ELEMENTSOF CIVIL ENGINEERING LAB MANUAL

DEPARTMENTOFCIVILENGINEERING

MARRI LAXMAN REDDY
INSTITUTE OF TECHNOLOGY AND MANAGEMENT
(AN AUTONOMOUS INSTITUTION)
(Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad)
Accredited by NBA and NAAC with 'A' Grade & Recognized Under Section2(f) & 12(B)of the UGC act,1956

2024-2025

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CERTIFICATE

This is to certify that this manual is a bonafide record of practical work in the **Elements of Civil Engineering Lab** in **Second Semester of First year B. Tech (Civil) program me** during the academic year **2024-25**. The book is prepared by **Ms. Nanditha Mandava, Assistant Professor, Department of Civil Engineering.**

Signature of HOD Signature of Dean Academics Signature of Principal

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PREFACE

This book entitled“Elements of Civil Engineering Lab Manual” is intended for the use of first semester (i.e., I - I) B. Tech (civil) students of Marri Laxman Reddy Institute of Technology and Management, Dundigal, Hyderabad. The main objective of the Elements of Civil Engineering Lab Manual is to teach the student basic concrete and Geology fundamentals in variouscivilengineeringapplications.Thisbooklaysfoundationofcertainbasicconceptsand skillsthatcanberepeatedlyemployedbythestudentsintheirfutureendeavours.Themainaim of this book is to develop the habit of scientific reasoning and providing answers to all the doubtsthatariseduringthecourseofconductingexperiments.Theseexperimentswillhelpthe studentstoexpertiseintheanalysisandreportingtheconcretequalityforconstructionpurpose andaboutminerals,rocks,stonesetc.Hence,wehopethisbookserveforbetterunderstanding by the student community with all details of experiments

By,

Ms.NandithaMandava
Asst Professor,Department of civil engineering

ACKNOWLEDGEMENT

It was really a good experience, working at Elements of Civil Engineering Lab. First,I would like to thank Mr. B. Mahender, Asst. Professor, Department of Civil Engineering, Marri Laxman Reddy Institute of technology & Management for giving the technical support in preparing the document.

I express my sincere thanks to Mr. K. Murali, Head of the Department of Civil Engineering, Marri Laxman Reddy Institute of technology&Management, for his concern towards me and gave me opportunity to prepare Elements of Civil Engineering laboratory manual.

I am deeply indebted and gratefully acknowledge the constant supportand valuable patronage of Dr. Ravi Prasad, Dean Academics, Marri Laxman Reddy Institute of technology & Management.I am unboundedly grateful to him for timely corrections and scholarly guidance.

I express my hearty thanks to Dr. K. Venkateswara Reddy, Principal, Marri Laxman Reddy Institute of technology&Management,for giving me this wonderful opportunity for preparing the Elements of Civil Engineering laboratory manual.

At last, but not the least I would like to thank the entire Civil Department faculties those who had inspired and helped me to achieve my goal.

By,

Ms .Nanditha Mandava

Asst Professor ,Department of civil engineering

GENERAL INSTRUCTIONS

1. Students are instructed to come to Elements of Civil Engineering laboratory on time. Late comers are not entertained in the lab.

2. Students should be punctual to the lab .If not, conducted experiments will not be repeated.

3. Students are expected to come prepared at home with the experiments which are going to performed.

4. Students are instructed to display their identity cards and apron before entering into the lab.

5. Students are instructed not to bring mobile phones to the lab.

6. The equipment's and other accessories used in Elements of Civil Engineering lab should be handled with care and responsibility.

7. Any damage to the equipment's during the lab session is student's responsibility and penalty or fine will be collected from the student.

8. Students should update the records and lab observation books session wise. Before leaving the lab,the student should get his lab observation book signed by the faculty.

9. Students should submit the labrecords2/3daysinadvancetotheconcerned faculty members in the staffroom for their correction and return.

10. Students should not move around the lab during the lab session.

11. If any emergency arises, the student should take the permission from faculty member concerned in written format.

12. The faculty members may suspend any student from the lab session on disciplinary grounds.

SAFETY PRECAUTIONS

1. While working in the laboratory suitable precaution should be observed to prevent accidents.
2. Always follow the experimental instructions strictly.
3. Use the first aid box incase of any accident/mishap.
4. Neverworkinthelaboratoryunlessademonstratororteachingassistantinpresent.
5. When the experiment is completed , students should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.

INSTITUTION VISION AND MISSION

VISION

To be a globally recognized institution that fosters innovation, excellence, and leadership in education, research, and technology development, empowering students to create sustainable solutions for the advancement of society.

OUR MISSION

- To foster a transformative learning environment that empowers students to excel in engineering, innovation, and leadership.
- To produce skilled, ethical, and socially responsible engineers who contribute to sustainable technological advancements and address global challenges.
- To shape future leaders through cutting-edge research, industry collaboration, and community engagement.

DEPARTMENT VISION , MISSION ,PROGRAMME EDUCATIONAL OBJECTIVES AND SPECIFIC OUTCOMES

VISION OF THE DEPARTMENT

To empower students to be skilled, competitive, and dedicated Civil Engineers by imparting advanced technical knowledge and ethical values, equipping them to play a key role in the planning and execution of the nation's infrastructure and development activities.

MISSION OF THE DEPARTMENT

M1: Provide exceptional education in civil engineering through a combination of excellent teaching, advanced facilities, and continuous mentorship.

M2: Produce civil engineering graduates who demonstrate exceptional skills and expertise.

M3: Encourage professional development to address complex technical challenges and engage in innovation with creativity, leadership,

PROGRAMME EDUCATIONAL OBJECTIVES

PEO – I:
Professional Excellence
Analyze, design, build, maintain, or improve civil engineering-based systems, considering environmental, economic, and societal requirements.

PEO – II:
Multidisciplinary Approach
Develop a strong educational foundation to design and conduct experiments, meeting needs within multidisciplinary constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability, while analyzing and interpreting data.

PEO – III:
Continued Self-Learning
Identify, formulate, and solve engineering problems, and engage in lifelong learning in advanced areas of civil engineering and related fields.

PEO – IV:
Effective Contribution to Society

Utilize modern engineering techniques, skills, and tools necessary for civil engineering practice, serving the community as ethical and responsible professionals.

PROGRAME OUTCOMES(POs)

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.

PROGRAM SPECIFIC OUTCOMES

PSO 1 – Demonstrate the ability to plan, design, implement, and supervise civil engineering systems in various sectors

PSO 2 - Focus on safety, serviceability, and eco-friendly technologies while operating, maintaining, and rehabilitating civil engineering systems.

PSO 3 - Utilize advanced civil engineering technologies to continue education, achieve entrepreneurial success, and explore various career options.

PROGRAMOUTCOMES(POs)

1. **Engineering knowledge:** Applythe knowledge of mathematics, science, engineering fundamentals,andanengineeringspecializationtothesolutionofcomplexengineering problems.
2. **Problemanalysis:**Identify,formulate,reviewresearchliterature,andanalyzecomplex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/developmentofsolutions**:Designsolutionsforcomplexengineeringproblems and design system components or processes that meet the specified needs with appropriateconsiderationforthepublichealthandsafety,andthecultural,societal,and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including designofexperiments, analysis and interpretationofdata, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **Theengineerand society:** Applyreasoning informed bythecontextualknowledgeto assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **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.
8. **Ethics:**Applyethicalprinciplesandcommit to professionalethicsandresponsibilities and norms of the engineering practice.
9. **Individualandteamwork:** Functioneffectivelyasanindividual,andasamemberor leader in diverse teams, and in multidisciplinary settings.
10. **Communication:**Communicateeffectivelyoncomplexengineeringactivitieswiththe engineering community and with society at large, such as, being able to comprehend andwriteeffectivereportsanddesigndocumentation,makeeffectivepresentations,and give and receive clear instructions.
11. **Projectmanagementandfinance:** Demonstrateknowledgeandunderstandingofthe 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.
12. **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.

COURSESTRUCTURE,OBJECTIVES&OUTCOMES

COURSESTRUCTURE

ElementsofCivilEngineering labwillhaveacontinuousevaluationduring1st semester for30 sessional marks and 70 end semester examination marks.

Outofthe30marks for internalevaluation, day-to-dayworkinthelaboratoryshallbeevaluated for 20 marks and internalpracticalexaminationshallbe evaluated for 10 marks conducted by the laboratory teacher concerned.

The end semester examination shall be conducted with an external examiner and internal examiner. The external examiner shall be appointed by the Principal / Chief Controller of examinations

COURSEOBJECTIVE

- Toprovidepracticalknowledgeaboutphysicalpropertiesofmineralsand rocks.
- Todeterminethecharacteristicsofcement,Coarse&Fineaggregate

COURSEOUTCOME

Attheend ofthecourse,thestudent willbeableto:

- Understandthemethodandwaysofinvestigationsrequiredfor CivilEngineering.
- Identifythevariousrocks,mineralsdependingongeologicalclassifications
- Evaluatethepropertiesofcement,fineandcoarseaggregatesanddetermine its suitability for constriction.

CE317.1	DetermineandIdentifying thepropertiesofmineralsbyconductingdifferent tests
CE317.2	DetermineandIdentifyingthepropertiesofRocksbyconductingdifferenttests
CE317.3	IdentifyingtheGeologicalfeaturesandsymbolsfromthe mapsandstructural problems.
CE317.4	Determinethepropertiesofcementingredientsbyconductingdifferent tests
CE317.5	Determinethepropertiesoffineaggregatebyconductingdifferenttests
CE317.6	Determinethepropertiesofcoarseaggregatebyconducting different tests

LISTOF EXPERIMENTS

I. IdentificationofMinerals

SilicaGroup,FeldsparGroup,CrystallineGroup,CarbonateGroup,PyroxeneGroup, Mica Group, Amphibole Group.

II. IdentificationofRocks

IgneousPetrology, SedimentaryPetrology, MetamorphicPetrology.

III. StudyofGeographicalFeatures

1. Study of Geographical Features from Geological Maps. Identification of symbols in maps.
2. SimplestructuralGeologyproblems(Folds,Faults&Unconformities)

IV. Teston Cement

1. Finenesstest&NormalConsistencytest.
2. Specificgravitytest,Initialsettingtimeandfinalsettingtimeofcement.

V. Test onFineAggregate

1. SpecificGravitytest
2. Bulkingofsand&FinenessmodulusofFineaggregate

VI. TestonCoarseAggregateFresh Concrete

1. SpecificGravitytest
2. Fineness modulusofCoarseaggregate

IDENTIFICATIONOFMINERALS

EXPERIMENT1

IDENTIFICATIONOFMINERALS

AIM:

Identifyingtheminerals

1. **SILICAGROUP**

Examples:

1. Quartz
2. Agate
3. Jasper
4. Flint
5. Opal

QUARTZ

1.	Form	Massive(sometimescrystals)
2.	Colour	ColourlessorWhite
3.	Streak	Colourless
4.	Luster	Vitreous
5.	Fracture	Uneventoconchoidal
6.	Cleavage	Absent
7.	Diaphaneity	Transparenttotranslucent
8.	Hardness	7
9.	SpecificGravity	3
10.	NameoftheSpecimen	Quartz
11.	Occurrence	SouthIndia
12.	Origin	Igneous
13.	PracticalUsage	Usedasgemstoneandinwatchindustriesetc
14.	Chemical Composition	Sio2

FLINT

1.	Form	Tabular form
2.	Colour	Brown
3.	Streak	Colourless
4.	Luster	Earthy
5.	Fracture	Absent
6.	Cleavage	Absent
7.	Diaphaneity	Opaque
8.	Hardness	7
9.	SpecificGravity	3to4
10.	Occurrence	Vijayanagaram,Visakhapatnam
11.	Origin	Igneous
12.	PracticalUsage	Fillersoffertilizers
13	Nameofthespecimen	Flint
14	ChemicalComposition	Silica

2. **FELDSPARGROUP**

Examples:

1. Orthoclase
2. Microcline
3. Albite
4. Anorthite
5. Feldspar

FELDSPAR

1.	Form	Tabular
2.	Colour	PalePink

3.	Streak	White
4.	Luster	Vitreous
5.	Fracture	Uneven
6.	Cleavage	Absent
7.	Diaphaneity	Opaque
8.	Hardness	7
9.	SpecificGravity	2.5
10.	Occurrence	Adilabad
11.	Origin	Igneous
12.	PracticalUsage	Tiles
13.	NameoftheSpecimen	Feldspar
14.	ChemicalComposition	KAISi308

3. CRYSTALLINEGROUP

Examples:

1. Garnet
2. Zeolite
3. Quartz
4. Amethyst
5. Pyrite
6. Galena

GARNET

1.	Form	Rhombic
2.	Color	Ruby
3.	Streak	LightBrown
4.	Luster	Earthy
5.	Fracture	Absent
6.	Cleavage	Absent
7.	Diaphaneity	Opaque
8.	Hardness	7
9.	Specific	4.5
10	NameoftheSpecimen	Garnet

11.	Occurrence	Gudur,AndhraPradesh
12.	PracticalUsage	Ornaments
13	ChemicalComposition	$Fe_3Al_2(SiO_4)_3$

GALENA

1	Form	Cubic/granular/ blocks
2	Colour	Grayandblack
3	Streak	Black
4	Luster	Splendent
5	Fracture	Rarelyfound
6	Cleavage	3setscubic
7	Diaphaneity	Opaque
8	Hardness	6
9	Specific	5.5
10	NameoftheSpecimen	Galena
11	Occurrence	Maharashtra
12	PracticalUsage	Ornamentalandatomicpurposes
13	ChemicalComposition	Pbs

4. CARBONATEGROUP

Examples:

1. Calcite
2. Aragonite
3. Dolomite
4. Pyrite

CALCITE

1	Form	Rhombic
2	Colour	Colorlesswhite/palecolour
3	Streak	White
4	Luster	Vitreous

5	Fracture	Rarelyfound
6	Cleavage	3sets
7	Diaphaneity	Transparenttotranslucent
8	Hardness	3
9	Specific	2.5to3
10	NameoftheSpecimen	Calcite
11	Occurrence	TamilNadu
12	PracticalUsage	Bombs,gunpowders,anti–aircraft
13	ChemicalComposition	$Caco_3$

PYRITE

1	Form	Cubic/granular
2	Colour	Fool'sgold,brass yellow
3	Streak	Black
4	Luster	Metallicto sub– metallic
5	Fracture	Uneven
6	Cleavage	3sets
7	Diaphaneity	Opaque
8	Hardness	6-7
9	Specific	5
10	NameoftheSpecimen	Pyrite
11	Occurrence	Cuddapah,AndhraPradesh
12	PracticalUsage	Paints,Paperindustries
13	ChemicalComposition	FeS_2

5. PYROXENEGROUP

Examples:

1. Hypersthene
2. Augite
3. Aergirine

AUGITE

1	Form	Massive
2	Colour	Black
3	Streak	Black
4	Luster	Vitreoustosub-vitreous
5	Fracture	Uneven
6	Cleavage	2 setsofprismatic,notperfect
7	Diaphaneity	NearlyOpaque
8	Hardness	5–6
9	Specific	Medium(3.2–3.5)
10	NameoftheSpecimen	Augite
11	Occurrence	
12	PracticalUsage	
13	ChemicalComposition	Complexsilicate

6. MICAGROUP

Examples:

1. Muscovite
2. Biotite

MUSCOVITE

1.	Form	Lamellar
2.	Colour	White
3.	Streak	White
4.	Luster	Vitreous
5.	Fracture	Uneven
6.	Cleavage	Absent
7	Diaphaneity	Transparentinindividuallayer&opaqueaswhole
8.	Hardness	2to3
9.	SpecificGravity	2.5

10.	Occurrence	Gudur
11.	Origin	Metamorphic
12.	PracticalUsage	Poorconductorofheat
13.	NameoftheSpecimen	Muscovite
14.	Chemical Composition	KAI2(AISi3)O10(OH,F)2

BIOTITE

1.	Form	Lamellar/flanky
2.	Color	Darkgreenishblack/ Black
3.	Streak	Darkbrown
4.	Luster	Pearly
5.	Fracture	Uneven
6.	Cleavage	Absent
7	Diaphaneity	Transparentinindividuallayers&opaqueaswhole
8.	Hardness	2to3
9.	SpecificGravity	2 .7to3
10.	Occurrence	Nellore
11.	Origin	Metamorphic
12.	PracticalUsage	Ironboxes
13	Nameofthe Specimen	Biotite
14	ChemicalComposition	K(Mg,Fe3)(AISi3)O10(OH, F)2

7. AMPHIBOLEGROUP

Examples:

1. Hornblende
2. Asbestos

HORNBLENDE

1.	FORM	Granular
2.	Colour	PalePink/greenishblack
3.	Streak	White
4.	Luster	Vitreous
5.	Fracture	Uneven
6.	Cleavage	Absent
7.	Diaphaneit	Opaque
8.	Hardness	5-6
9.	SpecificGravity	3.0-3.5
10.	Occurrence	Adilabad
11.	Origin	Igneous
12.	PracticalUsage	Tiles
13.	NameoftheSpecimen	Feldspar
14.	Chemical Composition	KAISi308

ASBESTOS

1.	Form	Fibrous
2.	Colour	Green
3.	Streak	Colourless
4.	Luster	Silky
5.	Fracture	Uneven
6.	Cleavage	Absent
7.	Diaphaneity	Opaque
8.	Hardness	4to6
9.	SpecificGravity	3to4.5
10.	Occurrence	Cuddapah,AndhraPradesh
11.	Origin	Metamorphic
12.	PracticalUsage	Itisusedtomake sheets
13.	NameoftheSpecimen	Asbestos
14.	ChemicalComposition	2Mg3Si2O5(OH)4

VIVA QUESTIONS

S.NO	FORM	DESCRIPTION
1	Lamellarform	
2	Tabularform	
3	GreasyLustre	
4	Crystalform	
5	PearlyLustre	
6	Rhombicform	
7	MetallicLustre	
8	Bladedform	
9	Translucent	
10	Even fracture	

IDENTIFICATIONOFROCKS

EXPERIMENT1

INDETIFICATIONOFROCKS

AIM:

Theaimofthisunitistopresentyouthedifferenttypeofrocks,mainfactorsforclassificationand petrogenesis of Igneous rocks.

IGNEOUSPETROLOGY

PEGMATITE

IPetrography		
1.	Colour index	Leucocratic(lightcolour)
2.	Mineralogy	a) Essentialminerals:Quartz, Feldspars, b) Accessoryminerals:Bery1,tourmaline,apatite
3.	Texture	Verycoarsegrainedgranular
4.	Structure	Pegmatitic
IIPetrogenesis		
1.	Modeofformation	Veinsanddykes.
2.	Depthof formation	Greatdepth
3.	Conditionsofformation	Plutonicconditions(highpressureandhigh temperature)
4.	Nameoftherock	**Pegmatite.**

GRANITE

IPetrography		
1.	Colour index	Leucocratic(lightcolour)
2.	Mineralogy	a)Essentialminerals:Quartz,alkalifeldsparandmicas

		b)apatite,magnetite,zircon,sphene,Hornblendeandpyroxene.
3.	Texture	Coarsegrained,Equigranular
4.	Structure	Pegmatitic
IIPetrogenesis		
1.	Modeofformation	Bigbatholithstosmallplutonic
2.	Depthof formation	Greatdepth(deepseated)
3.	Conditionsofformation	Plutonicconditions(highpressureandhightemperature)
4.	Nameoftherock	**Granite**

PORPHYRITICGRANITE

IPetrography		
1.	Colour index	Leucocratic
2.	Mineralogy	a) Essentialminerals:apatite,zircon,magnetite,sphene, Hornblende and pyroxene. b) Accessoryminerals:Coarsegrainedinequigranular
3.	Texture	Coarsegrained,Equi granular
4.	Structure	Porphyritic
IIPetrogenesis		
1.	Modeofformation	Bigbatholithstosmallplutonic
2.	Depthof formation	Greattointermediatedepth
3.	Conditionsofformation	Plutonicconditions(highpressureandhightemperature)
4.	Nameoftherock	**PorphyriticGranite**

DOLERITE

IPetrography		
1.	Colour index	Melanocratic
2.	Mineralogy	a) Essentialminerals:Labradoriteplagioclaseand augite pyroxene. b) Accessoryminerals:Magnetite,olivine,apatite andsphene.
3.	Texture	Mediumgrained.
IIPetrogenesis		
1.	Modeofformation	Dykes
2.	Depthof formation	Intermediate(shallowdepth)
3.	Conditionsofformation	Hypabyssalconditions(highpressureandhigh temperature)
4.	Nameoftherock	**Dolerite.**

BASALT

IPetrography		
1.	Colour index	Melnocratic
2.	Mineralogy	a) Essentialminerals:labradoriteplagioclaseand augite pyroxene b) Accessoryminerals:olivine.Hornblende, magnetiteandapatite
3.	Texture	Finegrained

4.	Structure	Vesicularandamygdaloidal
IIPetrogenesis		
1.	Modeofformation	Sills,flows,anddykes
2.	Depthof formation	Surface intrusiveandextrusives
3.	Conditionsofformation	Volcanicconditions(highpressureandhigh temperature)
4.	Nameoftherock	**Basalt**

SEDIMENTARYPETROLOGY

AIM:

Theaimofthisunitistopresentyouthedifferenttypeofrocks,mainfactorsforclassificationand petrogenesis of Sedimentary rocks.

CONGLOMERATE

1.	ClasticNon-clastic	Clastic
2.	Colour	shadesofgrey,brown
3.	Mineralogy	Quartzfeldspars,clay,hematiteandlimonite(goethite)
4.	Structure	Rounded rudite
5.	Texture	
	(a)Grainsize	Coarsegrained
	(b)Grainshape	Roundedtosubrounded
	(c)Sorting	Poorlysorted
6.	Natureofmatric	Ferrugeneousandsiliceous
7.	Name	Conglomerate

SANDSTONE

1.	ClasticNon-clastic	Clastic
2.	Colour	Brownoryelloworgreyorbuff
3.	Mineralogy	QuartzwithlittleamountoffeldsparandSiliceousor ferrugeneousclays
4.	Structure	Ripplemarks,arenite
5.	Texture	
	(a)Grainsize	Mediumgrained
	(b)Grainshape	Roundedtosubrounded
	(c)Sorting	Wellsorted
6.	Natureofmatric	Siliceousorferrugeneousorboth
7.	Name	Ripplesandstone

SHALE

1.	ClasticNon-clastic	Clastic
2.	Colour	Greybrownorblack
3.	Mineralogy	Chloritemuscovite,kaolin,andquartz.
4.	Structure	Thinlayering
5.	Texture	
	(a)Grainsize	Finegrained
	(b)Grainshape	Variable
	(c)Sorting	Poorlysorted
6.	Natureofmatric	Ferrugeneousor siliceous
7.	Name	Shale

LIME STONE

1.	ClasticNon-clastic	Nonclastic
2.	Colour	Grey
3.	Mineralogy	Calcite(CaC03)
4.	Structure	layering
5.	Texture	
	(a)Grainsize	finegrained
	(b)Grainshape	Variable
6.	Natureofmatric	Calcareous
7.	Name	Limestone

METAMORPHICPETROLOGY

AIM

Theaimofthisunit,istoprovideyoudescriptionofmetamorphicrocks.

GNEISSES

1.	Colour	Shadesofgrayish whits
2.	Mineralogy	Quartz,feldspar,biotite,hornblende
3.	Structure	Gneissoseorbanding(felsicand mfic bands)
4.	Typeofmetamorphism	Highgraderegionalmetamorphism
5	Conditionsofmetamorphism	Modertepressureandhightemperature
6.	Natureofparentrock	Granite
7.	Nameoftherock	Quartzo-feldspathicgneiss(peninsulargeniss)

MARBLE

1.	Colour	White(rarelypink,shadesofgreenetc)
2.	Mineralogy	Calcite
3.	Structure	Bedswithsacchardial form
4.	Typeofmetamorphism	Contact(thermal)metamorphism
5	Conditionsofmetamorphism	Hightemperatureandlowpressure
6.	Natureofparentrock	Limestone
7.	Nameoftherock	Marble

SLATE

1.	Colour	Variable (greyyellow greenbrownor black)
2.	Mineralogy	Muscovite,chlorite,feldspar,quartz
3.	Structure	Sheetorlayerswithslatycleavage
4.	Typeofmetamorphism	Regionalmetamorphism
5	Conditionsofmetamorphism	Lowpressureandlowtemperature
6.	Natureofparentrock	Pelitic(shale)
7.	Nameoftherock	Slate

QUARTZITE

1.	Colour	Variable(shades ofwhitetobrown
2.	Mineralogy	Quartz
3.	Structure	Bedswithgranularform

4.	Typeofmetamorphism	Contact metamorphism
5	Conditionsofmetamorphism	Hightemperatureandlowpressure
6.	Natureofparentrock	Sandstone
7.	Nameoftherock	Quartz

VIVA QUESTIONS

S.NO	FORM	DESCRIPTION
1	Massiveform	
2	VitreousLustre	
3	SubVitreousLustre	
4	Pisoliticform	
5	Ooliticform	
6	ResinousLustre	
7	Granularform	
8	AdamantineLustre	
9	SubmetallicLustre	
10	Fibrousform	

STUDYOFTOPOGRAPHICALFEATURES FROM GEOLOGICAL MAPS

EXPERIMENT1

STUDYOFTOPOGRAPHICALFEAUTRESFROMGEOLOGICALMAPS. IDENTIFICATION OF SYMBOLS IN MAPS

AIM:

TheaimofthisunitistodrawageologicalsectionalongX-Yaxisandinterpretethegeological map.

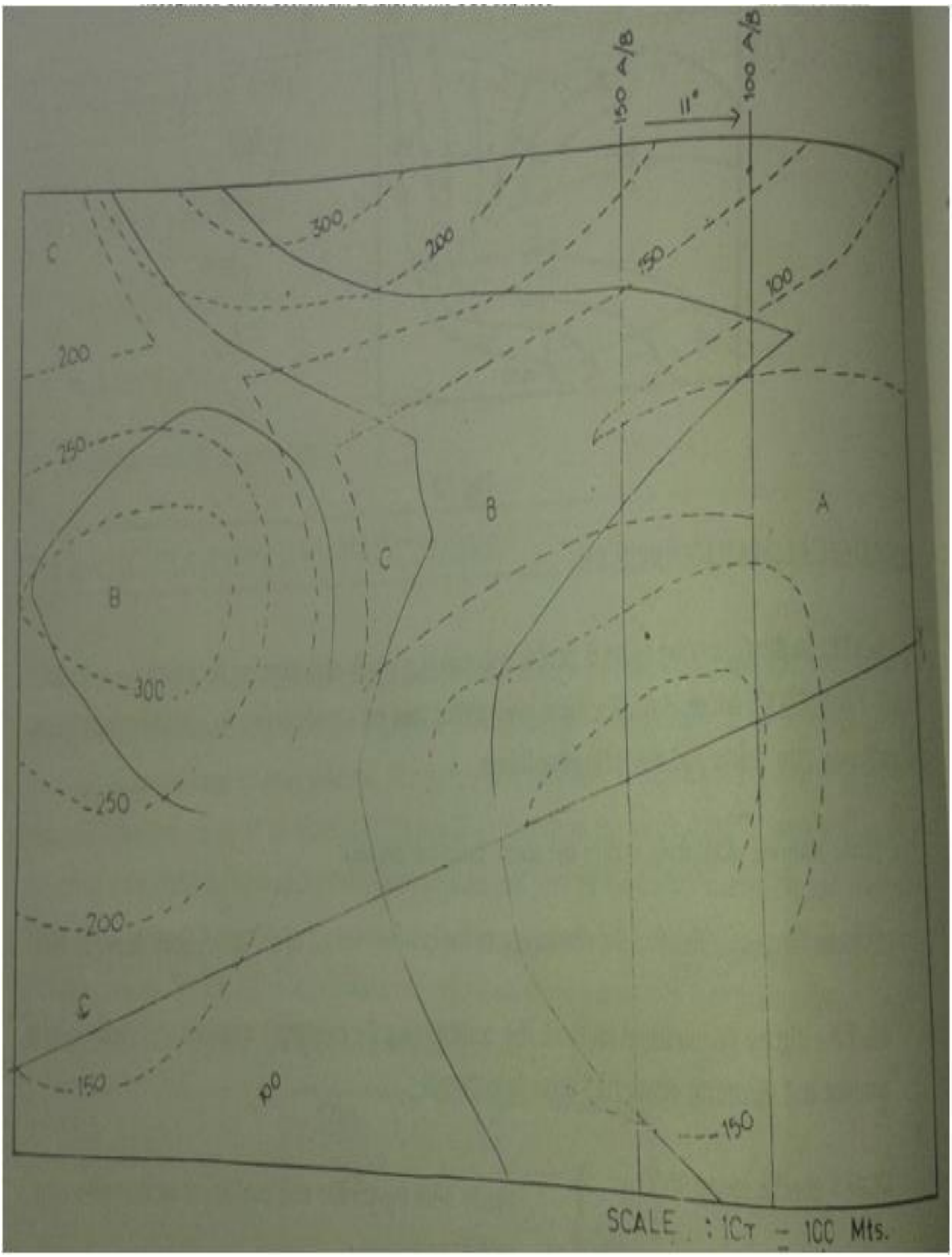
OBJECTIVES

- Afterdrawingtheprofile,youwillbeableto
- Describethegeologyofthearea
- Explainthestructureofthearea
- Describethetopography
- Explainthe successionofthebeds
- Listoutthebeds

PRECAUTION

Drawtwostraightlinesforthesamebeddingplaintocalculatethedipofthebed **Note**:Never drawonstraightlineforonebeddingplaneandasecondstraightlineforanotherBeddingplane for calculation of dip

SECTIONALONGX-Y(TRUEDIPDIRECTION)



SECTIONALONGX-Y(TRUEDIPDIRECTION)

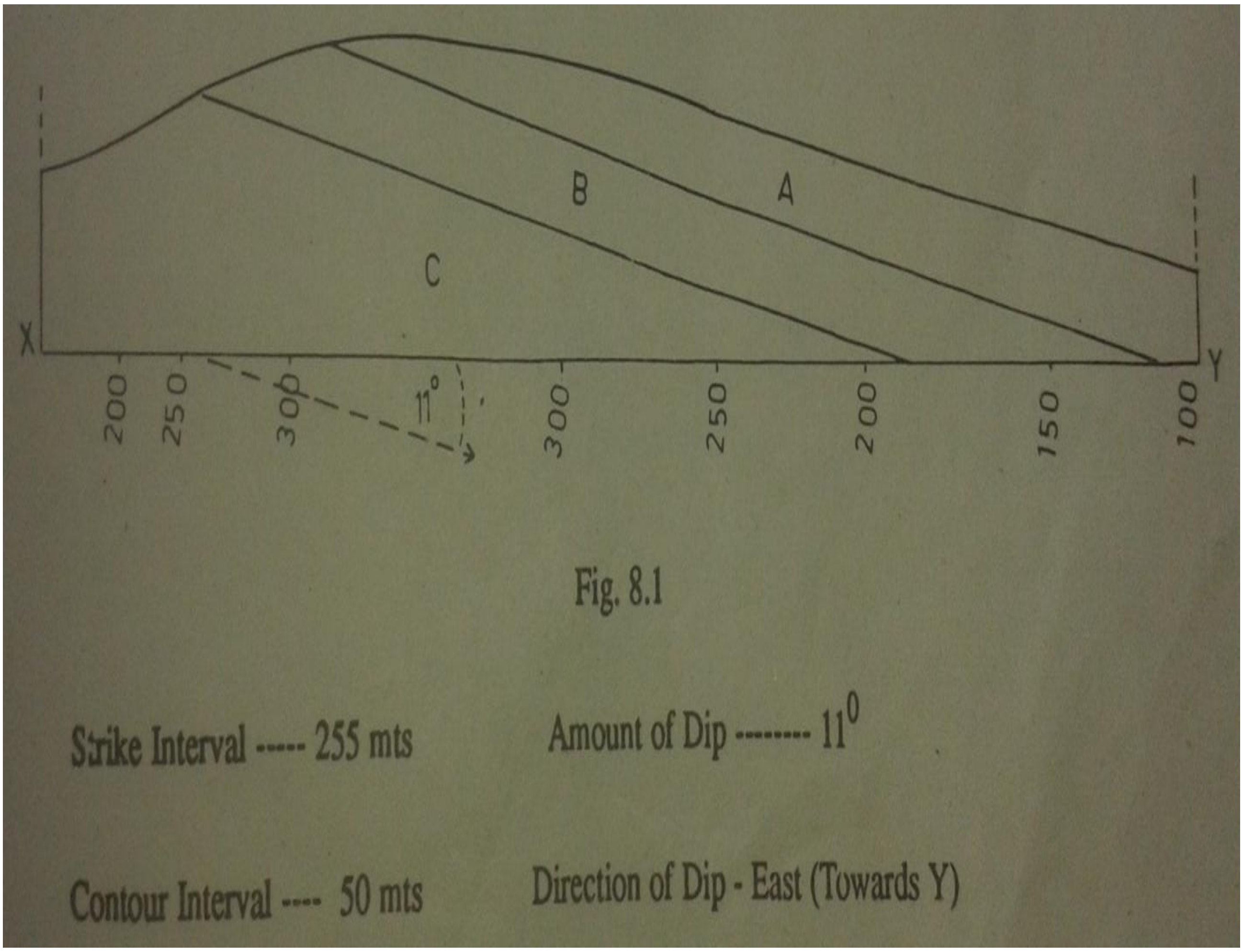


Fig. 8.1

GEOLOGICALINTERPRETATION

Topography

Inthemaphighestcontourisof300mts.Andthelowestisof100mts.Theareaishavingtwo Hills, one inthewest andtheother inSouth-East region. Thesetwo hillsare having different heights. Boththe hills are showing gradualslopes. These are valleys present inthe area.

GeneralGeology

Intheareathereisonlyone seriesof3bedswhichare confirmable.

Geological Structure

IntheareathebedsarestrikingNorth-Southanddippingwith11^{0}towardsEast(towardsY). A small out lier is present in Western region.

(Whenanyoungerbedissurrounded byanolder bedtheresultingstructureisoutlier).

GeologicalSuccession

In the area the beds are deposited in the order: C-B-A in normal marine conditions. All the formations are confirmable. Later they are up-lifted and tilted to attain the present attitude. When they are exposed to erosion, an outlier is formed.

NOTE:Thisoutlierispurelyanerosionalfeature.

VIVA QUESTIONS

1. Whentwogeologicalforces fromoppositedirections act oneachother,therock layers within the Earth's crust
2. TheHimalayaswereformedapproximately
3. slantsidesofthefolding rocksareknownas
4. Innormalfault, thedisplacementthattakesplaceis
5. Mostoftheriftvalleysandblockmountainsarefoundin
6. Thetremendouscompressionalforcesexertedontherocklayers bygeological movements Practical Usage rock layers to
7. Thereverse faultiscauseddueto
8. Whenthestrongercompressionalforcespushtheoverthrust foldtomovealongthe fracture line, it forms a
9. Rocksundertensionalforceare
10. Atearfaultoccursdue to

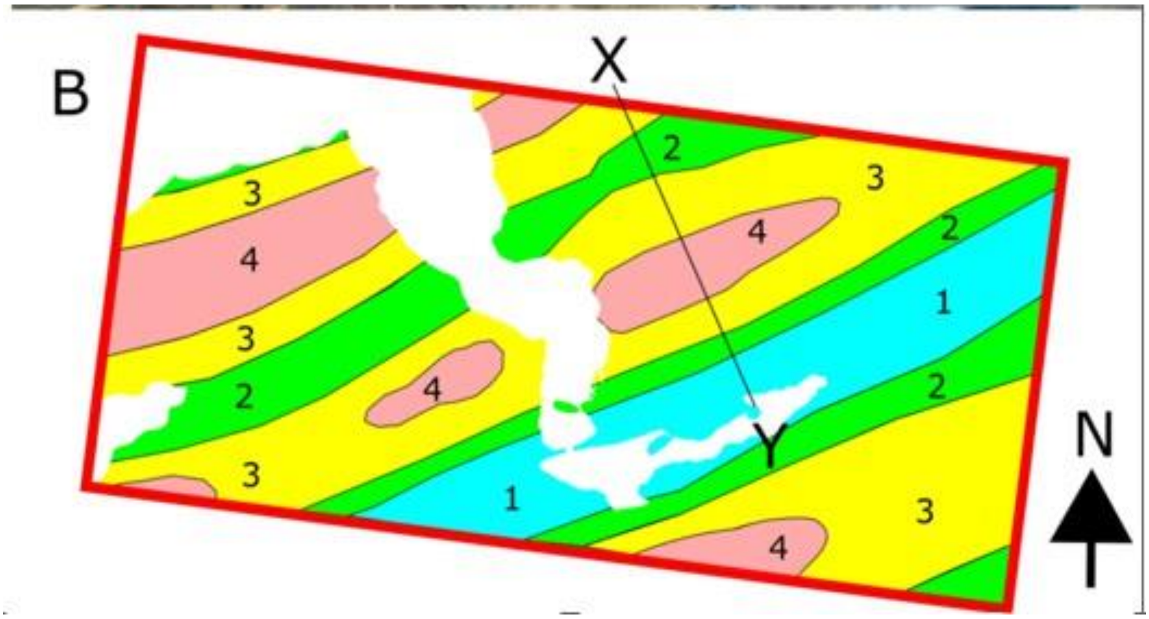
EXPERIMENT2

SIMPLESTRUCTURALGEOLOGYPROBLEMS(FOLDS,FAULTS&UNCONFIRMITIES)

AIM:

The primarygoalofstructuralgeologyisto use measurementsofpresent-dayrockgeometries to uncover information about the history of deformation (strain) in the rocks, and ultimately, to understand the stress field that resulted in the observed strain and geometries.

STUDYOFFOLDS,FAULTS&CONFIRMITIES



a) Describe the patterns formed bythe layers ofrock exposed in this image. What do these patterns tell you about the geologic structure(s) formed by the rocks in this area?
b) Note the relative ages of the rocks presented in Figure 9.1. Given this information, what kind of structure do you think is found in the red boxed area of the satellite image?
c) Sketcharoughcross-sectionofyour interpretation ofthegeologyin Figure9.1 , between points X and Y (X-Y).
d) Aredatamissingfromthemapthatwouldhelpyouimprovetheaccuracyofyour interpretation? If so, what data would help you to understand the geology better?

BlockDiagrams

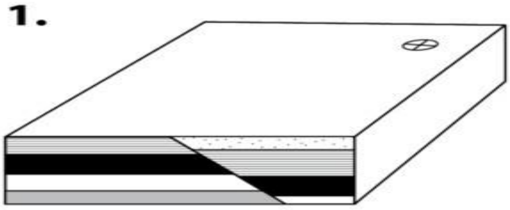
Inthediagramsshownin Figure9.2, numericallabelsonbeds indicatetherelativeagesofthe beds, with 1 being the oldest and 6 the youngest. Complete the block diagrams by doing the tasks listed below. Assume that the geologic units have not been overturned (flipped upside down).

a) Drawthe geologicalcontacts astheywouldappearonthe blanksurfaces.

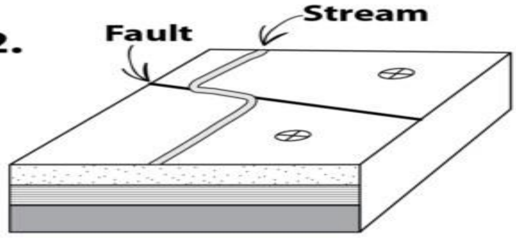
b) Addstrikeanddipsymbolsaswellassymbolsdocumentinganyothergeological features. Include the direction of motion for any faults.

c) Writethenameofthestructureintheblankbeneath eachdiagram

1.



2.



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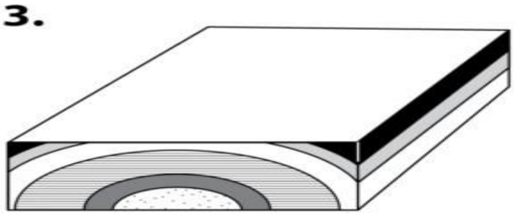

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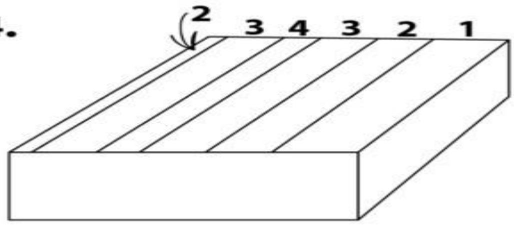

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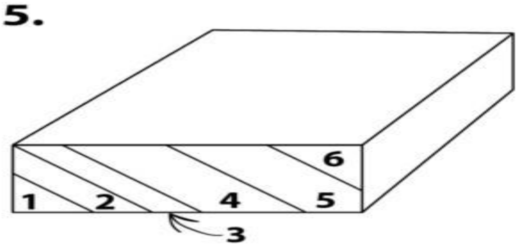

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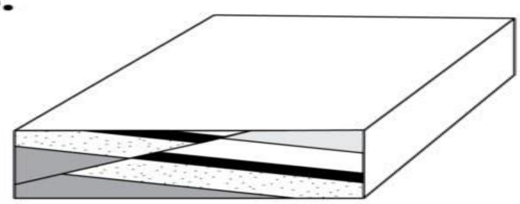
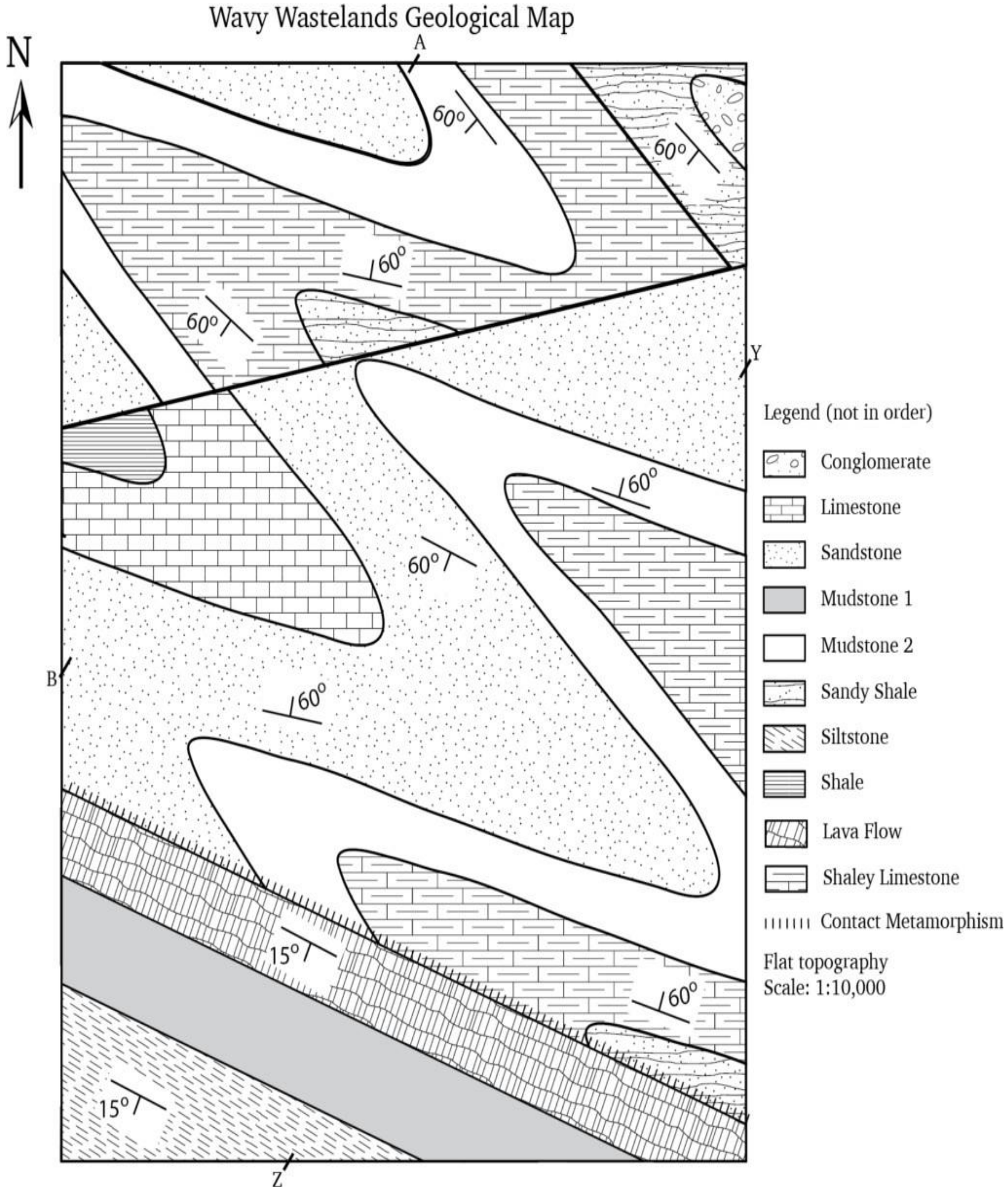


DrawingCross-SectionsoftheFolds,Faults,andUnconformitiesoftheWavy Wastelands

ForthisexerciseyouwillusethemapoftheWavyWastelandsRememberthattherocksinthe legend are not in the correct order. You will have to re-arrange themas part of the exercise.



a. Whatkindsofrocksarefoundinthismaparea(sedimentary,igneous,and/or metamorphic)? How many units can you see?
b. Note the strike and dipsymbols on themap.Which direction are the units striking and dipping?Dothestrikeanddipofthebedschangeatallas youmoveacrossthemaparea?
c. There is a major unconformity in the map area. What kind ofunconformityis it?Outline the trace of the unconformity in red on your map.

d. Draw fold axialtraces onthe map for the folds in the map area. (There are six.) Indicate whetherthefoldsareanticlinesorsynclinesbyputtingtheappropriatesymbolsonthemap for each fold. Note that all the folds are plunging in the same direction.

e. Makealistofformationsfromoldesttoyoungest.Whichgeologiclaws/principlesdidyou use to prepare your list?

f. There isa fault inthe maparea.Whichsideofthefault went uprelativetotheotherside? Markthisonyourmap. Hint:Whichsidehasolderbeds?Usethefoldsto help youfigure out the relative ages of the beds.

g. The fault is a **reverse** fault. In what direction does the fault plane dip? ___________Hint: The fault plane always dips toward the hanging wall. In a reverse fault, how does the hanging wall move relative to the footwall?

h. Notethescaleofthemap.WhatisthedistanceinmetresbetweenpointYandpoint Z?What is the distance in metres between point A and point B?

X toY distance: ___________ AtoB distance: ___________

i. Prepare a cross-sectionthroughthemapfrompositionY toZ(Y-Z).

j. Prepare a cross-sectionthroughthe map frompositionAto B (A-B). Drawthe fault with a dip angle of 45°.

k. Inpoint form,describethegeologicalhistoryofthe maparea. VV

VIVA QUESTIONS

1. AnexampleoffoldmountainrangeintheSouthernAmericais
2. Rocksundercompressionalforceare
3. Rift valleysandblockmountainsare landformsthatareformed by
4. FaultingtakesplacewhenrockswithinEarth'scrustform
5. Whentherocklayersbenddownwards,theyforma
6. Faultingoccursdueto
7. FaultingoccurswhenCrustalrocklayerexperience
8. Ariftvalleyformswhenthecentralblockismoved
9. Furtherunevencompressionofplateswouldcauseonelimbtobepushedovertheother to create a/an
10. Foldingalso takesplaceonalargescalewhen two

TESTONCEMENT

EXPERIMENT1

FINENESSOFCEMENT

AIM:

Todeterminethefinenessofthegivensampleofcementbysieving.

APPARATUS:

1. IS-90-micronsieveconformingto IS:460-1965
2. Standardbalance
3. Weights
4. Brush.

INTRODUCTION:

Thefinenessofcement hasanimportant bearingontherateofhydrationand henceontherate of gain of strength and on the rate of evolution of heat. Finer cement offers a greater surface area for hydration and hence the faster and greater the development of strength. Increase in fineness of cement is also found to increase the drying shrinkage of concrete. Fineness of cement is tested either by sieving or by determination of specific surface by air-permeability apparatus. Specific surface is the totalsurface area ofall the particles in one gramofcement.

FINENESSBYSIEVING:

PROCEDURE:

1. Weighaccurately100gofcementandplaceitonastandard90micronsIS sieve.

2. Breakdownanyair-setlumpsinthecementsamplewithfingers.

3. Continuouslysievethesamplegivingcircularandverticalmotionforaperiodof15minutes.

4. Weightheresidueleftonthesieve.AsperIScodethepercentageresidueshouldnotexceed 10%.

OBSERVATIONS:

S.No	Weightofsampletaken(g)	Weightofresidue(g)	Fineness(%)

Averagefineness ofcementis ________________.

RESULT: Fineness ofgivensample ofcementis _________________.

PRACTICALAPPLICATIONS:

Thefinenessofcement hasanimportant bearingontherateofhydrationand henceontherate of gain of strength and on the rate of evolution of heat.


NORMALCONSISTENCYOFCEMENT

AIM:

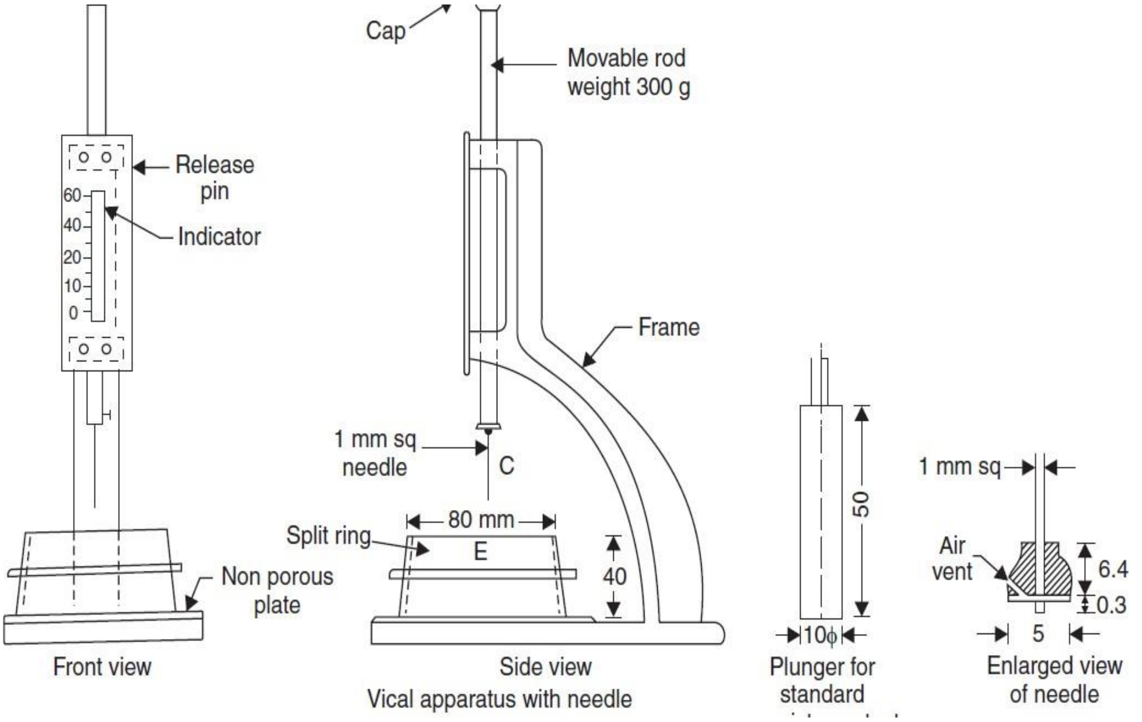
Normalconsistencytestisusedtooptimumpercentageofwatercontent required for acement paste.

APPARATUS:

1. Vicatapparatus(conformingtoIS:5513-1976)withplunger (10mmindiameter)
2. Vicatmould
3. Gaugingtrowel
4. Measuringjar
5. Balance
6. Tray.

INTRODUCTION:

Thestandardconsistencyofacementpasteisdefinedasthatconsistencywhichwillpermitthe Vi-catplungertopenetratetoapoint5to7mmfromthebottomoftheVicatmould.Forfinding out initial setting time, final setting time, soundness of cement and compressive strength of cement, it is necessary to fix the quantity of water to be mixed in cement in each case. This experiment isintendedtofindoutthequantityofwatertobemixed foragivencementtogive a cement paste of normal consistency and can be done with the help of Vi-cat apparatus.



PROCEDURE:

1. Prepareapasteofweighedquantityofcement(300grams)withaweighedquantityof potable or distilled water, starting with 28% water of 300g of cement.
2. Thepercentage ofwatertobe takenaccordingtotheroomtemperature27± 5^0C.
3. Take care thatthe time ofgauging is not less than 3 minutes, not morethan5 minutes and the gauging shall be completed before setting occurs.
4. Thegaugingtimeshallbecountedfromthetimeofaddingthewatertothedrycementuntil commencing to fill the mould.
5. Fillthe Vi-catmould withthispaste,themouldresting uponanon-porous plate.
6. Aftercompletelyfillingthe mould, trimoffthesurfaceofthepaste, making it inlevelwith the top of the mould. The mould may slightly be shaken to expel the air.
7. Place the test block with the mould, together with the non-porous resting plate, under the rod bearing the plunger (10mm diameter), lower the plunger gently to touchthe surface of the test block and quickly release, allowing it to penetrate into the paste.
8. Thisoperationshall becarriedoutimmediatelyafterfillingthe mould.
9. Preparetrialpastes with varying percentages ofwater and test as described above untilthe amountofwaternecessaryformakingthestandardconsistencyasdefinedaboveisobtained.
10. Expresstheamountofwateras a percentagebyweightofthedrycement.

CALCULATIONS:

1gmpercc=1mlofwater

$$P = \frac{W}{C} X100$$

WhereP = percentageofwater (b)

W=waterrequiredinml(c)

C=weightofcementrequired(a).

OBSERVATIONS:

S.No	Weight of cement takeningms (a)	Watertaken in % (b)	Water takeninml (c)	Plunger penetration (mm)	Consistency of cement in % by weightb/a*100
1	400	28	112		
2	400	30			
3	400	32			
4	400	34			
5	400	36			

RESULT: Normalconsistencyfor the givensample ofcementis______________________.

PRACTICALAPPLICATIONS:

Thestandardconsistencyofacementpasteisdefinedasthatconsistency.Forfindingoutinitial setting time, finalsetting time, soundnessofcement and compressive strengthofcement, it is necessary to fix the quantity of water to be mixed in cement in each case.

VIVA QUESTIONS:

1. Whatisthepercentageofwaterrequiredforpreparing1:3cementsandmortarfor compressive strength test?
2. Whatissignificanceofthetest?
3. What areISspecifications forcompressivestrengthof1:3 cement sand mortarafter3days and 7 days?
4. Whatistheminimumnumber ofspecimenstobemadeoreachageoftesting?
5. Howdoyou determinethecompressivestrengthofcement?
6. Howisthecuring ofatest specimen done?
7. Whyshould not thespecimenbeallowed todryuntiltheyare tested?
8. Whatistherateof loading?
9. Whatdoyouunderstandbystandard consistency?
10. Whatistheweightofthemovingpartofthevicatapparatus?

EXPERIMENT2

SPECIFICGRAVITYOFCEMENT

AIM:

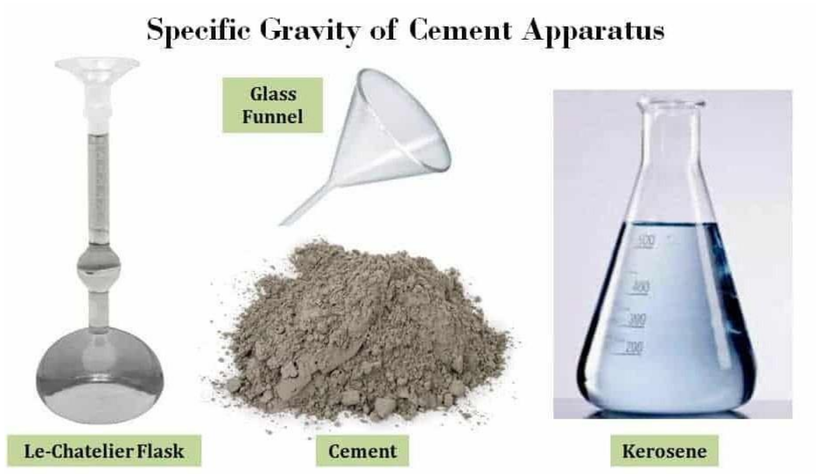
Todeterminethespecificgravityofgivensampleofhydraulic cement.

APPARATUS:

1. Physicalbalance
2. Specificgravitybottle of50mlcapacity
3. Cleankerosene.

INTRODUCTION:

Specificgravityisdefinedastheratiobetweenweightofagivenvolumeofmaterialandweight of an equal volume of water. To determine the specific gravity of cement, kerosene is used which does not react with cement.



PROCEDURE:

1. Cleanand drythespecificgravity bottleandweigh itwiththestopper(W1).
2. Fill the specific gravity bottle with cement sample at least half ofthe bottle and weigh with stopper (W2).
3. Fill the specific gravity bottle containing the cement, with kerosene (free of water) placing the stopper and weigh it (W3).
4. Whiledoingtheabove donotallowanyairbubblestoremaininthespecificgravitybottle.
5. Afterweighingthebottle, thebottleshallbecleanedanddried again.
6. Thenfillitwithfreshkeroseneandweighitwithstopper(W4).
7. Remove the kerosene fromthe bottle and fill it with full of water and weigh it with stopper (W5).
8. Allthe above weighingshouldbe done atthe roomtemperatureof27c + 10c.

OBSERVATIONS:

Descriptionofitem	Trial1	Trial2	Trial3
WeightofemptybottleW1g			
Weightofbottle+CementW2g			
Weight of bottle + Cement + Kerosene W3 g			
Weight ofbottle+FullKeroseneW4g			
Weightofbottle+FullWaterW5g			

SpecificgravityofKeroseneS_k=W4 -W1 / W5-W1.

SpecificgravityofCementS_c=W2-W1 / ((W4 -W1)-(W3-W2))* $S_k S_c$

=(W2-W1)*(W4-W1)/((W4-W1)-(W3-W2))*(W5-W1)

PRECAUTION:

1. Onlykerosenewhich isfreeofwater shall beused.
2. Attimeofweighingthetemperatureoftheapparatuswillnotbeallowedtoexceedthe specified temperature.
3. Allairbubblesshallbeeliminatedinfillingtheapparatusandinsertingthe stopper.
4. Weighingshallbedonequicklyafterfilling theapparatusand shallbeaccurateto0.1mg.
5. Precautionsshallbetakentopreventexpansionandoverflowofthecontentsresultingfrom the heat of the hand when wiping the surface of the apparatus.

RESULT:

Averagespecific gravityofgivensample ofcement=

PRACTICALAPPLICATIONS:

Specificgravityisdefinedastheratiobetweenweightofagivenvolumeofmaterialandweight of an equal volume of water.

INITIALANDFINALSETTINGTIMESOFCEMENT

AIM:

Todeterminetheinitialandfinalsettingtimesforthegivensampleofcement.

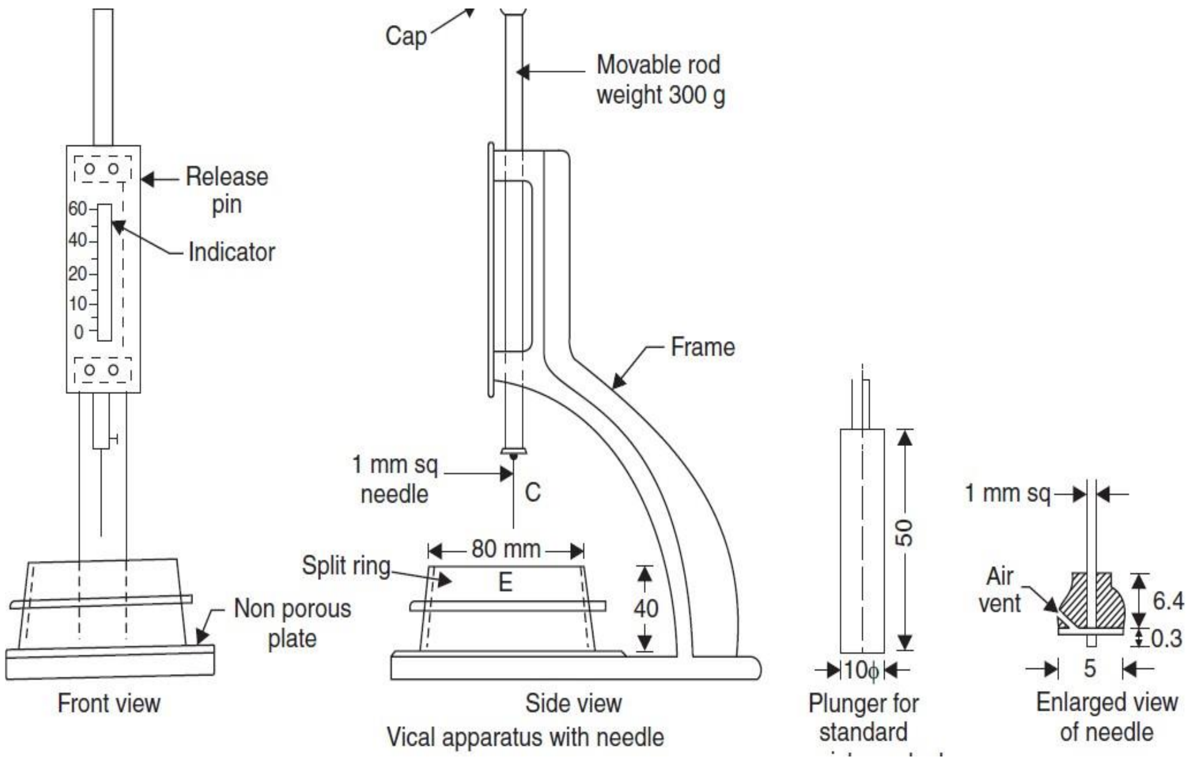
APPARATUS:

1. Vicatapparatus(conforming to IS:5513-1976)withattachments
2. Balance
3. Weights
4. Gaugingtrowel.

INTRODUCTION:

In actual construction dealing with cement, mortar or concrete, certain time is required for mixing,transportingandplacing.Duringthistimecement paste,mortar,orconcreteshouldbe inplasticcondition.Thetimeintervalforwhichthecementproductsremaininplasticcondition is known as the setting time. Initial setting time is regarded as the time elapsed between the momentthatthewaterisaddedtothecementtothetimethatthepastestartslosingitsplasticity.

Thefinalsettingtimeisthetimeelapsedbetweenthemomentthewaterisaddedtothecement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain pressure. The constituents and fineness of cement is maintained in sucha waythat the concrete remains in plastic condition for certain minimumtime. Once the concrete is placed in the final position, compacted and finished it should lose its plasticity in the earliest possible time so that it is least vulnerable to damages from external destructive agencies.Thistimeshouldnotbemorethan10hourswhichisreferredtoasfinalsettingtime. Initial setting time should not be less than 30 minutes.



Vical apparatus with needle

PROCEDURE:

PreparationofTestBlock:

1. Prepareaneatcementpaste by gauging300gramsof cementwith 0.85timesthewater required to give a paste of standard consistency (0.85P).
2. Potableordistilledwatershallbeusedinpreparingthe paste.
3. Thepasteshallbegaugedinthemannerandundertheconditionsprescribedin determination of consistency of standard cement paste.
4. Startastop-watchattheinstantwhenwaterisadded tothe cement.
5. Fill themould with thecementpaste gauged as above themould resting on a nonporous plate.

Fillthe mould completelyand smoothoffthe surface ofthe pastemaking it levelwiththe top of the mould. The cement block thus prepared in the mould is the test block.

DETERMINATIONOFINITIALSETTINGTIME:

1. Placethetestblocksconfinedinthemouldandrestitonthenon-porousplate,undertherod bearing initialsetting needle, lowerthe needle gentlyincontact withthe surface ofthe test block and quickly release, allowing it to penetrate into the test block.
2. Inthebeginning,theneedlewillcompletelypiercethetestblock.
3. Repeat this procedure until the needle, when brought in contact with the test block and released as described above, fails to pierce the block to a point 5 to 7 mm measured from the bottom of the mould shall be the initial setting time.

DETERMINATIONOFFINALSETTING TIME:

1. Replacetheneedle ofthe Vicatapparatusbythe needlewithanannularattachment.
2. The cement shall be considered as finallyset when, uponapplying the needle gentlyto the surfaceofthetestblock,theneedlemakesanimpressionthereon,whiletheattachmentfails to do so.
3. The period elapsed between the time when water is added to the cement and the time at whichtheneedlemakesanimpressiononthesurfaceoftestblockwhiletheattachmentfails to do so shall be the final setting time.

PRECAUTIONS:

Cleanappliancesshallbeusedforgauging.Alltheapparatusshallbefreefromvibrationduring thetest.Thetemperatureofwaterandthatofthetestroom,atthetimeofgaugingshallbe27^{0}C +20^{0}C.Careshallbetakento keeptheneedlestraight.

OBSERVATIONS:

Timeinminutes	
Heightinmmfailsto penetrate	

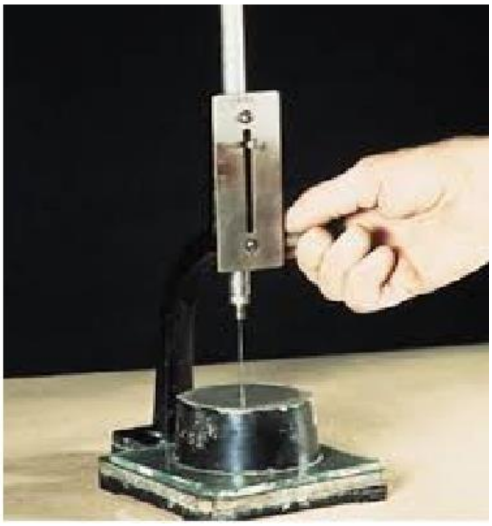
RESULT:

Initialsettingtime forthegivensampleofcement = Final

setting time for the given sample ofcement =

PRACTICALAPPLICATIONS:

In actual construction dealing with cement, mortar or concrete, certain time is required for mixing,transportingandplacing.Duringthistimecementpaste,mortar,orconcreteshouldbe inplasticcondition.Thetimeintervalforwhichthecementproductsremaininplasticcondition is known as the setting time.



VIVA QUESTIONS:

1. Differentiatebetweendensityandspecificgravityofamaterial.
2. Statetheimportance ofthis test.
3. Nameother methodsthatcanbeusedforfindingthespecificgravityofcement
4. Whatistheeffectonthespecificgravityvalueiftheairbubblesarenotremovedcompletely
5. Whatdoyouunderstandbyinitialandfinalsettingtimesofacementsample?
6. Whatprecautionsdoyouobserveinperformingtheabovetests?
7. What are is specifications for setting times of various types ofcements recommended for use on a construction site?
8. Whatistheamountofwatertobeaddedforinitialsettingtime?
9. Whatisdifference betweensettingandhardening?
10. Differentiatebetweendensityandspecificgravityofamaterial.

TESTSONFINE AGGREGATE

EXPERIMENT1

SPECIFICGRAVITYTEST

AIM:

Todeterminethespecificgravityfor thegivensampleof fine aggregate.

APPARATUS

1. Abalanceofcapacitynot lessthan3kg, readableand accurateto 0.5 gmand ofsucha type as to permit the weighing of the vessel containing the aggregate and water .
2. Awell-ventilatedoventomaintain atemperatureof100ºCto110ºC
3. Pycnometerofabout 1litrecapacityhavinga metalconicalscrewtopwitha6mmhole at its apex. The screw top shall be watertight.
4. Ameanssupplyingacurrentwarmair.
5. Atrayofareanotless than32cm².
6. Anairtightcontainerlargeenoughtotakethesample.
7. Filterpapersandfunnel.

PROCEDURE

1. Takeabout500gofsampleandplaceitinthe pycnometer.
2. Pourdistilledwaterintoit untilitisfull.
3. Eliminatetheentrappedairbyrotatingthepycnometeronitsside, thehole intheapex of the cone being covered with a finger.
4. Wipeouttheoutersurfaceofpycnometerandweighit**(W)**
5. Transferthecontentsofthepycnometer into atray,carebeingtakentoensurethat all the aggregate is transferred.
6. Refillthepycnometerwithdistilledwatertothesamelevel.
7. Findouttheweight**(W1)**
8. Drainwaterfromthesamplethroughafilterpaper.

9. Placethesample inoveninatrayat atemperatureof100ºCto 110º Cfor24±0.5 hours, during which period, it is stirred occasionally to facilitate drying.
10. Coolthesampleandweighit **(W2)**

CALCULATIONS

Apparentspecificgravity=(Weightofdrysample/Weightofequalvolumeofwater)

=W2/(W2-(W-W2))

VIVA QUESTIONS:

1. Whatistheapplicationofspecificgravitytestinmix design?
2. DefineSpecificgravity
3. Whatistheuseof findingspecificgravity
4. Whatarethefactorsaffectingspecificgravitytest
5. Thespecificgravityofaggregatesnormallyusedinroadconstructionrangesfromabout ____________withanaveragevalueofabout2.68.
6. Specificgravityofaggregatesisconsideredasanindicationof_________________.
7. TheinstrumentusedforSpecificGravitytestfor<6.3mmaggregate
8. Waterabsorptionofaggregateisameasureof___________________
9. ThissetofBasicChemicalEngineeringMultipleChoiceQuestions&Answers(MCQs)focuses on “Specific Gravity”.
10. Whatisthespecificgravityof a substance with density100 kg/m3withrespect to reference substance of density 100 lb/m3 ?

EXPERIMENT2

BULKINGOFSAND

AIM:

Toascertainthebulking phenomenaofgivensampleofsand.

APPARATUS:

1000mlmeasuring jar,brush.

INTRODUCTION:

Increase in volume ofsand due to presence of moisture is knownas bulking ofsand. Bulking is due tothe formationofthin film ofwater aroundthe sand grains and the interlocking ofair inbetweenthesandgrainsandthefilmofwater.Whenmorewaterisaddedsand,particlesget submergedandvolumeagainbecomesequaltodryvolumeofsand.Tocompensatethebulking effect extra sand is added in the concrete so that the ratio of coarse to fine aggregate will not change from the specified value. Maximum increase in volume may be 20 % to 40 % when moisturecontentis5%to10%byweight.Finesandsshowgreaterpercentageofbulkingthan coarse sands with equal percentage of moisture.

PROCEDURE:

1. Take1000mlmeasuringjar.
2. Fillitwith loosedrysand up to500mlwithouttamping atanystageoffilling.
3. Thenpourthatsandonapanandmixitthoroughlywithwaterwhosevolumeisequalto2% of that of dry loose sand.
4. Fillthewet loosesandinthecontainerandfindthevolumeofthesandwhichisinexcessof the dry volume of the sand.
5. Repeattheprocedureformoisturecontentof4%,6%,8%,etc.and notedownthe readings.
6. Continue the proceduretillthe sand getscompletelysaturated i.e.tillit reachestheoriginal volume of 500ml.

OBSERVATIONS:

S.No	Volumeofdry loosesandV1	% moisture contentadded	Volumeofwet loosesandV2	%BulkingV2 – V1 / V1
1		2%		
2		4%		
3		6%		
4		8%		
5				
6				

GRAPH:

Draw a graph between percentage moisture content on X-axis and percentage bulking on Y-axis. The points on the graph should be added as a smooth curve. Then from the graph, determine maximum percentage of bulking and the corresponding moisture content.

PRECAUTIONS:

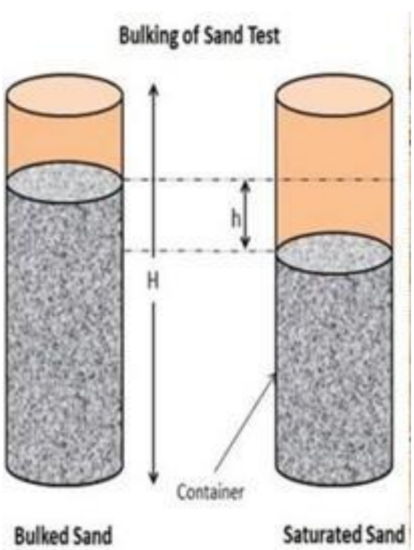
1. Whilemixingwaterwithsandgrains,mixingshouldbethoroughand uniform.
2. Thesampleshouldnot becompressedwhilebeingfilled in jar.
3. Thesamplemustbeslowlyandgraduallypouredintomeasuring jarfromitstop.
4. Increaseinvolumeofsandduetobulkingshouldbemeasuredaccurately.

RESULT:

Themaximumbulking ofthe givensandis ____________at __________%ofmoisture content.

PRACTICALAPPLICATIONS:

Increaseinvolumeofsand duetopresenceofmoistureisknownasbulkingofsand.



FINENESSMODULUSOFFINEAGGREGATE

AIM:

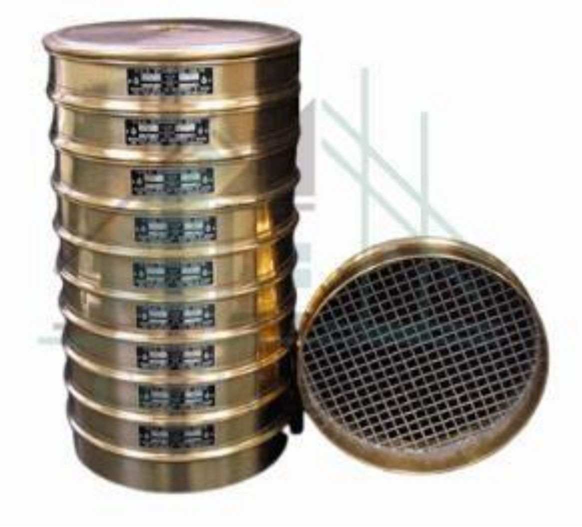
Theobjectofthisexperimentistodeterminethefinenessmodulus forthegivensampleoffine aggregate supplied.

APPARATUS

- IStestsieve10 mm,4.75mm,2.63mm,1.18mm,600Micron,300Micron,150Micron.
- Sieveshaker.
- WeighingMachine.

PROCEDURE

1. Takearepresentativeoven-driedsamplethatweighsapproximately500g.
2. Ifparticlesare lumpedorconglomerated,crushthe lumpsbut nottheparticlesusingthe pestle and mortar.
3. Determinethemassofthesampleaccurately–Weight(g).
4. Pourthesampleintothetopsieveinthenest.
5. Weighallthe sieves andthe panseparately.
6. Pourthesamples fromstep3intothetopofthestackofsievesandputthelidon, place the stack in the sieve shaker and fix the clamps, adjust thetimer to between 10 and 15 minutes, and switch on the shaker.
7. Stopthesieveshaker andmeasurethemassofeachsieveandretainedsoil/material
8. Determine the mass of the material retained on each sieve size. Record the cumulative mass retained for eachsieve size (the mass retained ona specific sieve size and the mass retained on all sieves with larger openings).
9. Select applicable sieves to obtainthe information required bythe specifications covering the materialto be tested. Sieve sizes typicallyused for Super pave mix design are 1½ in, 1.0inch,¾inch, ½inch,3/8-inch,No.4, No.8,No.16,No. 30,No.50,No.100andNo. 200(37.5,25.0,19.0,12.5,9.5,4.75,2.36,1.18,0.600,0.300,0.150and0.075mm)sieves. Assemble the sieves in order of decreasing size ofopening fromtop to bottomand place the nest of sieves over a pan.



NOTE:

Thefinenessmodulusoffineaggregatevaries from2.0to3.5mm.

TypeofSand	**FinenessModulusRange**
Fine sand	2.2 mm – 2.6mm
Medium sand	2.6 mm– 2.9 mm
Coarse sand	2.9 mm – 3.2 mm

RESULT:

- Fineness Modulus = ______________
- The givensand falls inthe grading zone___________________

CONCLUSION
Comment ontestresultsobtained byyou inthe laboratory.Give yourcommentsonthe suitability of using the sand sample for the construction site.

CALCULATIONS:

GRADATIONEXAMPLE1:

Sample:5/8”gravel, Initialweight: 9920g .

Sieve designation	Sieve weight empty(g)	Sieve weight full(g)	Aggregate weight retained(g)	Cumulative weight retained(g)	Cumulative percent retained(g)	Cumulative percent passing(%)
4.75mm			0	0		
2.36mm			100	10		
1.18mm			250	35		
0.6mm			350	70		
0.3mm			200	90		
0.15mm			100	100		
TOTAL			275			

Therefore, fineness modulusofaggregate=(cumulative% retained)/100=(275/100)= **2.75**

PRACTICAL APPALICATIONS:

Inagradationandsizeanalysis, asampleofdryaggregateofknownweight isseparated through a series of sieves with progressively smaller openings.



VIVA:

1. Inhowmanywayscansieveanalysiscanbecarried out?
2. Howisthepercentageretained oneachsieveis calculated?
3. Whatisareceiverinasieveanalyser?

4. Theaggregatesampleforthesieveanalysis isplacedon?
5. The sievetestsofcoarseaggregaterages from?
6. Whichisthelimitationofperforming thesieveanalysis?
7. Whatarethe typesofgradation?
8. Whatistheothernamefornarrowgradation?
9. Whatistimeofmechanicalvibratortobe shaked?
10. Forfineaggregatesthatis,samplepassingthrough4.75mmISsieve,howmuchsample should be taken?

TESTSONCOARSEAGGREGATE

EXPERIMENT1

SPECIFICGRAVITYTEST

AIM

To measure the strength or quality of the material and to determine the water absorption of aggregates.

APPARATUS

1. A balance of capacity about3kg, toweigh accurate 0.5g, and of such a type andshape as to permit weighing of the sample container when suspended in water.
2. Athermostaticallycontrolledoventomaintaintemperatureat100-110°C.
3. Awire **basketofnot** morethan6.3mmmeshoraperforatedcontainerof convenient size with thin wire hangers for suspending it from the balance.
4. Acontainerforfillingwaterandsuspendingthebasket
5. Anairtightcontainerofcapacitysimilartothat ofthe basket.
6. Ashallowtrayandtwoabsorbentclothes,eachnotlessthan75x45cm.

ProcedureofWaterAbsorption andSpecificGravity Test on Aggregates

Therearethree methodsoftesting forthedeterminationofthespecificgravityofaggregates, according to the size of the aggregates larger than 10 mm, 40 mm and smaller than 10 mm. ForSampleslargerthan10mm,40mm,thebelowgiventestmethodisusedandforsamples smaller than 10 mm Pycnometer test is done.

PROCEDURE

1. About 2 kgofaggregate sample is washed thoroughly to remove fines, drained and placed inwire basket and immersed indistilledwaterat atemperaturebetween22- 32° C and a cover of at least 5cm of water above the top of basket.
2. Immediatelyafterimmersiontheentrappedairisremovedfromthesamplebylifting thebasket containing it 25mmabovethebaseofthetankandallowing ittodropat the rate of about one drop per second. The basket and aggregate should remain completely immersed in water for a period of 24 hour afterwards.
3. The basket and the sample are weighed while suspended in water at a temperature of 22° – 32°C. The weight while suspended in water is noted **= W_1g.**
4. The basket and aggregates are removed from water and allowed to drain for a few minutes,afterwhichtheaggregatesaretransferredtothedryabsorbentclothes.The empty basket is then returned to the tank of water jolted 25 times and weighed in water= **W_2 g.**
5. The aggregates placed on the absorbent clothes are surface dried till no further moisturecouldberemovedbythis cloth. Thentheaggregatesaretransferredtothe second dry cloth spread in single layer and allowed to dry for at least 10 minutes untiltheaggregatesarecompletelysurfacedry.Thesurfacedriedaggregateisthen weighed = **W_3 g**
6. The aggregate is placed in a shallow tray and kept in an oven maintained at a temperatureof110°Cfor24hrs. Itisthenremovedfromtheoven, cooled inanair tight container and weighted=**W_4g**.

OBSERVATIONS

S.No	Details	Trail1	Trail2
1	Weight of saturated aggregate suspendedinwaterwithbasket =**W_1g**		
2	Weight ofbasketsuspended in water=**W_2g**		
3	Weightofsaturatedsurfacedry aggregateinair=**W_3**g		
4	Weightofovendryaggregate = **W_4 g**		

5	Weightofsaturatedaggregatein water=**W_1–W_2g**		
6	Weightofwaterequaltothevolume oftheaggregate=**W_3–(W_1–W_2)g**		

FORMULAS

1. Specific gravity=**W_3**/(**W_3**–(**W_1**–**W_2**))
2. Apparentspecificgravity=**W_4**/ (**W_4**–(**W_{11}**–**W_2**))
3. WaterAbsorption= ((**W_3** –**W_4**)/**W_4**)**X100****

Thesizeoftheaggregateandwhetherithasbeenartificiallyheatedshouldbe indicated. ******Though high specific gravity is considered as an indication of high strength, it is not possible to judge the suitabilityofa sample aggregate without finding the mechanical properties such as aggregate crushing, impact and abrasion values.

RESULT:

1. Specificgravity=
2. Apparent specificgravity=
3. WaterAbsorption=

RecommendedValuesofSpecificGravityandWaterAbsorption forAggregates

The specific gravityof aggregates normallyused in road construction ranges fromabout **2.5 to 3.0 with an average of about 2.68.** Water absorption shall not be morethan **0.6 perunit by weight.**

VIVA QUESTIONS

1. Whatisporosity?
2. Whatispermeability?
3. Whatisbulkdensity?
4. Whatisthe differencebetweenthedensityandbulkdensity?
5. Whatisspecific gravity?
6. Whatisvoidratio?
7. Inwhichvoidratiodepends?
8. Whatisthespecific gravityofcoarseaggregate?
9. Whatisthe bulkdensityofcoarseaggregate(10mmand20mm)?

EXPERIMENT2

FINENESSMODULUSOFCOARSEAGGREGATE

AIM:

The object of this experimentis todetermine thefinenessmodulusfor the given sample of coarse aggregate supplied.

APPARATUS

- IStestsieve10 mm,4.75mm,2.63mm,1.18mm,600Micron,300Micron,150Micron.
- Sieveshaker.
- WeighingMachine.

PROCEDURE

1. Takearepresentativeoven-driedsamplethatweighsapproximately500g.
2. Ifparticlesare lumpedorconglomerated,crushthe lumpsbut nottheparticlesusingthe pestle and mortar.
3. Determinethemassofthesampleaccurately–Weight(g).
4. Pourthesampleintothetopsieveinthenest.
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7. Stopthesieveshaker andmeasurethemassofeachsieveandretainedsoil/material
8. Determine the mass of the material retained on each sieve size. Record the cumulative mass retained for eachsieve size (the mass retained ona specific sieve size and the mass retained on all sieves with larger openings).
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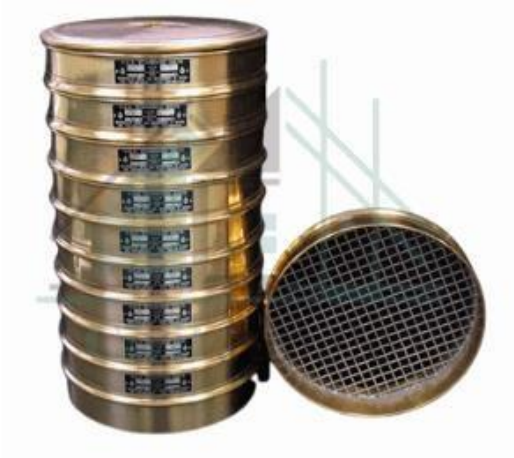

NOTE:

Maximumsizeofcoarseaggregate	**Finenessmodulusrange**
20mm	6.0–6.9
40mm	6.9–7.5
75mm	7.5–8.0
150mm	8.0–8.5

RESULT:

- Fineness Modulus = ______________
- The givensand falls inthe grading zone___________________

CONCLUSION

Comment ontestresultsobtained byyou inthe laboratory.Give yourcommentsonthe suitability of using the sand sample for the construction site.

CALCULATIONS:

GRADATIONEXAMPLE1:

Sample:5/8"gravel_______, Initialweight:____9920g_____.

Sieve designation (mm)	**Sieve weight empty(g)**	**Sieve weight full(g)**	**Aggregate weight retained(g)**	**Cumulative weight retained(g)**	**Cumulative percent retained(g)**	**Cumulative percent passing(%)**
80			0	0	0	
40			250	250	5	
20			1750	2000	42	
10			1600	3600	70	
4.75			1400	5000	100	
2.36			0	5000	100	
1.18			0	5000	100	
0.6			0	5000	100	
0.3			0	5000	100	
0.15			0	5000	100	
TOTAL			717			

Therefore, **finenessmodulusofcoarseaggregates**=sum(cumulative% retained) /100
=(717/100)=**7.17**

PRACTICALAPPALICATIONS:

Inagradationandsizeanalysis, asampleofdryaggregateofknownweight isseparated through a series of sieves with progressively smaller openings.

  

VIVA QUESTIONS:

1. Gradationaffectsthepropertiesofanaggregate.(Trueorfalse).
2. Coarseaggregatecanbeclassifiedintohowmanygroups?
3. How much percent of material which passes through a specific sieve is contained inthat single-size aggregate?
4. Graded aggregatecontains particles ofsize __________________.
5. Flakyparticles have ______________________.
6. Whichsizecoarseaggregateisidealforuseinconcretemix?
7. Elongationindexofcoarseaggregatesiscalculatedusing____________________________.
8. Incrushingtestoncoarseaggregates,whatsizeparticleistakenassample?
9. Whatisthedensityofundisturbed gravel?
10. Whatisthesymbolusedforwellgraded gravelasperISCsystemofclassification?