotic	Lime stones, Laterites
Oolitic	Lime stones
Solution cavities	Lime stones
Lamination	Shales

6. Flaggy

Tendency to break in to slab, due to parallel fractures. Sometimes these are noticed in lime stones and sand stones.

7. Fissility

Tendency to split along bedding planes. Some shale has this character.

8. Conchoidal fracture

In dense compact Lime stones, less distinctly in shales

9. Composition

Argillaceous	Shales
Arinaceous	Sand stones
Calcareous	Lime stones

10. Grain Size

Too fine to be seen as separate particles in shales and lime stones.

11. Surface touch

Gritty or rough in sand stones, smooth in shales and lime stones.

12. Appearance

Panels of colours for laterites, dense very fine grained for lime stone.

SEDIMENTARY ROCKS

l. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

SEDIMENTARY ROCKS

l . Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

SEDIMENTARY ROCKS

l. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

SEDIMENTARY ROCKS

l . Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

SEDIMENTARY ROCKS

l . Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

METAMORPHIC ROCKS

Details relevant for the study of metamorphic rocks

1. Foliation

It refers to the parallel alignment of platy or lamellar minerals in metamorphic rocks.

2. Lineation

It refers to the parallel alignment of prismatic or columnar minerals in metamorphic rocks.

3. Metamorphic minerals

Minerals like garnet, tale, chlorite, graphite are suggestive of metamorphic origin of a rock.

4. Gneissose structure

It is generally observed in granite gneisses where in alternating black (hornblende) and white (feldspars and quartz) colour bands appear.

5. Schistose structure

They have predominantly lamellar (mica, tale, chlorite) or prismatic (hornblende, Kyanite etc) minerals. These do not have any alternating colour bands.

METAMORPHIC ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

METAMORPHIC ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

METAMORPHIC ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

METAMORPHIC ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

METAMORPHIC ROCKS

1. Colour :

2. Grain :

3. Texture or Structure :

4. Mineral Present :

INFERENCE:

1. Essential Minerals :

2. Accessories :

3. Mode of Origin :

Special properties/Uses:

GEOLOGICAL

MAPS

INTERPRETATION AND DRAWING OF SECTIONS FOR GEOLOGICAL MAPS SHOWING TITLED BEDS, FAULTS, UNIFORMITIES, ETC.

GEOLOGICAL MAPS

Geological Map

A map is described as representation of an area on a plain paper to a scale. The geological map is one which reveals the geological information in terms of topography, litho logy, and geological structure, order of superposition, thickness of beds and geological history of that region. A geological map is a contour map over which geological formations, structures etc are marked.

Civil Engineering Importance

For safe, stable, successful and economical Civil Engineering constructions such as dams, reservoirs, tunnels, etc., detailed geological information is essential. Proper interpretation of a geological map provides all details which a Civil Engineer requires. This study of geological maps is of great importance.

Aim

The purpose of interpretation of the following maps is not to tackle any specific Civil Engineering project but to equip with all necessary geological information, so as to enable the concerned to utilize the same as the required by the context.

Interpretation

In a geological map, normally contours are marked as dotted lines with elevation value and bedding planes, fault planes etc are marked as continuous lines. The interpretation comprises of details of topography, litho logy, structure and geological history.

Interpretation of Topography

From the study of contour the information noted is about

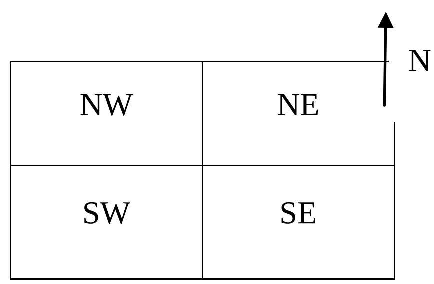
1. Maximum height, Minimum height, Surface relief

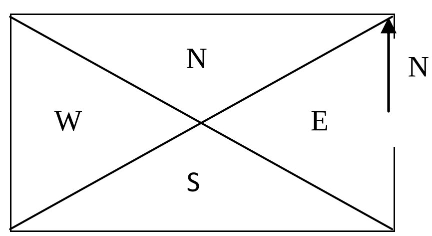
2. Number of Hills, Valleys, ridges, etc

3. Nature of slope, whether it is uniform or irregular and steep or gentle

Relevant details

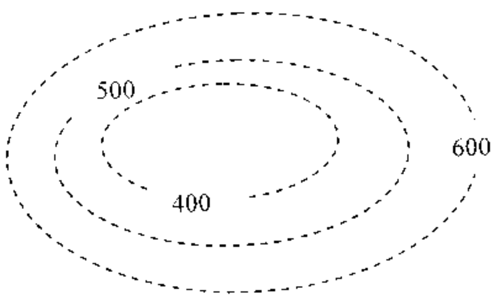
1. Area in the map indicated as below



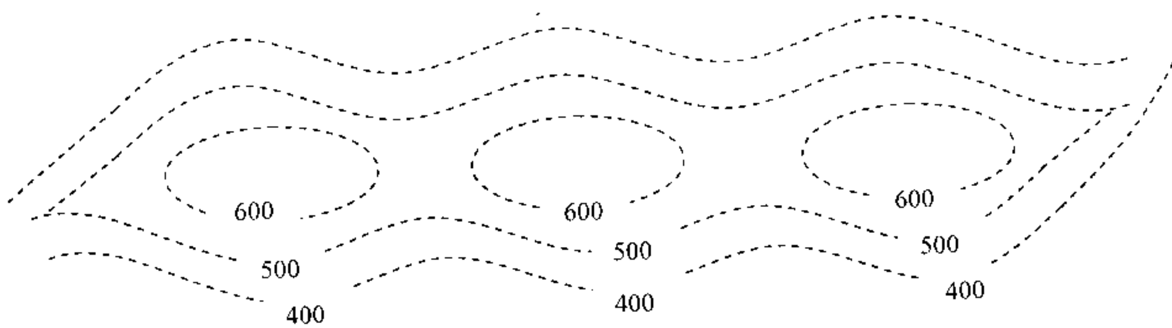


2. Hills or Hill ranges

- Closed contour with contour values increasing inwards
- Repeated appearance of the same in a row is Hill Range
- Contours also indicate shape of Hills



Hill



Hill Range

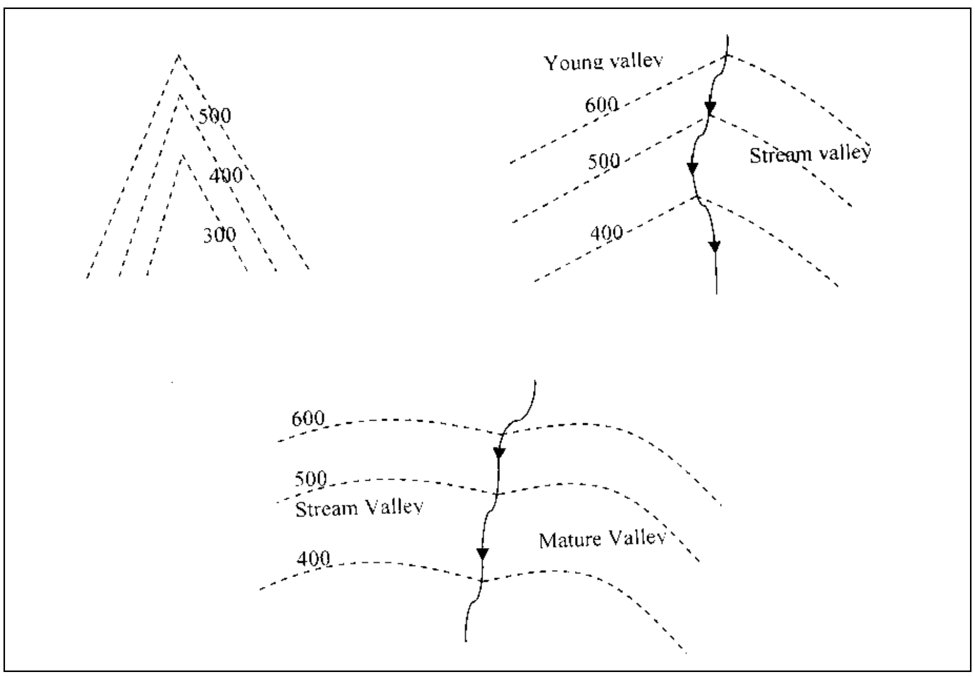
3. (a) Maximum height is the elevation which is more than the highest contour marked in the map.

(b) Minimum height is the elevation which is less than the lowest contour marked in the map.

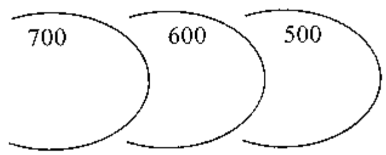
(c) Surface relief is the difference between the maximum height and the minimum height.

4. (a) Valleys: These are a series of V shaped (sharply bent) contours with successively higher elevation towards the pointed ends (convex side) of the contours.

- The sharpness of bends indicates the stage of valley development
- Young valleys have sharply contours but mature valleys have bluntly curve contours

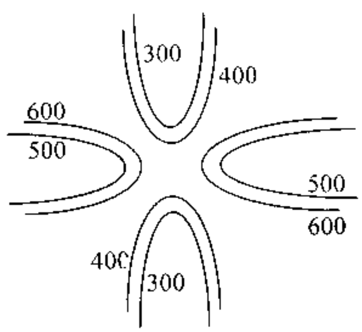


(b) Ridges: These resemble valleys but in these towards the convex side of the contours, successively lower elevations appear.



Ridges

(c) Saddle like structures:



Saddle like structure

SIMPLE STRUCTURAL GEOLOGY PROBLEMS

Interpretation of Litho logy and Structure

1. Horizontal Beds: If the bedding planes and associating contours are mutually parallel it indicates beds are Horizontal.

a) Highest elevation is the youngest
b) Can't have Strike and Dip

2. Vertical Beds: If the bedding planes appear as straight lines and also cuts across the associating contours, it indicates beds are vertical.

a) Bedding plane itself is their strike direction
b) No dip direction but dip amount is 90°

3. Inclined Beds: If the bedding planes are curved and cut across the associating contours, it indicates beds are inclined.

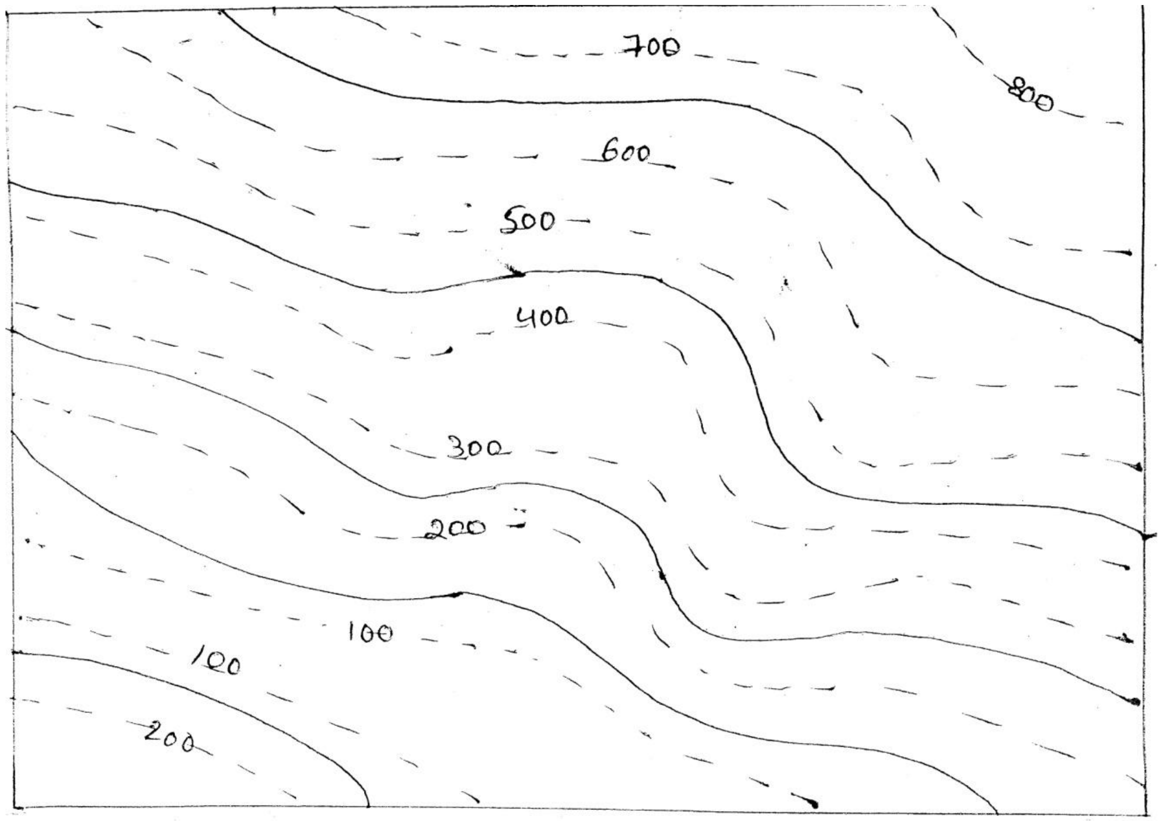
a) Choose any bedding plane which cuts across the same contour minimum at two places. Draw a line passing through. It gives the strike direction of beds.

b) Next check where the bedding planes cut next contour, draw a parallel line passing through this point.

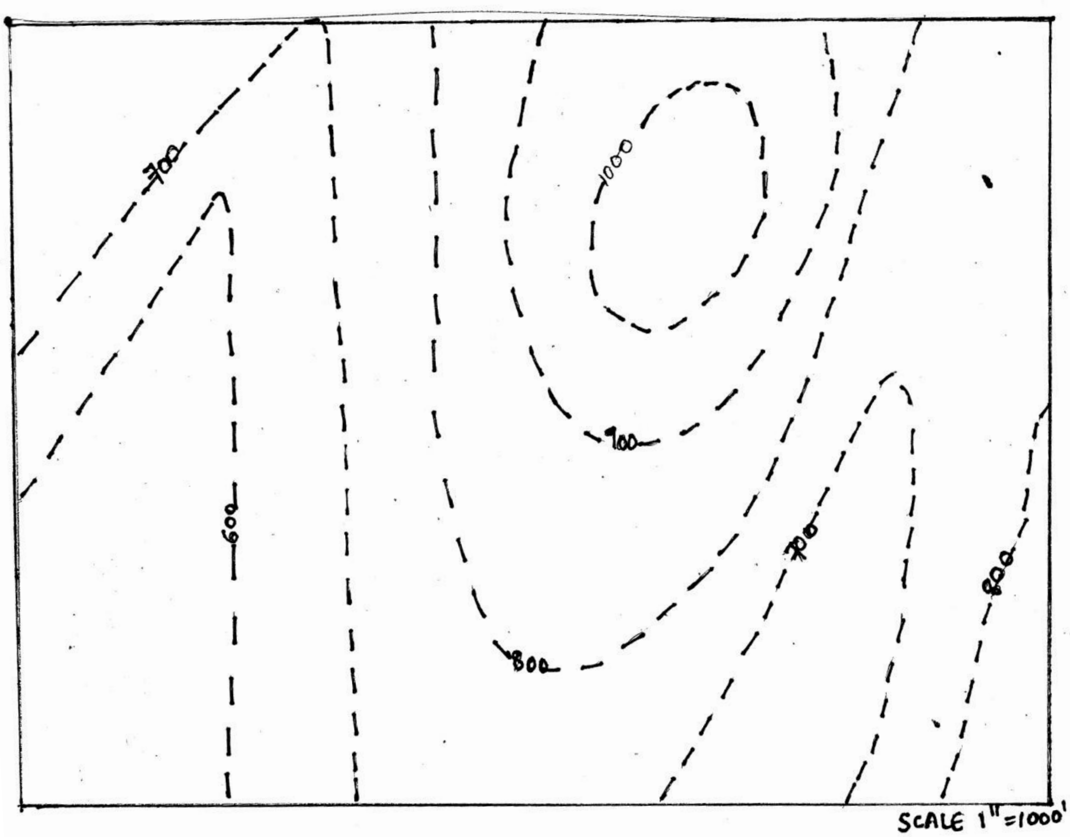
c) If the bedding plane refers to A/B contact and contour passes at the intersection point (where bedding plane, strike line, contour line intersect) is 500 and is called A/B 500. Second value is either A/B 600 or A/B 400.

d) A short line perpendicular to the strike line in the decreasing side is the Dip direction.
   i. Dip amount = (contour interval*60)/strike interval.
e) Since the arrow head of the dip direction points to successively younger Beds, Order of Superposition is known
f) Strike direction is expressed both with N or S, but dip direction is expressed only either N or S. For example if N 10° E is dip direction, then strike direction is N 80 ° W or S 80 ° E

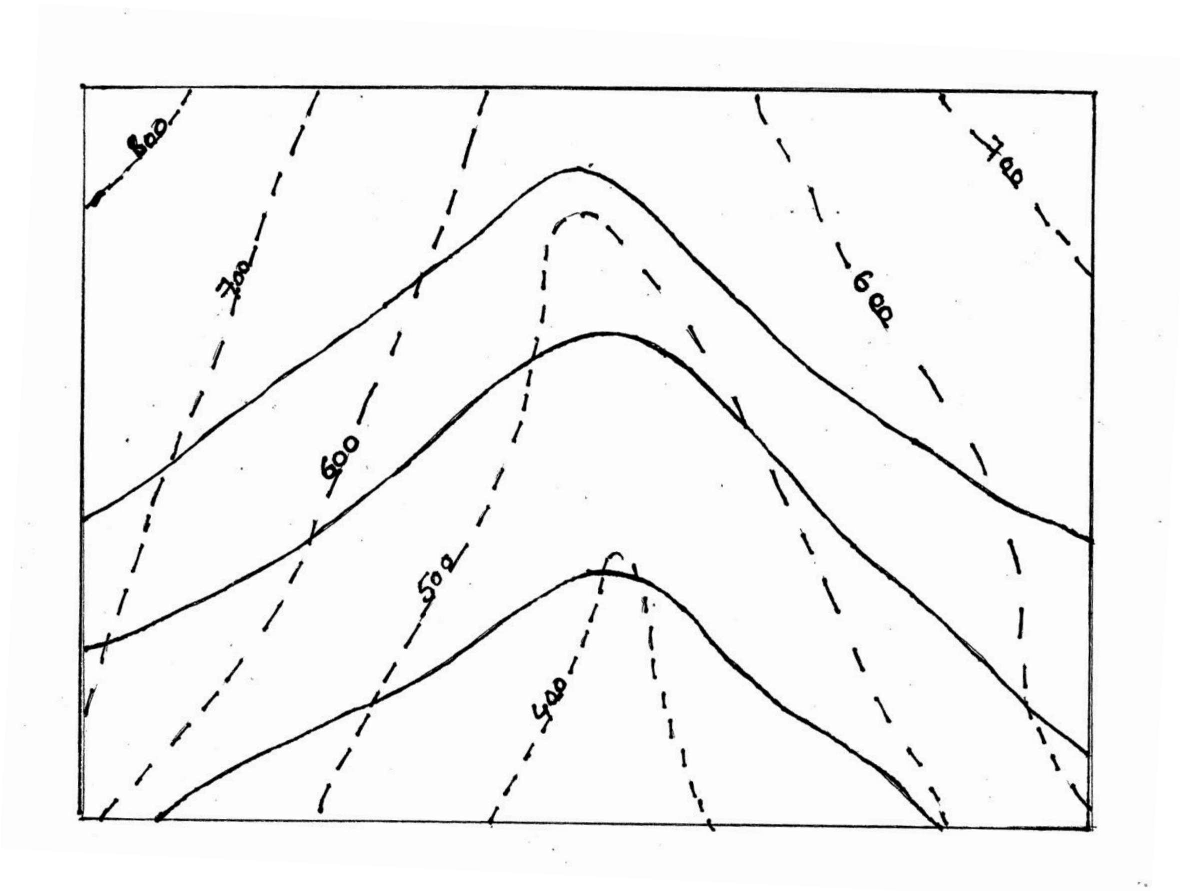
MAP I: A CASE OF HORIZONTAL BEDS



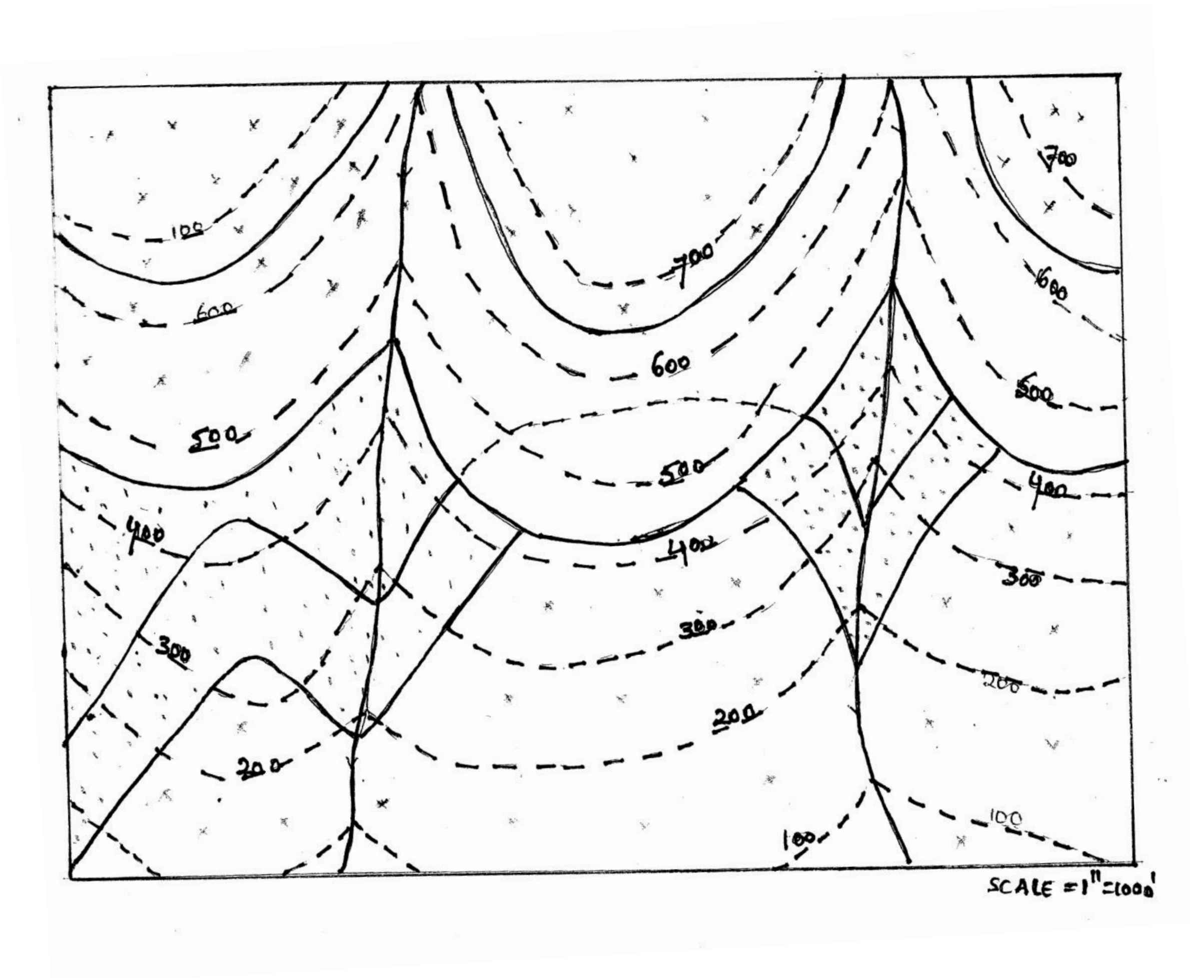
MAP II: A CASE OF VERTICAL BEDS



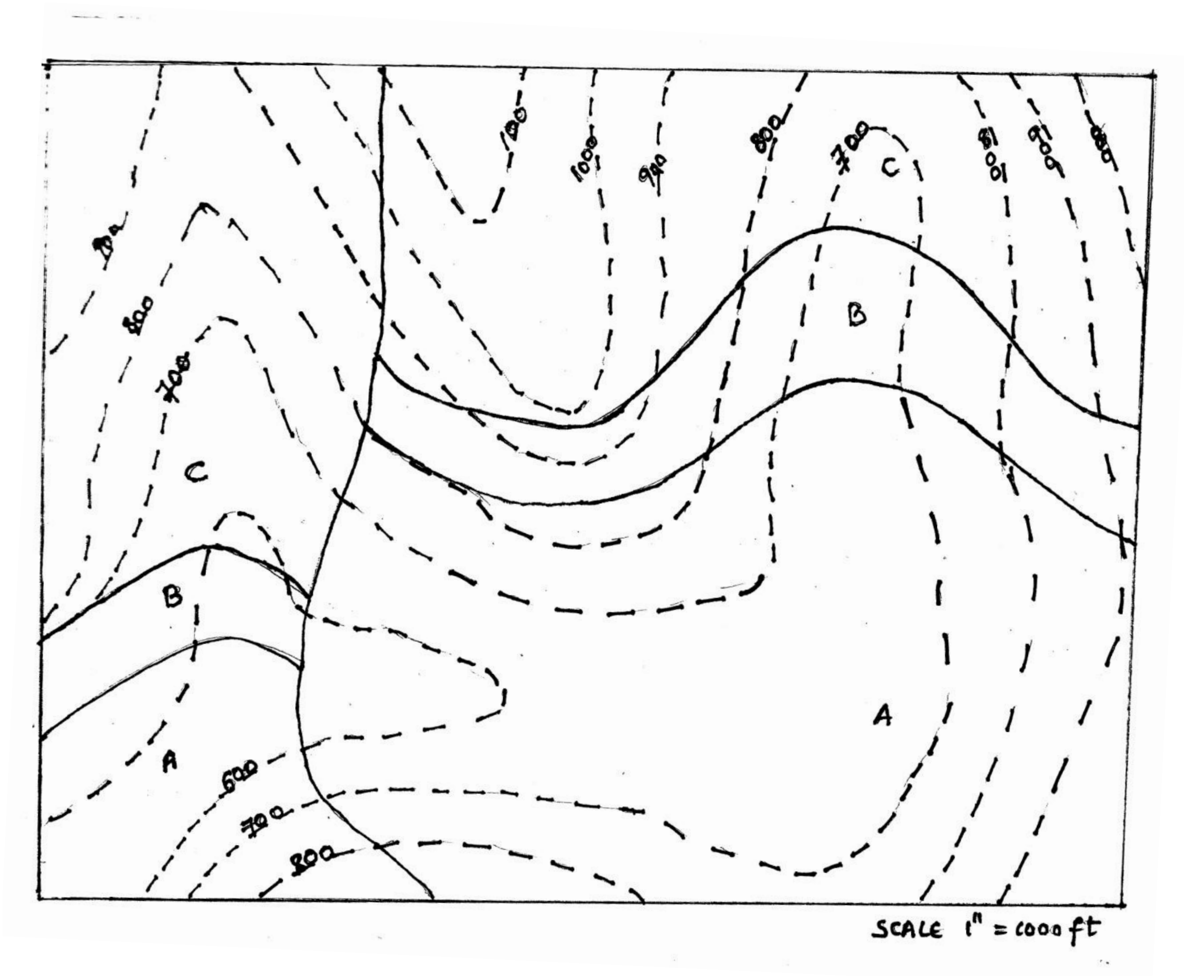
MAP III: A CASE OF INCLINED BEDS



MAP IV: A CASE OF UNCONFORMITY



MAP V: A CASE OF FAULTED BEDS



MAP VI: A CASE OF FOLDED BEDS