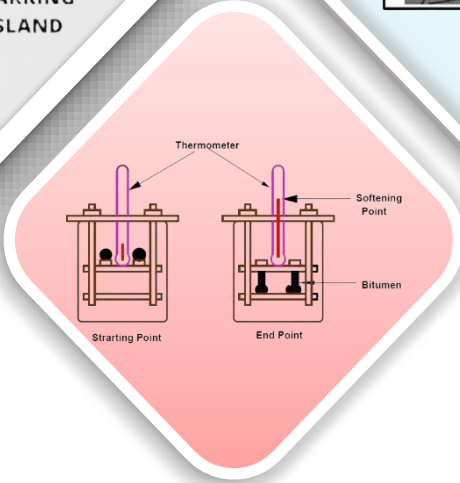
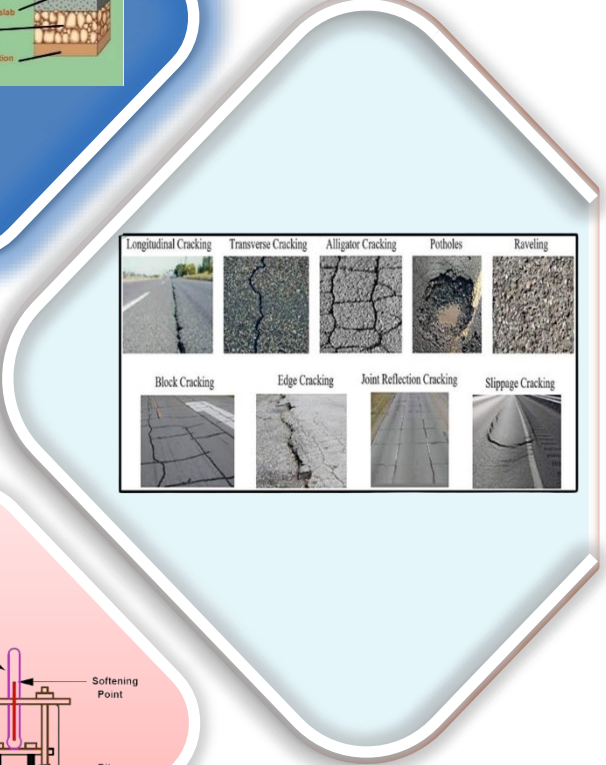
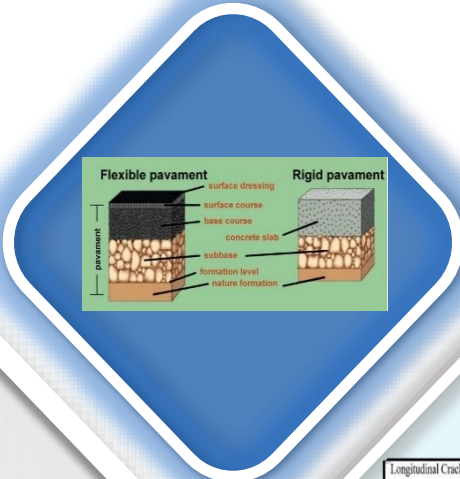


SCHEME : K

Name : _____
Roll No. : _____ Year : 20__ 20__
Exam Seat No. : _____

LABORATORY MANUAL FOR HIGHWAY ENGINEERING (313323)



CIVIL ENGINEERING GROUP



**MAHARASHTRA STATE BOARD OF
TECHNICAL EDUCATION, MUMBAI
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)**

VISION:

To ensure that the Diploma Level Technical Education constantly matches the latest requirements of Technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION:

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the challenging technological & environmental challenges.

QUALITY POLICY:

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES:**MSBTE believes in the following:**

- Skill development in line with industry requirements
- Industry readiness and improved employability of Diploma holders
- Synergistic relationship with industry
- Collective and Cooperative development of all stake holders
- Technological interventions in societal development
- Access to uniform quality technical education.

A Laboratory Manual

For

Highway Engineering

(313323)

SEMESER-III

“K-SCHEME”

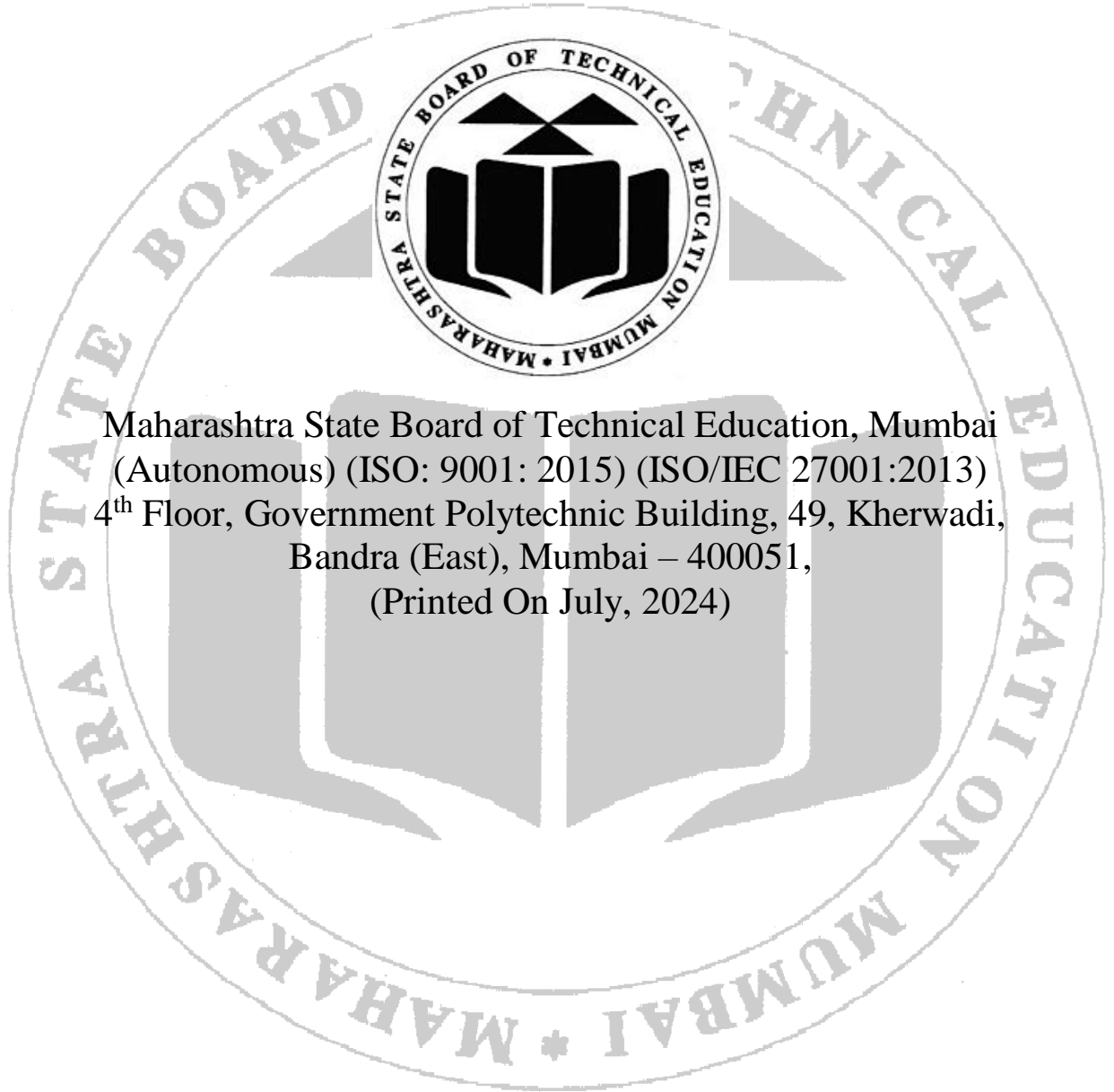
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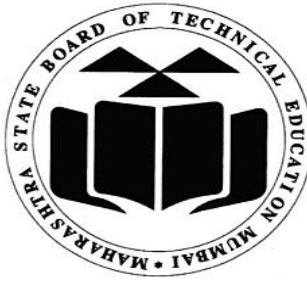
Maharashtra State

Board of Technical Education, Mumbai.

(Autonomous) (ISO: 9001: 2015) (ISO/IEC 27001:2013)



Maharashtra State Board of Technical Education, Mumbai
(Autonomous) (ISO: 9001: 2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai – 400051,
(Printed On July, 2024)



**Maharashtra State
Board of Technical Education, Mumbai.**

Certificate

This is to certify that Mr. / Ms.

Roll No.....of Third semester of Diploma in
.....of
Institute.....

..... (Code.....) has completed the term
work satisfactorily in course **Highway Engineering (313323)** for the academic
year 20..... to 20..... as prescribed in the curriculum.

Place:

Enrollment No:

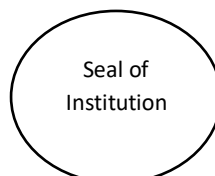
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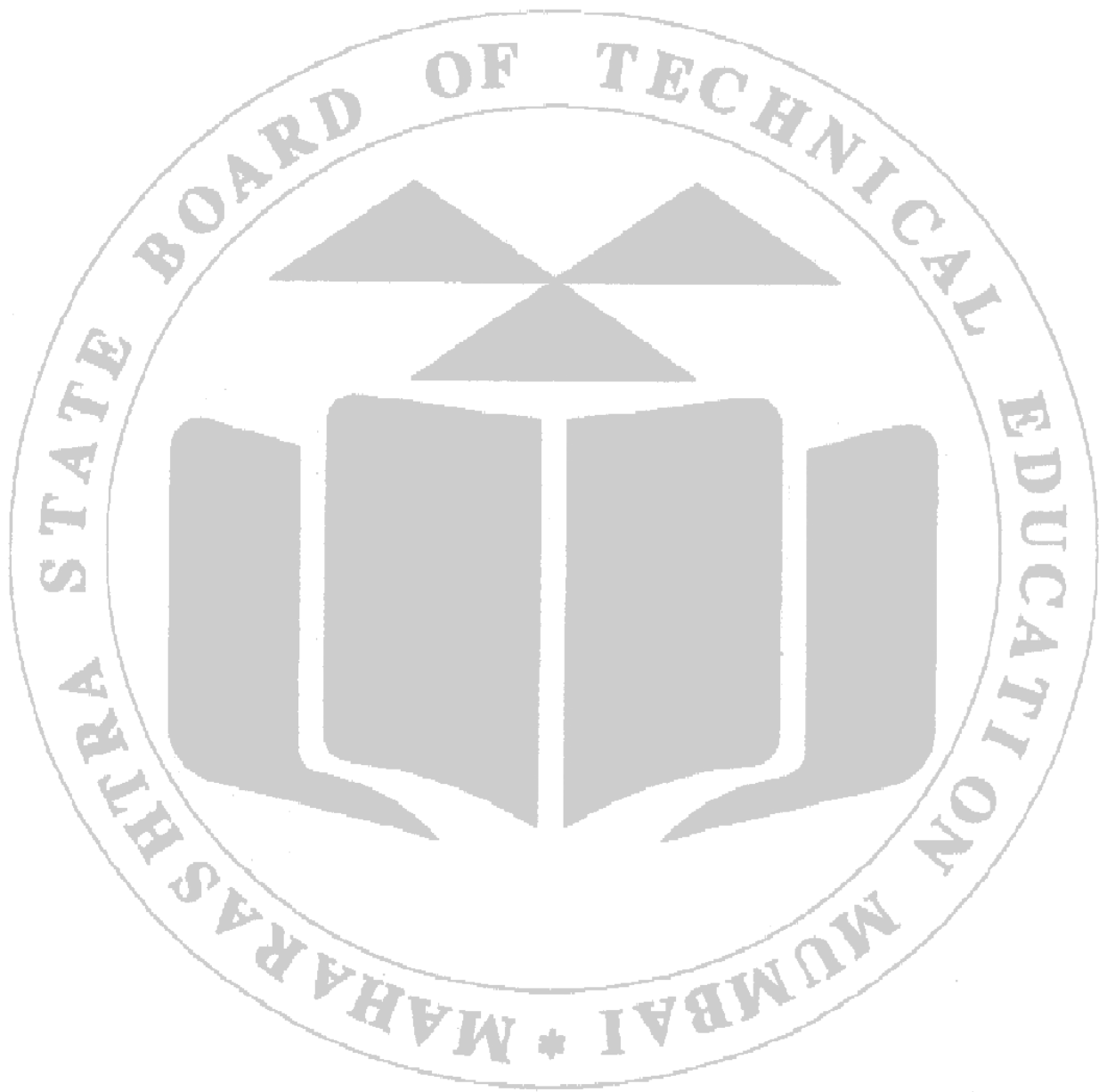
Exam. Seat No:

Subject teacher

Head of the Department

Principal





PREFACE

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curriculum for engineering diploma programs outcome- based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making catch teacher, instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the "K" scheme laboratory manual development team designed the practical's to focus on the outcomes, rather than the traditional age old practice of conducting practical's to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student- centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

Road Transportation is the most effective and economical means of transportation in our country. The need for travel to various places at faster speed has also increased. In order to professionally contribute to the field of highway engineering, the associated engineers and supervisors must have adequate knowledge and skills relating to technical aspects of continuously increasing volume of traffic flow, design of highway intersections/interchanges, geometric alignment and design, materials, structural design of pavement, new developments in road construction and use of modern and waste materials, techniques, design and maintenance of pavements. Agencies like NHAI and State Government and private organization are intensely involved in improving and building road networks in India. Diploma Engineering students have good scope in jobs related to road construction as well as such infrastructural associated different projects works. This course provides scope of learning about various aspects of roads, carrying out survey, investigation, planning, design, construction and maintenance works related to road constructions.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome

Program outcome (POs)

PO 1. Basic & Discipline specific knowledge: Apply knowledge of basic mathematics, sciences and engineering fundamentals and engineering specialization to solve the engineering problems.

PO 2. Problem Analysis: Identify and analyze well defined engineering problems using codified standard methods.

PO 3. Design /Development Solutions: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

PO 4. Engineering tools experimentation and testing: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO 5. Engineering practices for society sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO 6. Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

PO 7. Lifelong learning: Ability to analyze individual needs and engage in updating in context of technological changes.



List of Relevant Skills

The following industry relevant skills of the competency 'Undertake construction and maintenance of pavements (Roads).' are expected to be developed in you by undertaking the practical of this laboratory manual.

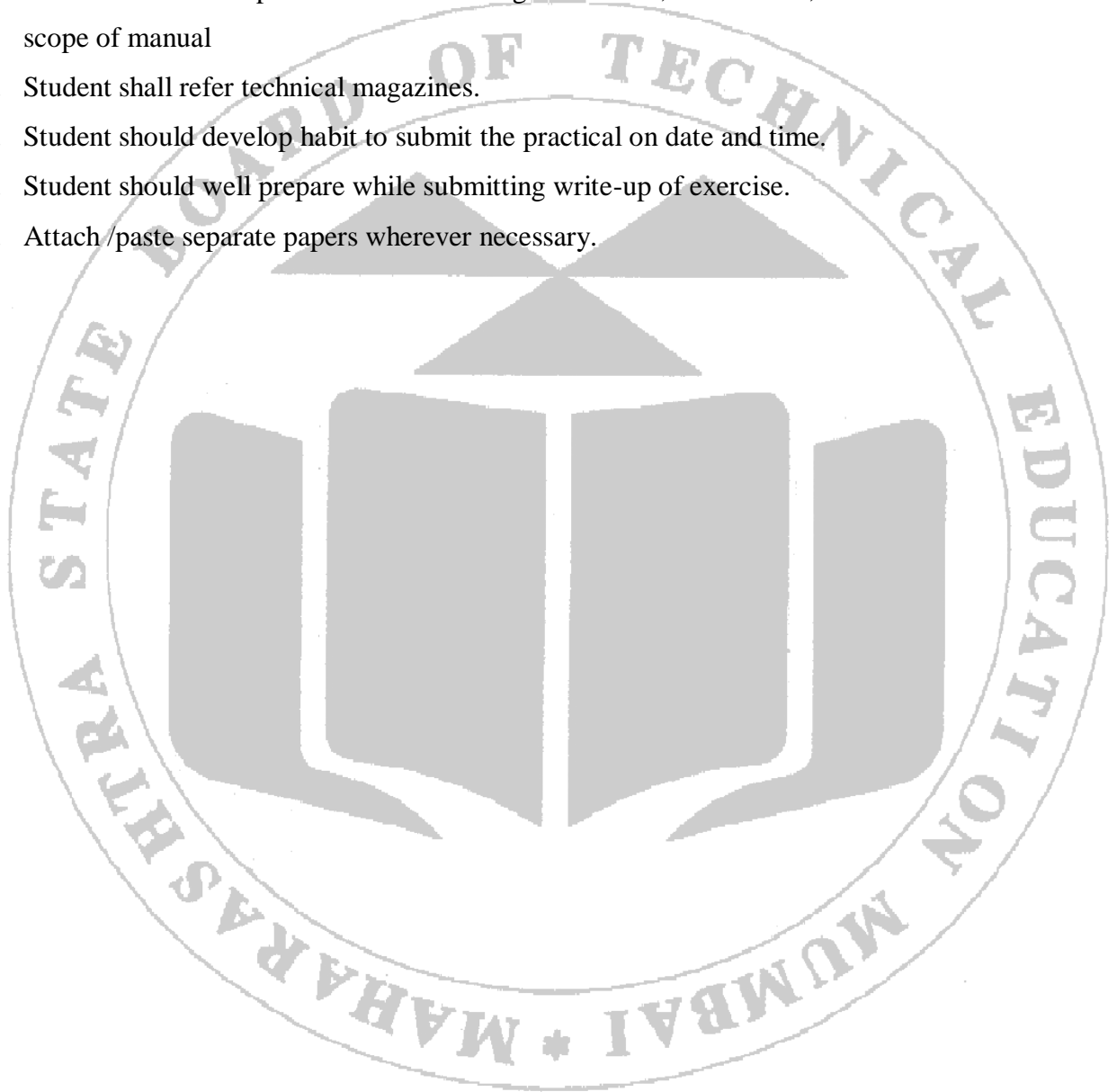
1. Identify the components of roads as per geometric design.
2. Perform the test as per procedure
3. Implement the geometric design of roads
4. Interpret the results of test performed.
5. Analyze the traffic volume count.
6. Undertake the maintenance required for various roads.

Guidelines to teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each practical.
3. Involve students in performance of each practical.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions to Students

1. Organize the work in the group and make record all programs.
2. Students shall develop maintenance skill as expected by industries.
3. Student shall attempt to develop related hand-on skills and gain confidence.
4. Student shall develop the habits of evolving more ideas, innovations, skills etc. those included in scope of manual
5. Student shall refer technical magazines.
6. Student should develop habit to submit the practical on date and time.
7. Student should well prepare while submitting write-up of exercise.
8. Attach /paste separate papers wherever necessary.



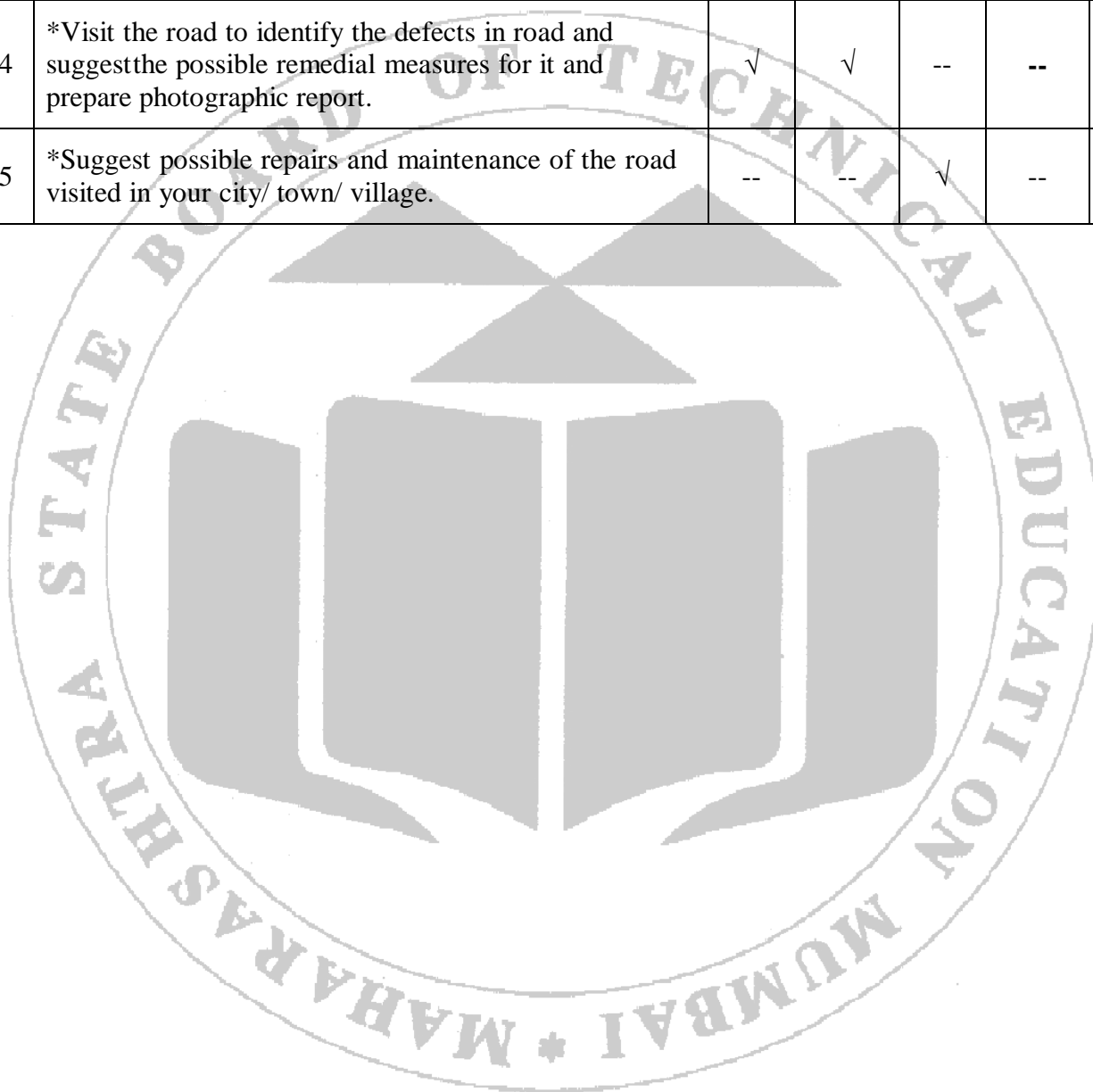
Practical Course Outcome matrix

Course Outcomes (Cos)

- CO1 - Identify the roads based on recommendations of IRC.
- CO2 - Implement geometrical features of different Highways.
- CO3 - Observe the various road construction activities.
- CO4 - Suggest the traffic control devices and intersections based on traffic flow survey data.
- CO5 – Suggest the relevant precautionary measures to control the drainage based on inspection to maintain the given section of roads.

Sr. No	Title of the Practical	Mapped Course Outcome				
		CO 01	CO 02	CO 03	CO 04	CO 05
01	*Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, VR in embankment and cutting on A3 size sketch book.	√	√	--	--	--
02	*Visit the existing road to identify the component parts of road and prepare photographic report.	√	√	--	--	--
03	*Conduct Softening point test on bitumen.	--	--	√	--	--
04	*Conduct Penetration test on bitumen.	--	--	√	--	--
05	Conduct Flash and Fire Point test on bitumen.	--	--	√	--	--
06	Conduct Ductility test on Bitumen.	--	--	√	--	--
07	*Conduct Bitumen Extraction Test.	--	--	√	--	--
08	*Visit the road under construction to identify layers in the flexible pavement/Rigid Pavement. prepare photographic report consisting of Materials,	√	√	√	--	--
09	Visit the hill road to study its components, geometrics and prepare the photographic report containing details.	√	√	√	--	--
10	*Carry out Traffic Volume Study (minimum two hours of peak period) for an important road intersection or roadway in your city/ town/ village.	--	--	--	√	--
11	Analysis traffic volume data obtained from above experiment.	--	--	--	√	--

12	*Draw and identify the traffic signs, road markings, islands, intersections in your city/ town/ village and prepare the photographic report.	--	--	--	√	--
13	Visit the road of any one type flexible or rigid to know the road drainage system.	√	√	--	--	√
14	*Visit the road to identify the defects in road and suggest the possible remedial measures for it and prepare photographic report.	√	√	--	--	√
15	*Suggest possible repairs and maintenance of the road visited in your city/ town/ village.	--	--	√	--	√



CONTENT PAGE**List of Practical's and Formative Assessment sheet.**

Pr. No	Title of the Practical	Page No.	Date of performance	Date of Submission	Assessment marks	Dated sign of teacher	Remarks (if any)
01	*Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, VR in embankment and cutting on A3 size sketch book.	01					
02	*Visit the existing road to identify the component parts of road and prepare photographic report.	05					
03	*Conduct Softening point test on bitumen.	10					
04	*Conduct Penetration test on bitumen.	16					
05	Conduct Flash and Fire Point test on bitumen.	22					
06	Conduct Ductility test on Bitumen.	27					
07	*Conduct Bitumen Extraction Test.	33					
08	Visit the road under construction to identify layers in the flexible pavement/Rigid Pavement.	38					
09	Visit the hill road to study its components, geometrics and prepare the photographic report containing details.	44					
10	*Carry out Traffic Volume Study (minimum two hours of peak period) for an important road intersection or roadway in your city/ town/ village.	52					
11	Analysis traffic volume data obtained from above experiment.	59					
12	*Draw and identify the traffic signs, road markings, islands, intersections in your city/ town/ village and prepare the photographic report.	66					

13	Visit the road of any one type flexible or rigid to know the road drainage system.	74					
14	*Visit the road to identify the defects in road and suggest the possible remedial measures for it and prepare photographic report.	84					
15	*Suggest possible repairs and maintenance of the road visited in your city/ town/ village.	92					
Total marks :							
<p>These marks are to be transferred in pro-forma published by MSBTE.</p> <ul style="list-style-type: none"> • '*' Marked Practical (LLOs) are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs are to be performed to achieve desired outcomes. 							

Practical No: 01 *Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, VR in embankment and cutting on A3 size sketch book.

I. Practical Significance:

This exercise is prior important for understanding the basic components of typical pavement. The details of cross sections of various types of roads like National Highway (NH), State Highway (SH), Major District Road (MDR) and Other District Road (ODR) are required to sketch, so that one can easily identify the type of road, components and geometric elements of road.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Draw the details of cross sections of NH, SH, MDR and ODR.
- Identify the components and its dimensions of above mentioned roads.

III. Course Level Learning Outcome (COs):

- CO 1- Identify the roads based on recommendations of IRC.
- CO 2- Implement geometrical features of different Highways.

IV. Laboratory Learning Outcome (LLO):

- LLO 1.1 - Draw the sketches showing standard cross sections of NH, SH, MDR, ODR, and VR.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices
- Practice good housekeeping
- Demonstrate working as a leader/a team member.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

It is the graphical representation of the cross section of road indicating the width and thickness of pavement, width of shoulders, road side drains with width of land required and road side arboriculture. The dimensions of various geometrical features for NH, SH, MDR and ODR are different as per IRC recommendations. The typical cross section of road pavement is as shown below.

VII. Actual Diagram with equipment specification

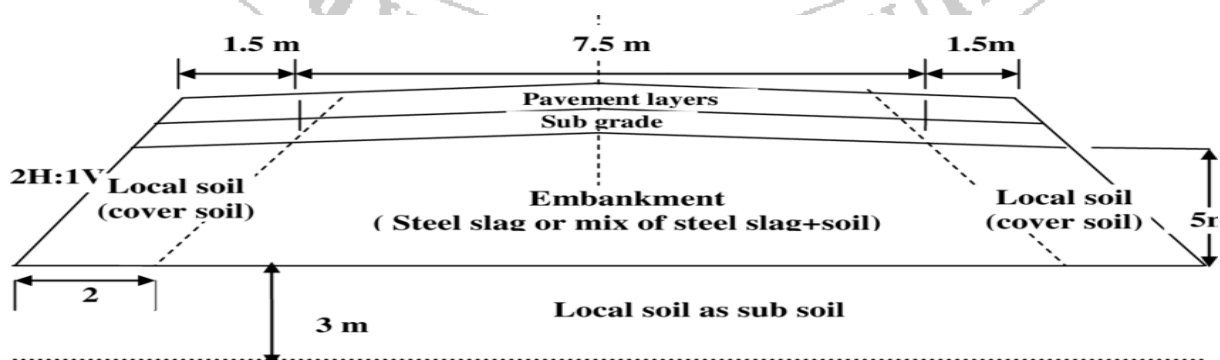


Figure 1.1: Typical cross section of Road

VIII. Required resources:

Sr. No.	Resource required	Particulars	Quantity
01	Drawing sheet	A3 size sketch plate	3-4 nos.
02	Metallic or PVC tape		
03	Typical drawing of various types of road		

IX. Precautions to be followed:

1. The sketches should be drawn in appropriate proportion so as to accommodate the figures on the drawing sheet.
2. The detailed information should be written on sheet comprising title of sheet, details of students etc.

X. Procedure:

1. Take the A3 size drawing sheet and necessary drawing accessories.
2. Study the typical cross sections of various roads.
3. Mark the centerline of the road in the mid portion of the particular sheet.
4. Draw the carriage way and shoulder on either side of the center line i.e. alignment of road proportionally.
5. Similarly draw other geometric features like side slope, berm, road side trees, spoil bank, side drain etc. as per typical drawings available.
6. Mark the dimensions and label all the maximum possible components of road in the drawing.
7. Enclose this drawing in the separate file along with this manual.

XI. Observation Table:

Sr. No.	Types of Road	Uses
1		
2		
3		
4		
5		

XII. Result:

XVI. References/ suggestions for further Reading

Sr. No.	Link	Description
1	https://rb.gy/64v69i	-
2	https://rb.gy/prusfz	Cross Sectional elements of roads

XVII. Suggested Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Neatness and proportionate drawings	25%
2.	Details marked in the drawing	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 02 *Visit the existing road to identify the component parts of road and prepare photographic report.

I. Practical Significance:

Identify components and preparing photographic reports enhances documentation, inspection, maintenance planning, design, safety, communication, cost management, and environmental sustainability. This comprehensive approach ensures that road infrastructure is well-maintained, safe, and efficient for all users.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- A student should be able to identify the Components of road.
- Enhances knowledge of urban transportation system

III. Course Level Learning Outcome (COs):

- CO 1- Identify the roads based on recommendations of IRC.
- CO 2- Implement geometrical features of different Highways.

IV. Laboratory Learning Outcome (LLO):

- LLO 2.1 Identify components of Road.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Maintain Practice good housekeeping
- Demonstrate working as a leader/a team member.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

Road Design and Components:

Pavement Structure: Understanding the layers of pavement (subgrade, sub-base, base course, and surface course) and their functions.

Geometric Design: Knowledge of the geometric elements such as alignment (horizontal and vertical), cross-section (lanes, shoulders, medians), and sight distance.

Main Components-

- a) Sub Grade-The subgrade supports the layers above it, including the sub-base, base, and surface layers. It must bear the traffic load and distribute it evenly to prevent deformation and failure of the road structure.
- b) Sub Base-The sub base helps to distribute traffic loads from the pavement layers above to the subgrade below, reducing stress and potential deformation.

Frost Protection: It minimizes frost action by preventing the upward movement of water, which can cause heaving and cracking during freeze-thaw cycles.

VII. Actual Diagram with equipment specification:

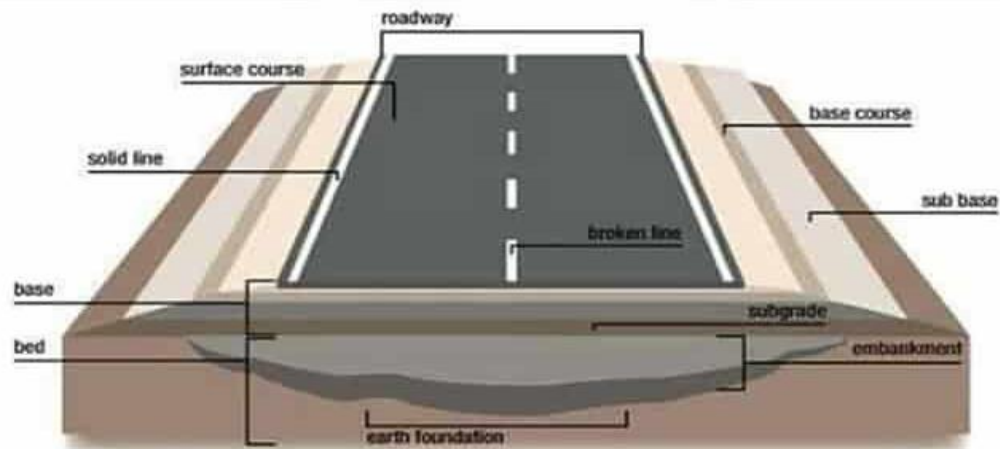


Figure 2.1: Components of Road

VIII. Resources required:

Sr. No.	Resource required	Particulars	Quantity
01	Camera Photographs	As per availability	1 no.
02	Note Pad ,Pencil etc.		1 no. each student

IX. Precautions to be followed:

1. The clear photographs should be paste to understand the actual layout of road.
2. The group photograph of site visit should be also attached at the end of this assignment.

X. Procedure:

1. Mention the details of visit undertaken i.e. location of visit, date and time of visit, purpose of visit etc. as given below.
2. Summarize the photographs of road components taken during the site visit.
3. Paste the photographs of each of the identified components and write the functions of the same in the specified format given below.
4. Share the experience of site visit and give the possible measures to be taken to enhance the working of road.

XI. Observation Table:

Sr. No.	The component of road observed with Photograph	Functions of Observed Components
1		
2		
3		
4		
5		

XVI. References/ suggestions for further Reading:

Sr. No.	Links	Description
1	https://rb.gy/f7crx0	Components parts of Road
2	https://rb.gy/8q86sv	Elements and Parts of Road
3	https://unplash.com/	--

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Identifying the components	25%
2.	Understanding the functions of components	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions with suggestions	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 03 *Conduct Softening point test on bitumen.

I. Practical Significance:

Bitumen does not suddenly change from solid to liquid state, but as the temperature increases, it gradually becomes softer until it flows readily. All semi-solid state bitumen grades need sufficient fluidity before they are used for application with the aggregate mix. For this purpose, bitumen is sometimes cut back with solvent like kerosene. The common procedure however is to liquefy the bitumen by heating. The softening point is the temperature at which the substance attains particular degree of softening under specified condition of test. For bitumen, it is usually determined by Ring and Ball Test. A brass ring containing the test sample of bitumen is suspended in liquid like water or glycerin at a given temperature. A steel ball is placed upon the bitumen and liquid medium is then heated at a specified rate. The temperature at which the soften bitumen touches the metal plate placed at a specified distance below the ring is recorded as the softening point of a particular bitumen. The apparatus and test procedure are standardized by ISI. It is obvious that harder grade bitumen possesses higher softening point than softer grade bitumen.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the quality of bitumen in terms of degree of softening.
- Check the suitability of given bitumen sample for proposed bituminous road construction work.

III. Course Level Learning Outcome (COs):

- CO 3 - Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 3.1 Interpret the result of Softening point test on bitumen.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

Bitumen is a thermoplastic material and its stiffness is dependent on temperature. The temperature-vs-stiffness relationship of bitumen is dependent on the source of crude oil and the method of refining.

The Bureau of Indian Standards (BIS) introduced paving grade bitumen specifications (IS: 73-1950) for the first time in the year 1950 and classified it on penetration. The specifications were revised in the years 1962 and 1992. To improve the quality of Bitumen, BIS revised IS-73-1992 specifications based on Viscosity (Viscosity at 60oC) in July 2006. As per these specifications, there are four grades VG-10, VG-20, VG-30 & VG-40. A few qualification tests like specific gravity, water content, ductility, loss on heating & Farads breaking point were removed from IS:73-1992 specifications as these tests do not have any relationship either with the quality or performance of the product.

Indian Oil commenced marketing of Bitumen as per Viscosity Grade specifications conforming to IS: 73-1992 from all its refineries from Aug 2009. Therefore, the Penetration grades have been replaced by Viscosity Grade Bitumen. According to viscosity (degree of fluidity) grading, higher the grade, stiffer the Bitumen. Tests are conducted at 600 C and 1350 C, which represent the temperature of road surface during summer (hot climate, similar to northern parts of India) and mixing temperature respectively. The penetration at 250 C. which is annual average pavement temperature, is also retained.

Different Grades of Bitumen marketed by Indian Oil:

VG-10 BITUMEN: VG-10 is widely used in spraying applications such as surface dressing and paving in very cold climate in lieu of old 80/100 Penetration grade. It is also used to manufacture Bitumen Emulsion and Modified Bitumen products.

VG-20 BITUMEN: VG-20 is used for paving in cold climate & high altitude regions **VG-30 BITUMEN:** VG-30 is primarily used to construct extra heavy duty Bitumen pavements that need to endure substantial traffic loads. It can be used in lieu of 60/70 Penetration grade.

VG-40 BITUMEN: VG-40 is used in highly stressed areas such as intersections, near toll booth sand truck parking lots in lieu of old 30/40 Penetration grade. Due to its higher viscosity, stiffer Bitumen mixes can be produced to improve resistance to shoving and other problems associated with higher temperature and heavy traffic loads.

IRC Recommendations:

The temperature at the instant when each of the ball and sample touches the bottom plate of support is recorded as softening point value. The mean of duplicate determinations is noted. It is essential that the mean value of the softening point (temperature) does not differ from individual observation by more than the following limits.

Softening Point	Repeatability	Reproducibility
Below 30 °C	2°C	4°C
30 °C to 80 °C	1°C	2°C
Above 80 °C	2°C	4°C

VII. Actual Diagram with equipment specification:



Figure 3.1 Bitumen and its Melting.

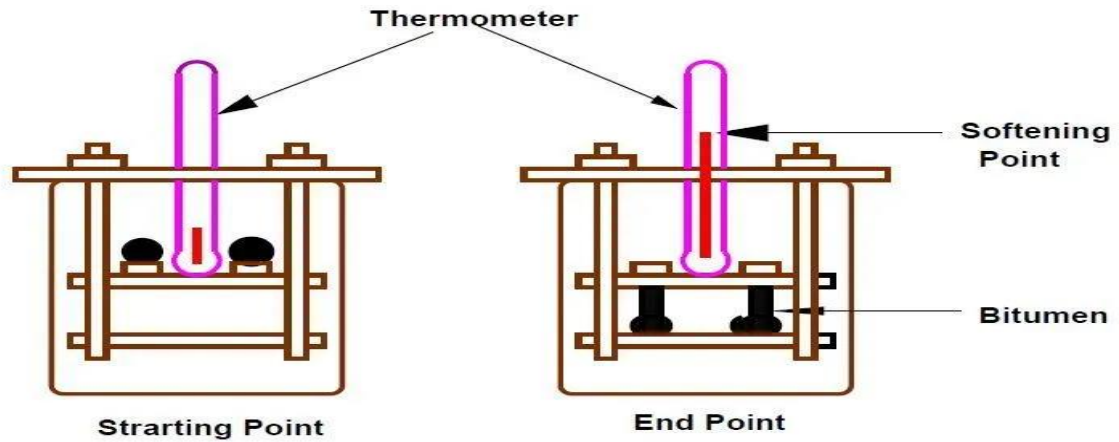


Figure 3.2 Softening Point Test Apparatus or Ring and Ball Test Apparatus.

VIII. Resources required:

Sr. No.	Resource required	Particulars	Quantity
01	Ring and Ball Test Apparatus	As per IS:1205-1978	1 no.
02	Steel Balls	Each has a diameter 9.5 mm and weighs 2.5+0.5 gm	2 nos.
03	Brass Rings	Depth: 6.4 mm Inside diameter at bottom: 15.9mm Inside diameter at top 17.5 mm Outside diameter: 20.6mm	2 nos.
04	Bath and Stirrer	A heat resistant glass container of 85 mm diameter and 120 mm depth is used. Bath liquid is water for materials having softening point above 80 °C, and glycerin for materials having softening point above 80 °C. Mechanical stirrer is used for ensuring uniform heat distribution at all times throughout the bath	1 no.

IX. Precautions to be followed:

1. Use hand gloves, apron while removing containers from hot plate after switching off the hotplate.
2. Record the temperature as soon as steel ball will touch the lower platform.
3. Maintain the room temperature as specified.
4. Distilled water should be used as the heating medium.
5. During the conduct of test, the apparatus should not be subjected to vibrations.
6. The bulb of the thermometer should be at about the same level as the rings.
7. Use glycerin for remove of bitumen from the container.
8. Use safety shoes & Apron at the time of test.
9. Equipment should be cleaned thoroughly before testing & after testing.

X. Procedure:

1. Sample material is heated to a temperature between 75 °C TO 100 °C above the approximate softening point until it is completely fluid and is poured in heated rings placed on metal plate.
2. To avoid sticking of the bitumen to metal plate, coating is done to this with a solution of glycerin and dextrin.
3. After cooling the rings in air for 30 minutes, the excess bitumen is trimmed and rings are placed the support as discussed in item (c) above.
4. At this time, the temperature of distilled water is kept at 50 °C. This temperature is maintained for 15 minutes after which the balls are placed in position.
5. The temperature of water is raised at a uniform rate of 5 °C per minute with a controlled bottom plate by sinking of balls. At least two observations are made.
6. For material whose softening point is above 80 °C. Glycerin is used in heating medium and the starting temperature is 35 °C instead of 5°C.

XI. Observation Table:

Sr. No.	Temperature at which bitumen soften and steel ball touches the bottom plate by sinking of ball	Reading 1 in Degree Centigrade (Ball 1 touches plate)	Reading 2 in Degree Centigrade (Ball 2 touches plate)	Mean value in Degree Centigrade
1				
2				
3				
Final softening point temperature in degree centigrade				

XII. Result:

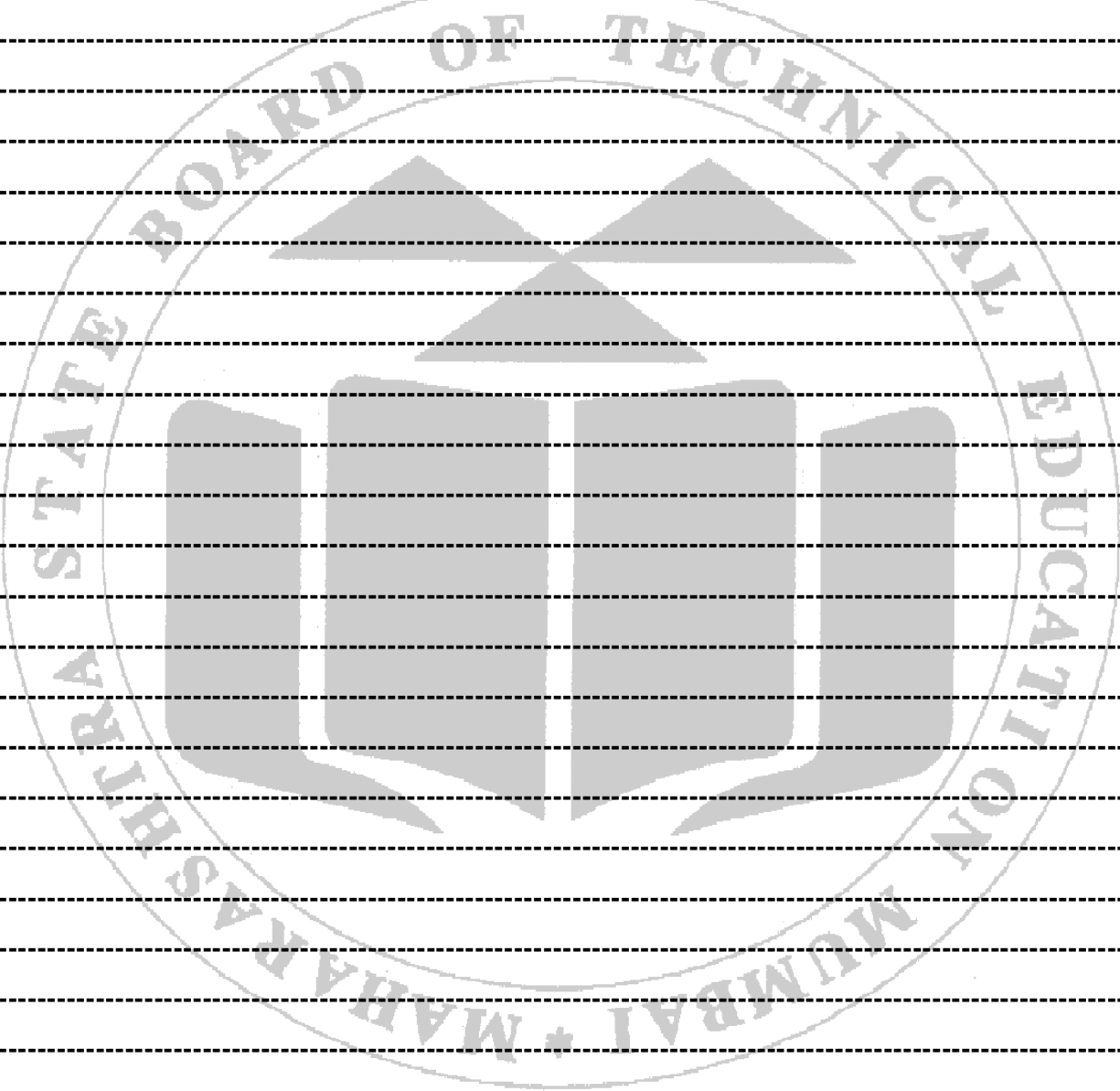
XIII. Interpretation of results:

XIV. Conclusions:

XV. Practical Related Questions:

1. Give the significance of softening point of bitumen for road construction works.
2. State the media used for heating the bitumen sample in this experiment.
3. State the softening point of bitumen of various grades used in bituminous pavement construction.
4. Compare the softening point for asphalt and tar.
5. State the rate of heating the bitumen sample

Space for Answer



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VI. References/ suggestions for further Reading:

Sr. No.	Links	Description
1	https://rb.gy/3ltop4	-
2	https://rb.gy/qwumhb	-
3	https://rb.gy/7x1x6p	Softening point of Bitumen
4	https://rb.gy/oht3gt	Softening point of Bitumen

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Performing the test accurately	25%
2.	Noting down the observations	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions.	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 04 * Conduct Penetration test on bitumen.

I. Practical Significance:

Bituminous materials are available in variety of types and grades. The penetration test determines the hardness of these materials by measuring the depth in tenth of a millimeter to which a standard needle will penetrate vertically under specified conditions of standard load, time and temperature. The sample is maintained at the standard temperature of 25°C. The total load on needle is 100 gm. The softer the bitumen, the greater will be its number of penetration unit.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the quality of bitumen in terms of penetration resistance.
- Check the suitability of given bitumen sample for proposed bituminous road construction work

III. Course Level Learning Outcome (COs):

- CO 3- Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 4.1 Interpret the result of Penetration test on bitumen.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

It may be noted that the penetration value is largely influenced by an inaccuracy as regards Pouring Temperature, Size of needles, Weight placed on the needle and Test Temperature. It is obvious to obtain high values of penetration if the test temperature and/or weight (placed over the needle) are/is increased. Higher pouring temperatures than the specified may result into hardening of bitumen and may give lower penetration values. Higher test temperatures have given considerably higher penetration values. It is also necessary to keep the needle clean before testing in order to get consistent results. The penetration needle should not be placed more than 10 mm from the side of the dish.

IRC Recommendations:

The depth of penetration is reported in hundredths of a centimeter. The mean value of three consistent Measurement is reported as the penetration value. It is further specified by I SI that results of each Measurement should not vary from the mean value reported above by more than the following:
Penetration Grade Repeatability 0-80 4% 80-225 5% above 225 7%

Penetration grade	Repeatability
0-80	4%
80-225	5%
Above 225	7%

VII. Actual Diagram with equipment specification:

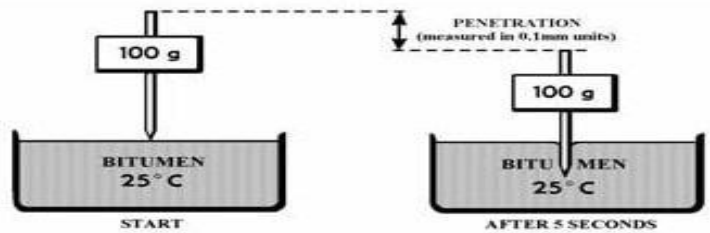


Figure 4.1: Bitumen Penetrometer & Concept of penetration resistance of bitumen

VIII. Resources required

Sr. No.	Resource required	Particulars	Quantity
01	Penetrometer	As per IS: 1203-1978	1 no.
02	Container	A flat bottomed cylindrical metallic container 55 mm in diameter and 35 mm or 57 mm in height	1 no.
03	Needle	A straight, highly polished cylindrical hard steel needle with conical end, having the shape and dimensions as shown in fig. Needle is provided with a shank appropriately 3 mm in diameter into which it is immovably fixed.	1 no.
04	Water Bath	A water bath is maintained at 25+ 1 °C containing not less than 10 liters of water, the sample is immersed to depth not less than 100 mm from the top and supported on a perforated shelf not less than 50 mm from the bottom of the bath.	1 no.
05	Transfer Tray	It is an apparatus which allows the needle to penetrate without appreciable friction. It is accurately calibrated to yield results in hundreds of centimeters "These days automatic Penetrometers (electrically operated) are also available. Typical sketch of Penetrometer is shown in figure.	1 no.

IX. Precautions to be followed:

1. Place the needle accurately on the top surface of bitumen sample.
2. The penetration needle should not be placed more than 10 mm from the side of the mould.
3. Maintain the room temperature as specified.

X. Procedure:

1. The bitumen is softened to a pouring consistency between 75 °C and 100 °C above the approximated temperature at which bitumen softens.
2. The sample material is thoroughly stirred to make it homogenous and free from air bubbles and water.
3. The sample material is then poured into the container to a depth at least 15 mm more than the expected penetration.
4. The sample containers are cooled in atmosphere of temperature not lower than 18°C for one hour. Then they are placed in temperature controlled water bath at a temperature of 25 °C for a period of one hour.
5. The sample container is placed in the transfer tray with water from the water bath and is placed under the needle of the penetrometer.
6. The weight of needle, shaft and additional weight are checked. The total weight of this assembly should be 100+/-0.25 gm.
7. The needle is now arranged to make contact with the sample surface. This is done by placing a lamp to the rear of the apparatus in such a way that the image of the needle can be checked to make surface contact.
8. Zero reading of the penetrometer dial is taken before-releasing the needle.
9. The needle is released-for-5 seconds and-the final reading is taken on the dial.
10. At least three measurements are made on this sample by testing at distance not less than 10 mm apart.
11. After each test, the needle is disengaged and wiped with benzene and carefully dried.
12. The sample container is also transferred in the water bath before next testing is done so as to maintain a constant temperature of 25 °C.
13. The test is repeated with sample in the other containers.

XI. Observation Table:

Pouring Temp °C =
Bath material =
Period of air cooling at 30 °C temp. =
Period of water bath at constant temp, of 25 °C =
Room Temp. =

Sr. No.	Sample	Penetration Dial Gauge Reading			Mean Penetration
		Initial	Final	Difference	
1					
2					
3					
4					
5					
6					

XII. Results:

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XIII. Interpretation of results:

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XIV. Conclusions:

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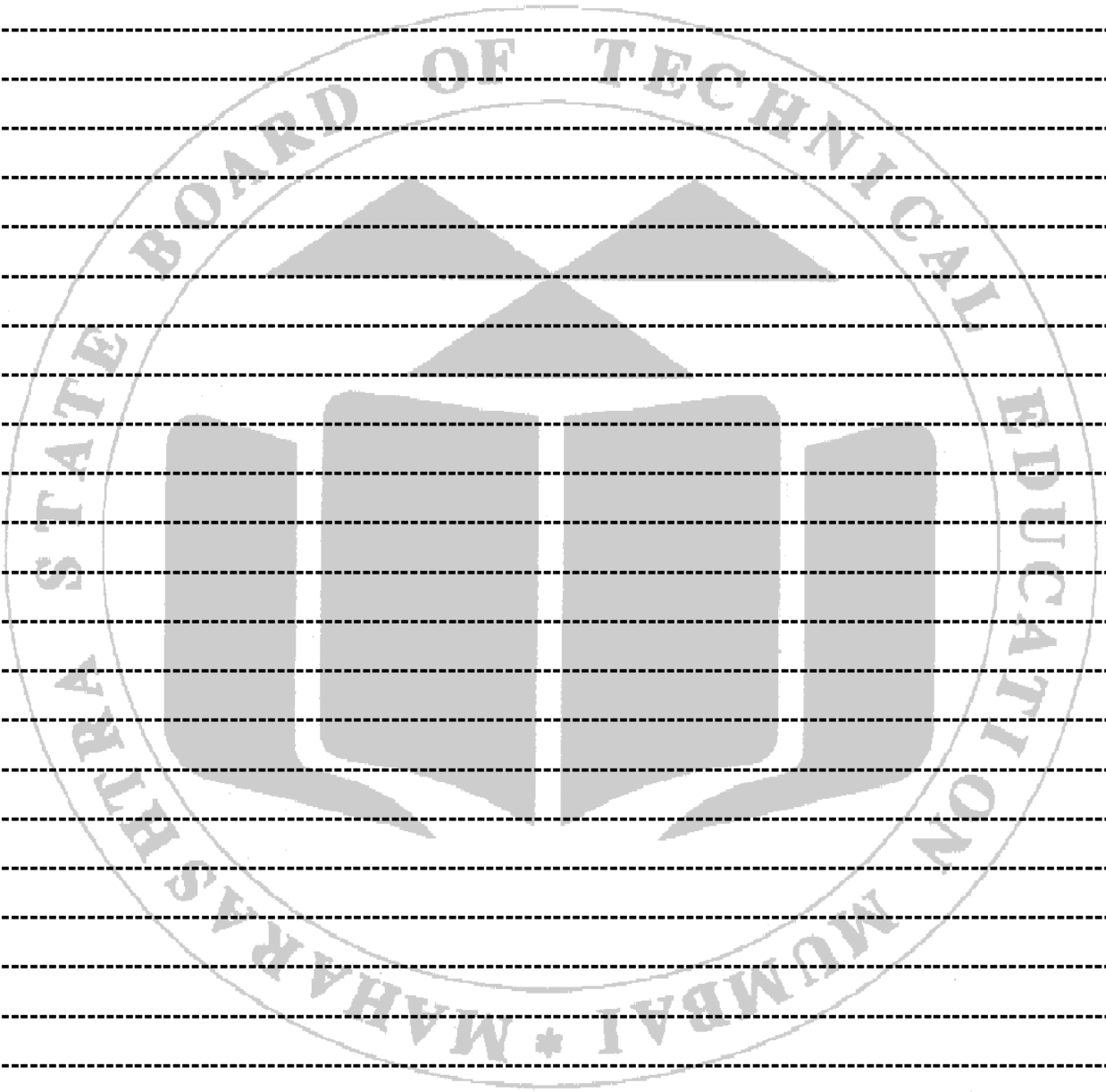
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XV. Practical Related Questions:

1. How penetration value is expressed?
2. What are the standard load, time and temperature specified for penetration test?
3. What are the effects of higher test temperature, higher pouring temperature on penetration value of bitumen sample?
4. Bitumen of 80/100 grade means the penetration value is in the range of according to the standard test. IS which type of brick used for decorative purpose?

Space for Answer



XVI. References/ suggestions for further Reading:

Sr. No.	Links	Description
1	https://rb.gy/mh67m2	
2	https://www.youtube.com/watch?v=kBoDxnDoOMQ&pp=ygUbcGVuZXRYyXRpb24gdGVzdCBvbiBiaXR1bWVu	Penetration test on Bitumen

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Performing the test accurately	25%
2.	Noting down the observations	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 05 Conduct Flash and Fire Point test on bitumen.

I. Practical Significance:

The fundamental reason for the requirement of flash point measurements is to access the safety hazard of bitumen with respect to flammability. It is used to warn of a risk and to enable the correct precautions to be taken when using such bitumen for road construction. It gives an idea about selecting the bitumen for proposed bituminous road work according to temperature of area. The appropriate use of bitumen leads to better resistance in particular temperature and further such road work shows minimum defects in it. It is necessary to conduct the flash and fire point test prior to its use, so that it can be easily handled even in extreme hot climatic conditions.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the quality of bitumen in terms of ignition point.
- Check the suitability of given bitumen sample for proposed bituminous road construction work.
- Recording the temperature of bitumen for its ignition.

III. Course Level Learning Outcome (COs):

- CO 3- Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 5.1 Interpret the result of Flash and Fire Point on bitumen.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

This test is done to determine the flash point and the fire point of asphaltic bitumen and fluxed native asphalt, cutback bitumen and blown type bitumen as per IS: 1209 - 1978. The principle behind this test is given below:

Flash Point- The flash point of a material is the lowest temperature at which the application of test flame causes the vapors from the material to momentarily catch fire in the form of a flash under specified conditions of the test.

Fire Point-The fire point is the lowest temperature at which the application of test flame causes the material to ignite and burn at least for 5 seconds under specified conditions of the test.

IRC RECOMMENDATIONS:

The minimum value of flash point by Pensky Martens closed type apparatus is 175°C for all grades of bitumen.

VII. Actual Diagram with equipment specification:

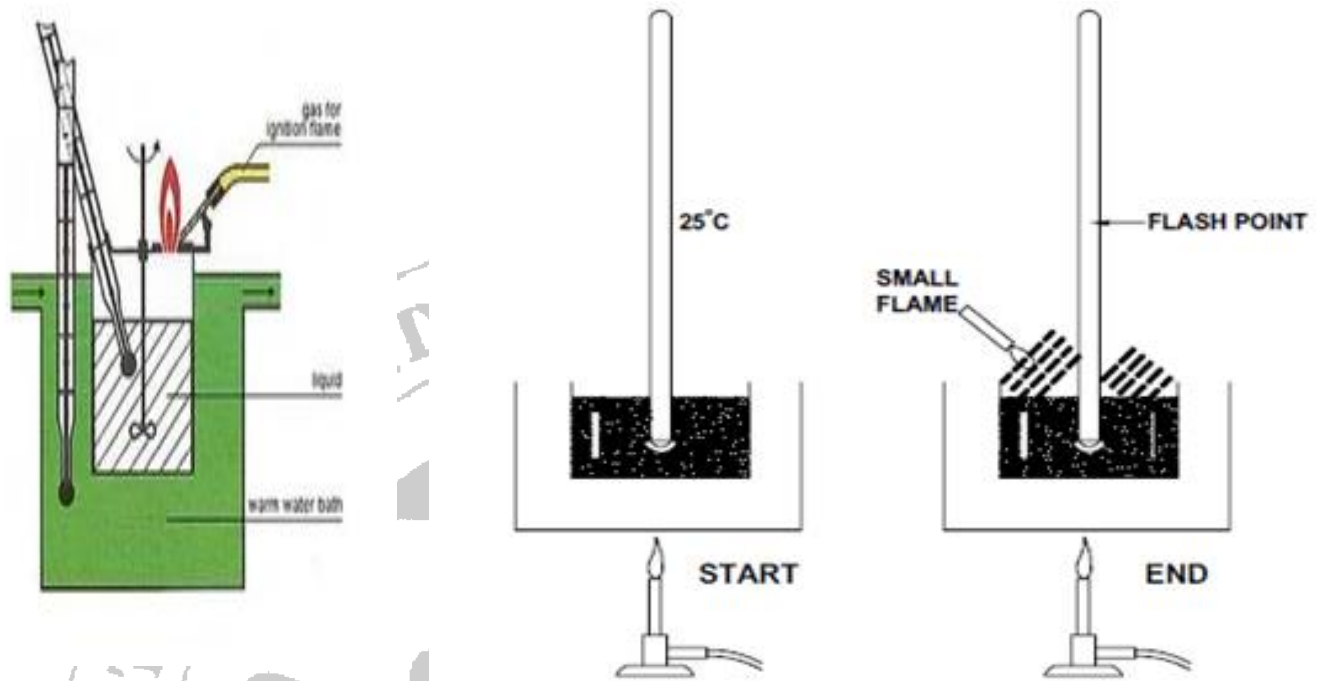


Figure 5.1: Schematic Diagram of Flash and Fire Point Test

VIII. Resources required:

Sr. No.	Resource required	Particulars	Quantity
01	Pensky-Martens apparatus	As per IS: 1209-1978	1 no.
02	Thermometer	Low Range: -7 to 110°C. Graduation 0.5 °C High Range: 90 to 370 C. Graduation 2°C	1 no.

IX. Precautions to be followed:

1. The flash point should be taken as the temperature read on the thermometer at the time of the flame application that causes a distinct flash in the interior of the cup.
2. The fire point should be taken as the temperature read on the thermometer at which the application of test flame causes the material to ignite and burn for at least 5 seconds.
3. Keep the body away from flame area. Also use hand gloves to handle heated parts.

X. Procedure:

For Flash Point

1. Soften the bitumen between 75 and 100°C. Stir it thoroughly to remove air bubbles and water.
2. Fill the cup with the material to be tested up to the filling mark. Place it on the bath. Fix the open clip. Insert the thermometer of high or low range as per requirement and also the stirrer, to stir it.
3. Light the test flame, adjust it. Supply heat at such a rate that the temperature increase, recorded by the thermometer is neither less than 50C nor more than 60C per minute.

4. Open flash point is taken as that temperature when a flash first appears at any point on the surface of the material in the cup. Take care that the bluish halo that sometimes surrounds the test flame is not confused with the true flash. Discontinue the stirring during the application of the test flame.
5. Flash point should be taken as the temperature read on the thermometer at the time the flash occurs.

For Fire Point

6. After flash point, heating should be continued at such a rate that the increase in temperature recorded by the thermometer is neither less than 5°C nor more than 6°C per minute. ii) The test flame should be lighted and adjusted so that it is of the size of a bead 4mm in dia. Identify the properties of brick.

XI. Observation Table:

Sr.No.	Test Property	Test 1	Test 2	Mean Value
1	Flash Point (°C)			
2	Fire Point (°C)			

XII. Results:

The flash point of given bitumen sample is..... °C.

The fire point of given bitumen sample is..... °C.

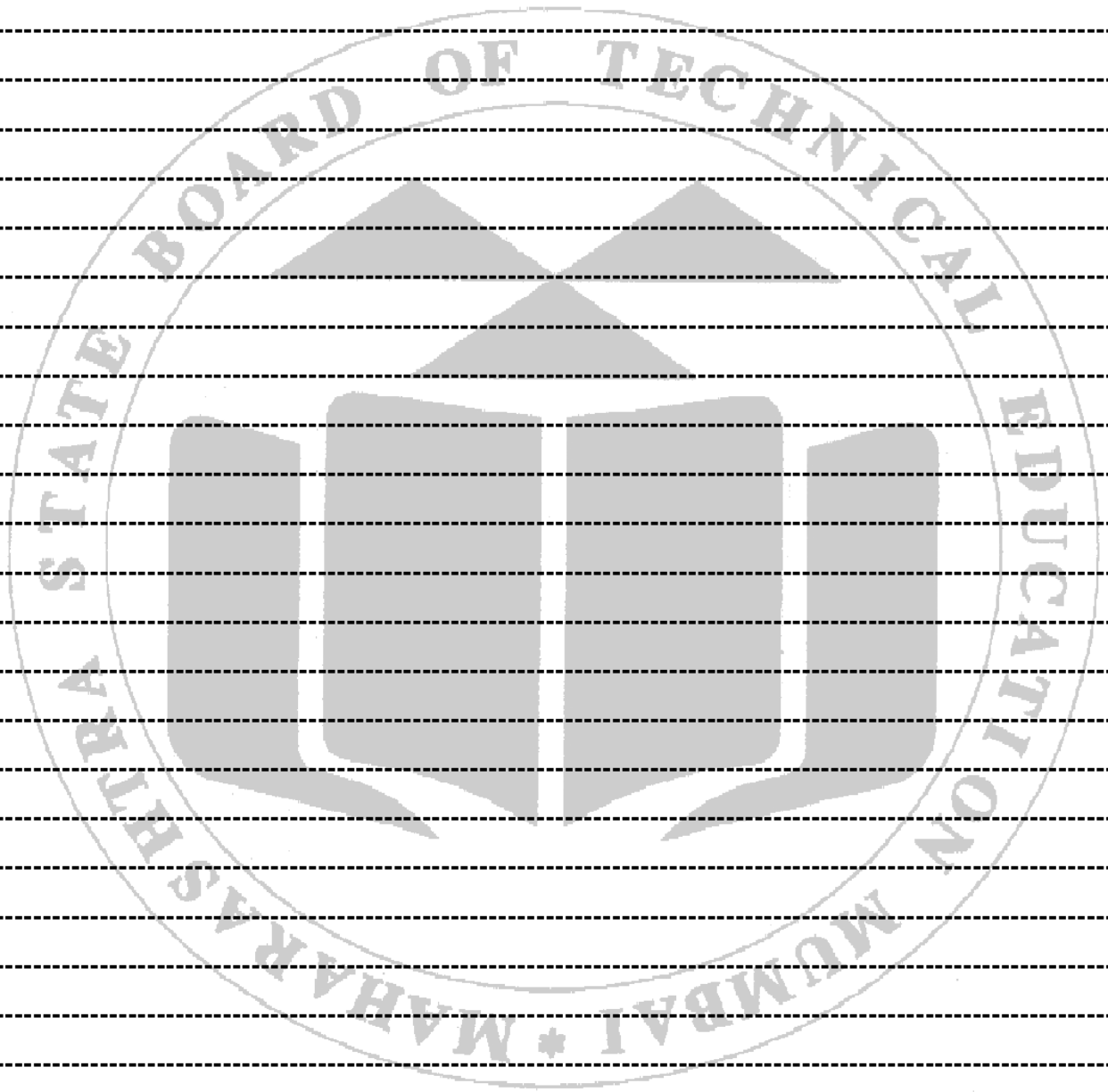
XIII. Interpretation of results:

XIV. Conclusions:

XV. Practical Related Questions:

1. Explain the purpose of flash and fire point test.
2. State the rate of heating of bitumen in flash and fire point test.
3. 'The flash and fire point should be lesser as far as possible', justify the statement.
4. What are the factors affecting the value of flash and fire point of bitumen in this test?

Space for Answer



XVI. References/ suggestions for further Reading:

Sr. No.	Links	Description
1	https://www.youtube.com/watch?v=L5_69I7HLc4&pp=ygUkZmxhc2ggYW5kIGZpcmUgcG9pbmQgdGVzdCBvbiBiaXR1bWVu	Flash and fire point test on bitumen
2	https://rb.gy/0jzj4v	-
3	https://rb.gy/xop19o	-

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Performing the test accurately	25%
2.	Noting down the observations	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No:06 Conduct Ductility test on Bitumen.

I. Practical Significance:

In the flexible pavement construction where bitumen binders are used, it is of significant importance that the binders form ductile thin films around the aggregates. It has been stated by some agencies that the penetration and ductility properties go together; but depending upon the chemical composition and the type of crude source of the bitumen, sometimes it has been observed that the above statement is incorrect. It may hence be mentioned that the bitumen may satisfy the penetration valve, but may fail to satisfy the ductility requirements. Bitumen paving engineer would however want that both test requirements are satisfied in the field jobs.

II. Industry/Employer Expected Outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the quality of bitumen in terms of ignition point.
- Check the suitability of given bitumen sample for proposed bituminous road construction work.
- Recording the temperature of bitumen for its ignition.

III. Course Level Learning Outcome (COs):

- CO3 - Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 6.1: - Interpret the result of Ductility test on bitumen.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

This serves as a satisfactory binder in improving the physical interlocking of the aggregates. The binder material which does not possess sufficient ductility would crack and thus provides pervious pavement surface. This in turn results in damaging effect to the pavement structure.

IRC RECOMMENDATIONS:

The distance traveled up to the point of breaking of thread measured in centimeters is recorded as ductility value. It is recommended by ISI that results should not differ from mean value by more than the following.

Repeatability	Reproducibility
5%	10%

Recommended Values of Bitumen Ductility:

Suitability of bitumen is judged depending on its type and proposed use. Bitumen with low ductility value may get cracked especially in cold weather. Minimum values of ductility specified by ISI 1208-1978 for various grades are as follows.

Source of paving bitumen and penetration grade	Min ductility value (cms)
Assam Petroleum A25	5
A35	10
A45	12
65, A90 and A200	15
Bitumen from sources other than Alum Petroleum S35	50
S45, S65 and S90	75

VII. Actual Diagram with equipment specification:



Figure 6.1: Ductility Test Apparatus

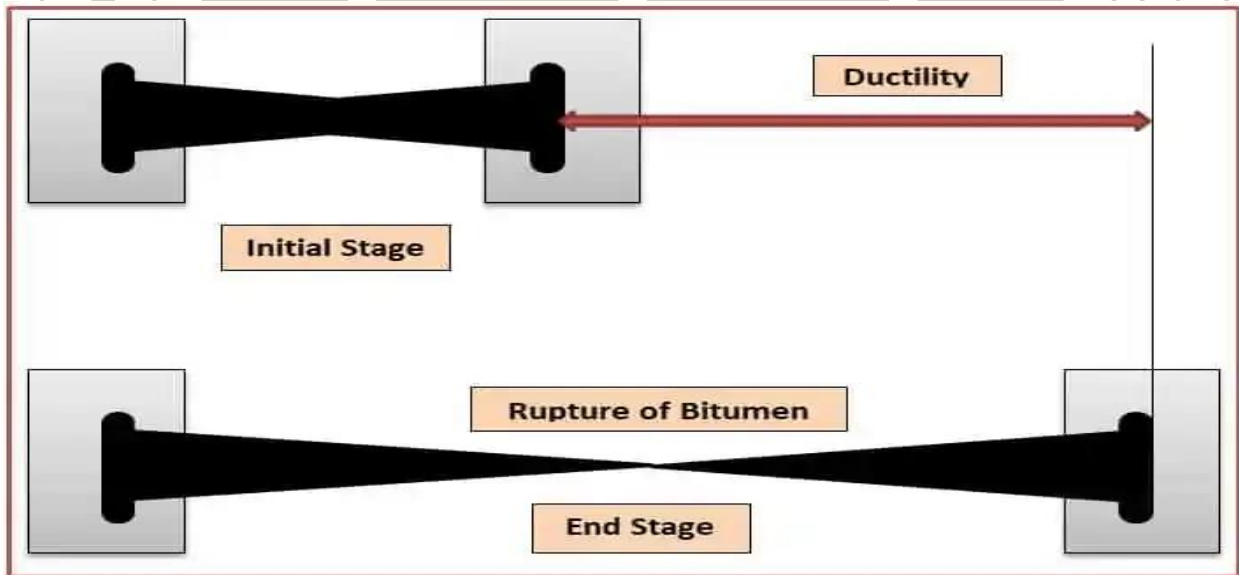


Figure 6.2: Measurement of Ductility of Bitumen

VIII. Resources required:

Sr. No.	Resource required	Particulars	Quantity
01	Ductility Machine	As per IS: 1208-1978. It is equipment which functions as constant temperature water bath and a pulling device at a pre calibrated rate. The central rod of the machine is threaded and through gear system provides a movement to one end where the clip is fixed during initial pavement. The other clip end is hooked at the fixed end of the machine. Two clips are thus pulled apart horizontally at a uniform speed of 50+ 2.5 mm per minute.	1 no.
02	Briquette Mould	Mould is made of brass metal with shape and dimensions as indicated in fig. 10 2. Both ends called lips possess circular holes to grip the fixed and movable ends of the testing machine, sidepieces when placed together form the briquette of the following dimensions: Length 75 mm. Distance between clips 30 mm, Width at mouth of elip- 20 mm. Cross section at minimum width= 10 mm x 10 mm	1 no.

IX. Precautions to be followed:

1. Before filling the bitumen sample, apply glycerin and dextrin uniformly to the inner surface of mould.
2. The bitumen sample should be filled in briquette mould immediately after its prescribed softening. Also it should be leveled properly by removing extra sample if any.

X. Procedure:

1. The bitumen sample is melted to a temperature of 75 to 100°C above the approximate softening point until it is fluid.
2. It is strained through IS sieve 30, poured in the mould assembly and placed on a brass plate, after a solution of glycerin and dextrin is applied at all surfaces of the mould exposed to bitumen.
3. Thirty to forty minutes after the sample is poured into the moulds, the plate assembly along with the sample is placed in water bath maintained at 27°C for 30 minutes.
4. The sample and mould assembly are removed from water bath and excess bitumen material is cut off by leveling the surface using hot knife.
5. After trimming the specimen, the mould assembly containing sample is replaced in water bath maintained at 27°C for 85 to 95 minutes.
6. The sides of the mould are now removed and the clips are carefully hooked on the machine without causing any initial strain.
7. The pointer is set to read zero.
8. The machine is started and the two clips are thus pulled apart horizontally while the test is in operation, it is checked whether the sample is immersed in water at depth of at least 10 mm.
9. The distance at which the bitumen thread breaks is recorded in cm to report as ductility value.

XI. Observation Table:

1. Grade of Bitumen –.....
2. Pouring temp-.....
3. Test temp. -.....
4. Period of air cooling-.....
5. Rate of cooling -.....

Sr. No.	Test Property	Briquette Mould No.			Mean Value
		1	2	3	
1	Ductility Value in cm to which standard briquette mould having 10x10 cm cross- section in center can stretch where thread just break				

Sample Calculations:

XII. Result:

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XIII. Interpretation of Results:

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XIV. Conclusions:

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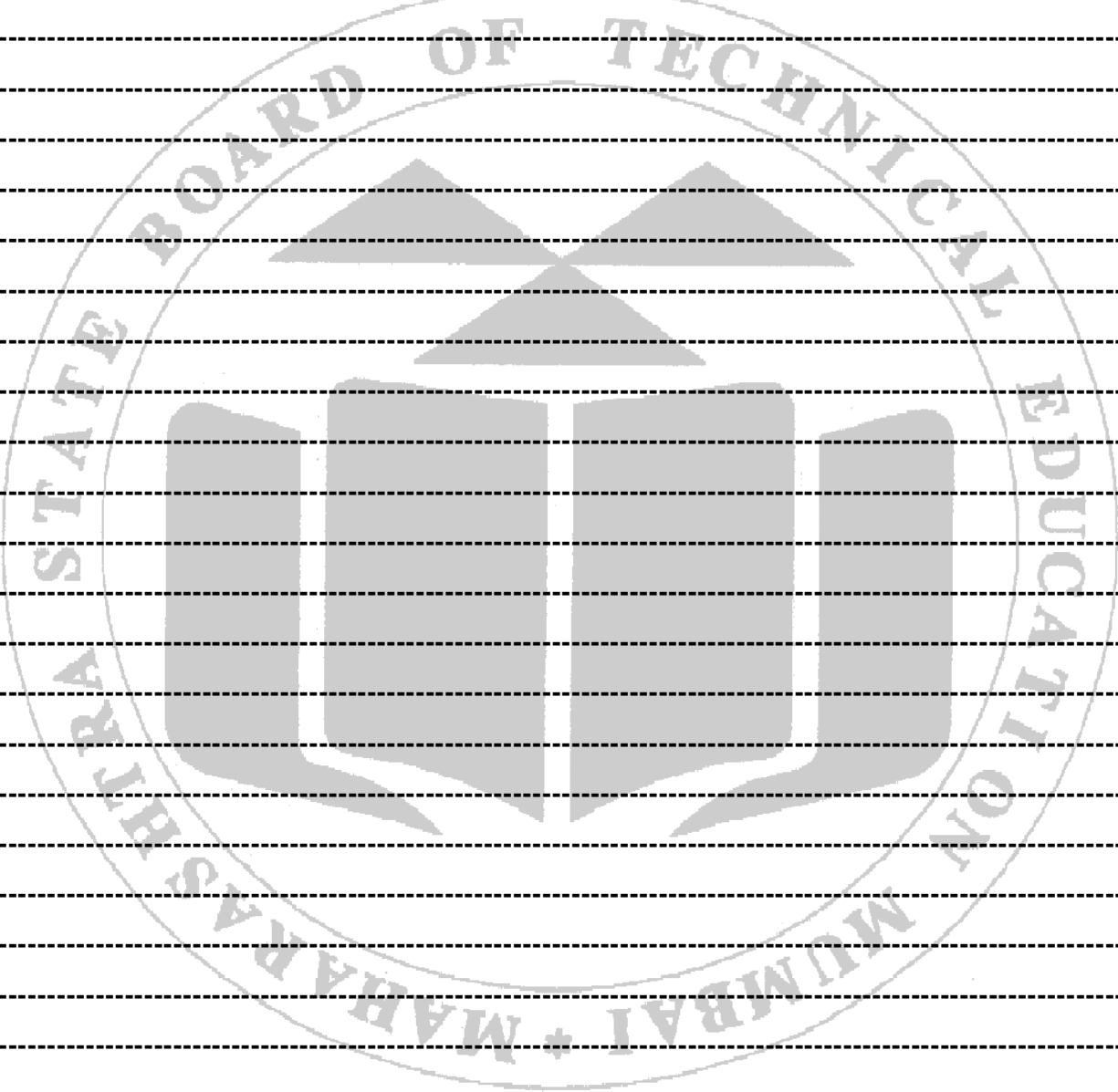
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XV. Practical Related Questions:

1. Explain the purpose of ductility test of bitumen.
2. State the rate of pull of bitumen in ductility test.
3. If the grade of two bitumen samples is 30/40 and 80/100, then in which sample the ductility value will be more. Why?
4. Which factors may affect the value of ductility of bitumen?

Space for Answer



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XVI. References/ suggestions for further Reading:

Sr. No.	Links	Description
1	https://www.youtube.com/watch?v=TE8zYxUJHt0&pp=ygUZRHVjdGlsaXR5IHRlc3Qgb24gYml0dW1lbg%3D%3D	Ductility test on Bitumen
2	https://rb.gy/0jzj4v	-
3	https://rb.gy/xop19o	-

XVII. Assessment Scheme:

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Performing the test accurately	25%
2.	Noting down the observations	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 07 *Conduct Ductility test on Bitumen.

I. Practical Significance:

The Bitumen Extraction Test is essential for ensuring the quality, durability, and performance of asphalt pavements. It serves as a critical quality control measure, supports economic and environmental sustainability, enhances safety, and provides valuable data for both immediate construction needs and long-term research and development. By understanding and interpreting the results of this test, engineers and construction professionals can make informed decisions that improve the overall success and sustainability of road infrastructure projects.

II. Industry/Employer Expected Outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the quality of bitumen in terms of ignition point.
- Check the suitability of given bitumen sample for proposed bituminous road construction work.
- Recording the temperature of bitumen for its ignition

III. Course Level Learning Outcome (COs):

- CO3: - Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 7.1: - Interpret the result of Bitumen Extraction Test on bitumen.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices.
- Practice good housekeeping.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

Bitumen involves understanding the principles of bitumen content determination, the composition and properties of asphalt mixtures, and the methods used to separate and quantify bitumen from these mixtures. This test is pivotal in assessing the quality and consistency of bituminous materials used in pavement construction.

Role of Bitumen:

Binder: Acts as an adhesive to bond aggregate particles.

Waterproofing: Provides water resistance to the pavement, protecting it from moisture damage.

Flexibility: Imparts flexibility to the pavement, allowing it to accommodate traffic loads and temperature variations.

VII. Actual Diagram with equipment specification:**Figure 7.1: Bitumen Extractor****VIII. Required Resources:**

Sr. No.	Resource required	Particulars	Quantity
01	Bitumen Extractor		1 no.
02	Weighing Balance	Capacity 500 grams and sensitivity 0.01grams.	1 no.
03	Thermostatically controlled oven	Capacity up to 2500 °C.	1 no.
04	Beaker for collecting extracted material		1 no.

IX. Precautions to be followed:

1. Wear chemical-resistant gloves to protect your hands from solvents.
2. Conduct the test in a well-ventilated area or under a fume hood to avoid inhalation of solvent fumes.
3. Protect your eyes from splashes of solvents and bitumen.

X. Procedure:

1. Take exactly 500 grams of the representative sample and place it in the bowl of the extraction apparatus (WI).
2. Add benzene to the sample until it is completely submerged.
3. Dry and weigh the filter paper and place it over the bowl of the extraction apparatus containing the sample (B).
4. Clamp the cover of the bowl tightly.
5. Place a beaker under the drainpipe to collect the extract.
6. Sufficient time (not more than an hour) is allowed for the solvent to disintegrate the sample before running the centrifuge.
7. Run the centrifuge slowly and then gradually increase the speed to a maximum of 3600 rpm.
8. Maintain the same speed till the solvent ceases to flow from the drainpipe.
9. Run the centrifuge until the bitumen and benzene are drained out completely.
10. Stop the machine, remove the cover and add 200ml of benzene to the material in the extraction bowl and the extraction is done in the same process as described above.

11. Repeat the same process not less than three times till the extraction is clear and not darker than a light straw color.
12. Collect the material from the bowl of the extraction machine along with the filter paper and dry it to constant weight in the oven at a temperature of 1050 C to 1100 C and cool to room temperature.
13. Weigh the material (W2) and the filter paper (D) separately to an accuracy of 0.01grams.

XI. Observation Table:

Sr. No.	Observation	Sample 1	Sample 2	Sample 3
1	Weight of mix taken before extraction (W1)			
2	Weight of filter paper before extraction (B)			
3	Weight of mix after extraction (W2)			
4	Weight of filter paper after extraction (D)			
5	Weight of filler collected in filter paper (B-D) =W3			

Formula-

$$= W1-(W2+W3)/W1 \times 100$$

Sample Calculations:

XII. Result:

XIII. Interpretation of Results:

XVI. Conclusions:

XVI. References/ suggestions for further Reading

Sr. No.	Links	Description
1	https://youtu.be/JEySduXuxCc?si=qvixXxmY651mySzy	Bitumen Extractor test
2	https://youtu.be/4Zz2Don-Qhg?si=A0_e-v1o1S0i0MuZ	Bitumen Content test
3	https://rb.gy/h4c2c1	-

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Performing the test accurately	25%
2.	Noting down the observations	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 08 *Visit the road under construction to identify layers in the flexible pavement/Rigid Pavement. Prepare photographic report consisting of Materials, Machineries used, Method of Construction and on-site testing of Materials.

I. Practical Significance:

Educational Insight Provides hands-on learning for students and professionals about the actual construction process and the different layers involved in both types of pavements. Quality Assurance allows for the verification of construction quality, ensuring that each layer meets design specifications and standards. Material Verification ensures that the correct materials are being used and that they are being applied properly.

II. Industry/Employer Expected Outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- A student should be able to identify the Components of road.
- Enhances knowledge of flexible and rigid pavement

III. Course Level Learning Outcome (COs):

- CO1 - Identify the roads based on recommendations of IRC.
- CO2 - Implement geometrical features of different Highways.
- CO3 - Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 8.1: - Write the function of each layer of Pavement.
- LLO 8.2: - Observe the working of Highway Construction machineries.
- LLO 8.3: - Onsite testing of Material and sequential method of Construction.

V. Relevant Affective Domain related Outcome(s):

- Follow safety practices & precautions.
- Demonstrate working as a leader/a team member.
- Maintain tools and equipment.
- Practice good housekeeping.
- Follow ethical Practices.

VI. Relevant Theoretical Background:

Flexible Pavements-

Surface Course material typically composed of asphalt concrete, which includes a mix of asphalt binder and aggregates. Provides a smooth, durable, and skid-resistant surface for vehicles. It also protects the underlying layers from weather and wear. Binder course material made of asphalt binder and aggregates but with a different mix compared to the surface course. Distributes traffic loads to the base course and provides structural support.

Rigid Pavements-

Materials made of Portland cement concrete. Provides a durable, high-load capacity surface with good skid resistance. Base Course material is Granular or stabilized material. Provides additional structural support and improves drainage.

VII. Actual Diagram with equipment specification:

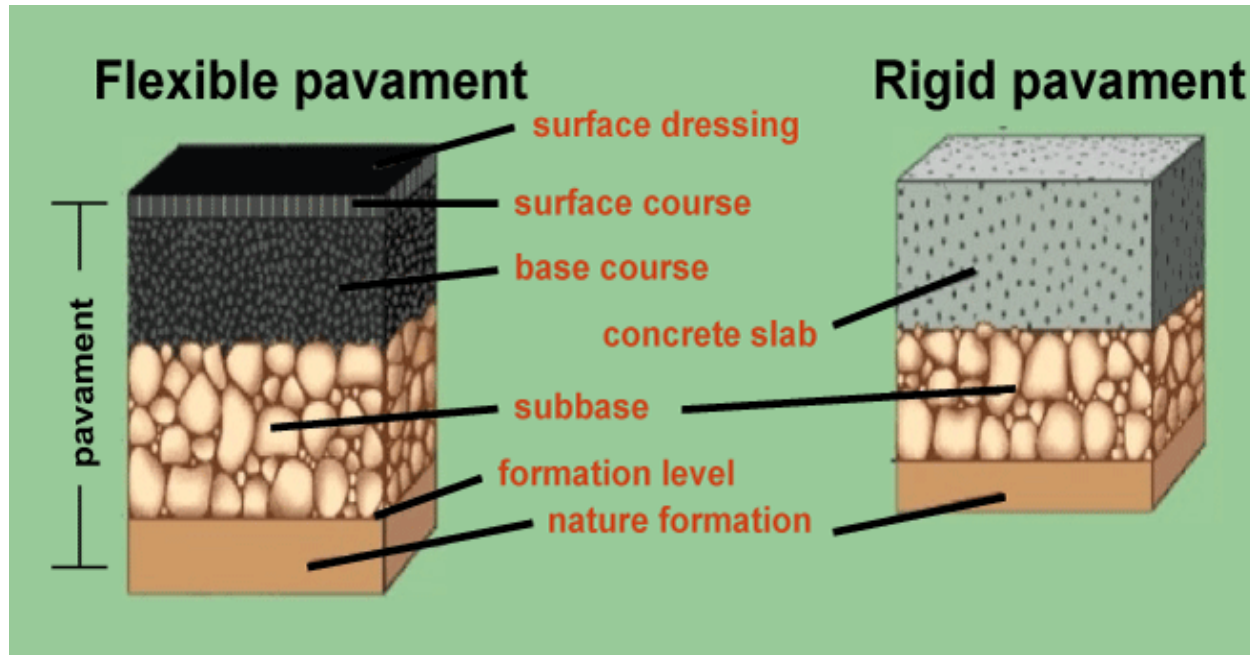


Figure 8.1: Difference between flexible and rigid pavement

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Camera Photographs	As per availability	1 no.
02	Note Pad Pencil etc.		1 no. each student

IX. Precautions to be followed:

1. The clear photographs should be paste to understand the actual Construction of road.
2. The group photograph of site visit should be also attached at the end of this assignment.

X. Procedure:

1. Mention the details of visit undertaken i.e. location of visit, date and time of visit, purpose of visit etc. as given below.
2. Summarize the photographs of road components taken during the site visit.
3. Paste the photographs of each of the identified components and write the functions of the same in the specified format given below.
4. Share the experience of site visit and give the possible measures to be taken to enhance the working of road.

XI. Observation Table:

Sr. No.	The components of road observed with photograph	Functions of observed components
1		
2		
3		
4		

5		
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XII. Result:

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XIII. Interpretation of Results:

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XVI. Conclusions:

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XV. Practical Related Questions:

1. Write the difference between flexible and rigid pavement.
2. List the material used in construction of road.
3. List the machineries used in construction of road.
4. Enlist the test conducted in construction of road

Space for Answer

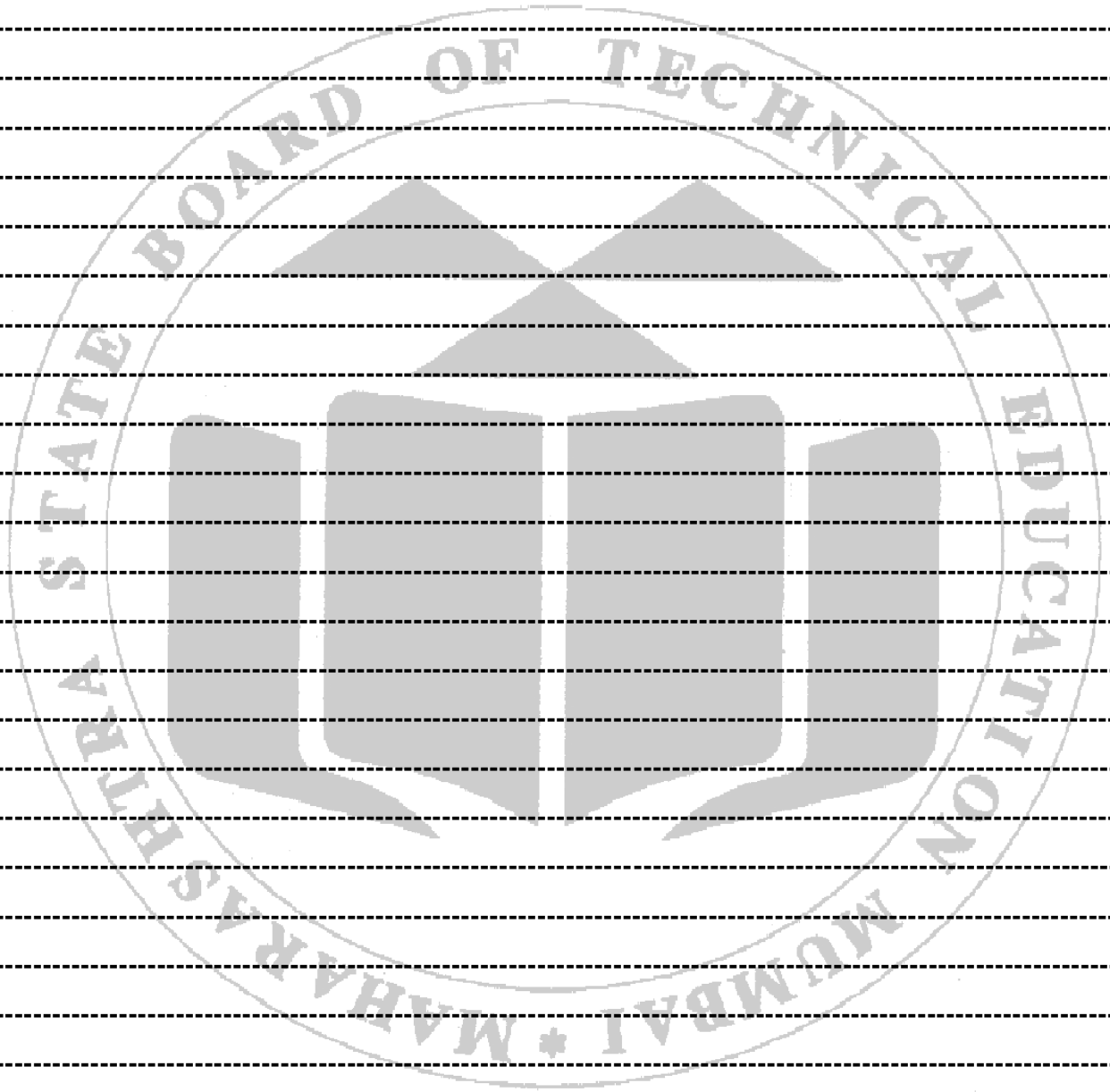
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XVI. References/ suggestions for further Reading

Sr. No.	Links	Description
1	https://static.javatpoint.com/difference/images/difference-between-flexible-and-rigid-pavement4.png	-
2	https://youtu.be/jUrI3IzO6s?si=gISQcnAOwiQx0BfT	Difference between flexible and rigid pavement.

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Identifying the components	25%
2.	Understanding the functions of components	25%
3.	Working in team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answer to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 09 Visit the hill road to study its components, geometrics and prepare the photographic report containing details.

I. Practical Significance:

India has a total area about 259000 sq.km covered with densely forested and thinly populated hills. Due to mountainous terrain, navigation and rail traffic are not possible. In consideration of strategic need of the country and to provide for communications facilities a hill road is one which passes through a terrain. Visiting Hill road and studying its components lies in the potential to enhance safety, efficiency, and sustainability of transportation. By examining factors like road conditions, drainage systems, signage, and traffic flow etc. and examining geometry features like proper alignment, gradient and curvature can navigate safely, and minimizing accidents.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads). **This practical is expected to develop the following skills for the Industry identified.**

- Observe the hill road components.
- Understand the function of various components.
- To know relevant materials, techniques and methods use while hill road construction.

III. Course Level Learning Outcome (COs):

- CO 1- Identify the roads based on recommendations of IRC.
- CO 2-Implement geometrical features of different Highways.
- CO 3- Observe the various road construction activities.

IV. Laboratory Learning Outcome (LLO):

- LLO 9.1 Identify the components of Hill Roads.

V. Relevant Affective Domain related Outcome(s):

- Follow safe practices.
- Demonstrate working as a leader/a team member.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

1. Difference between the road on fairly leveled ground and road constructed along hill side.
2. **Components of Hill Road:** The typical hill road section has following components.
 - i. Catch water drain
 - ii. Breast wall
 - iii. Side drain
 - iv. Catch water drain
 - v. Brest wall
 - vi. Retaining wall with parapet

- vii. Road bed with pavement
- viii. Cross drain pipe

3. Types of hill road curves: The hill road section has following types of curves to be provided, which are different than curves provided in case of normal roads.

- i. Hair pin bend curve
- ii. Salient curve
- iii. Re-entrant curve

VII. Actual Diagram with equipment specification

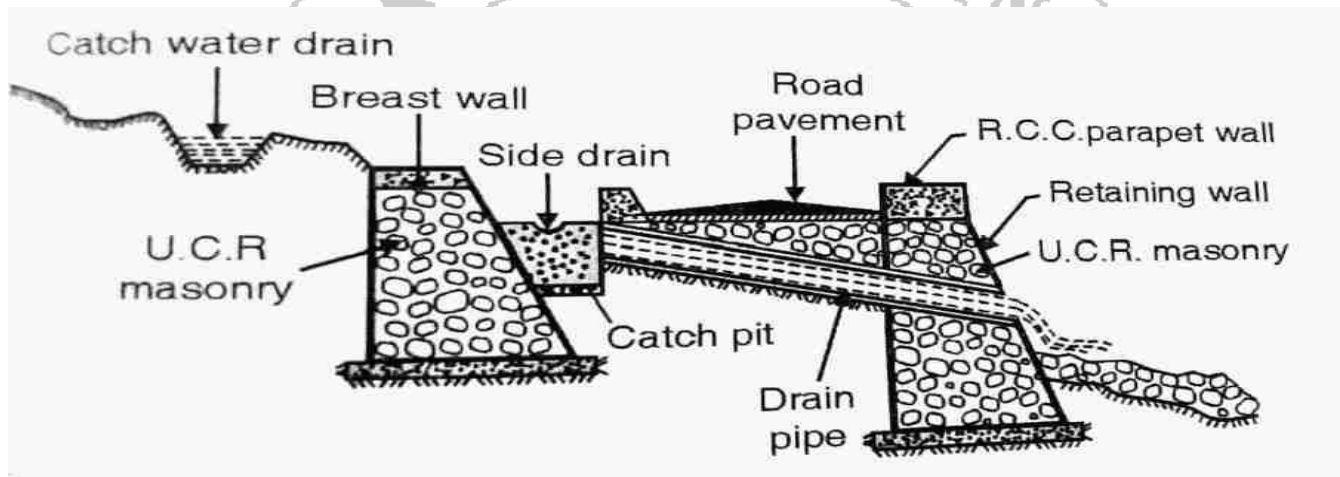


Figure 9.1: Hill Road Showing its Components

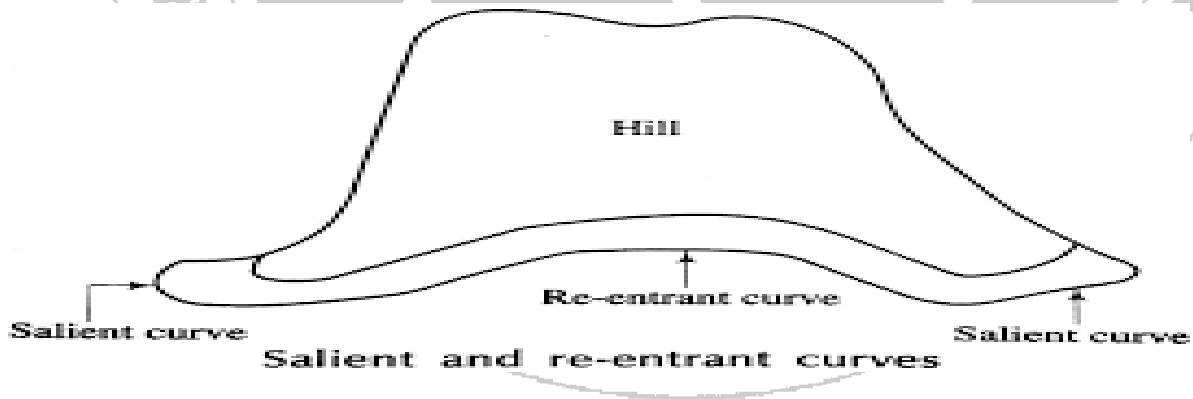


Figure 9.2: Types of Hill Road Curve

VIII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
01	Camera	As per availability	1 No.
02	Note pad, Pencil etc.	1No each students	1 No.

IX. Precautions to be followed:

1. Mention the details of visit undertaken i.e. location of visit, date and time of visit purpose of visit etc. as given below.
2. Summarize the photographs of hill road components taken during the site visit.
3. Paste the photographs of each of the identified components and write the functions of the same in the specified format given below.
4. Compare the theoretical and practical profile of hill road section stating the differences.
5. Share the experience of site visit and give the possible measures to be taken to enhance the working of hill road.

X. Procedure:

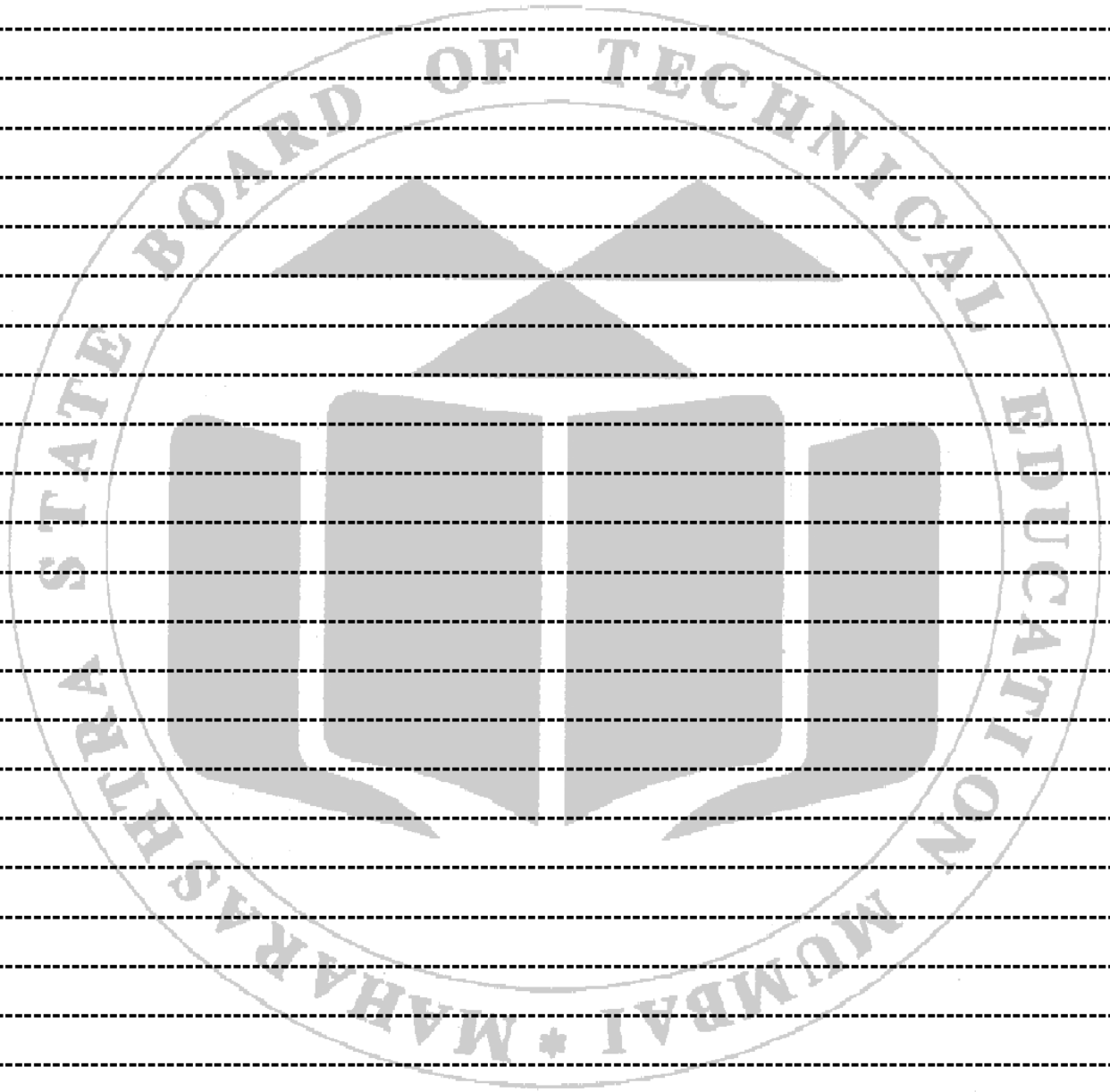
1. The clear photographs should be paste to understand the actual layout of hill road.
2. The group photograph of site visit should be also attached at the end of this assignment.
3. The suggestions regarding the modifications in hill road section should be given with justification.

XI. Observation Table:

Sr. No.	The component of hill road observed with photograph	Functions of observed components.
1		
2		

3		
4		
5		

Brief description of Hill Road Component observed at site – (Attached group Photograph)



XII. Result:

XIII. Interpretation of results:

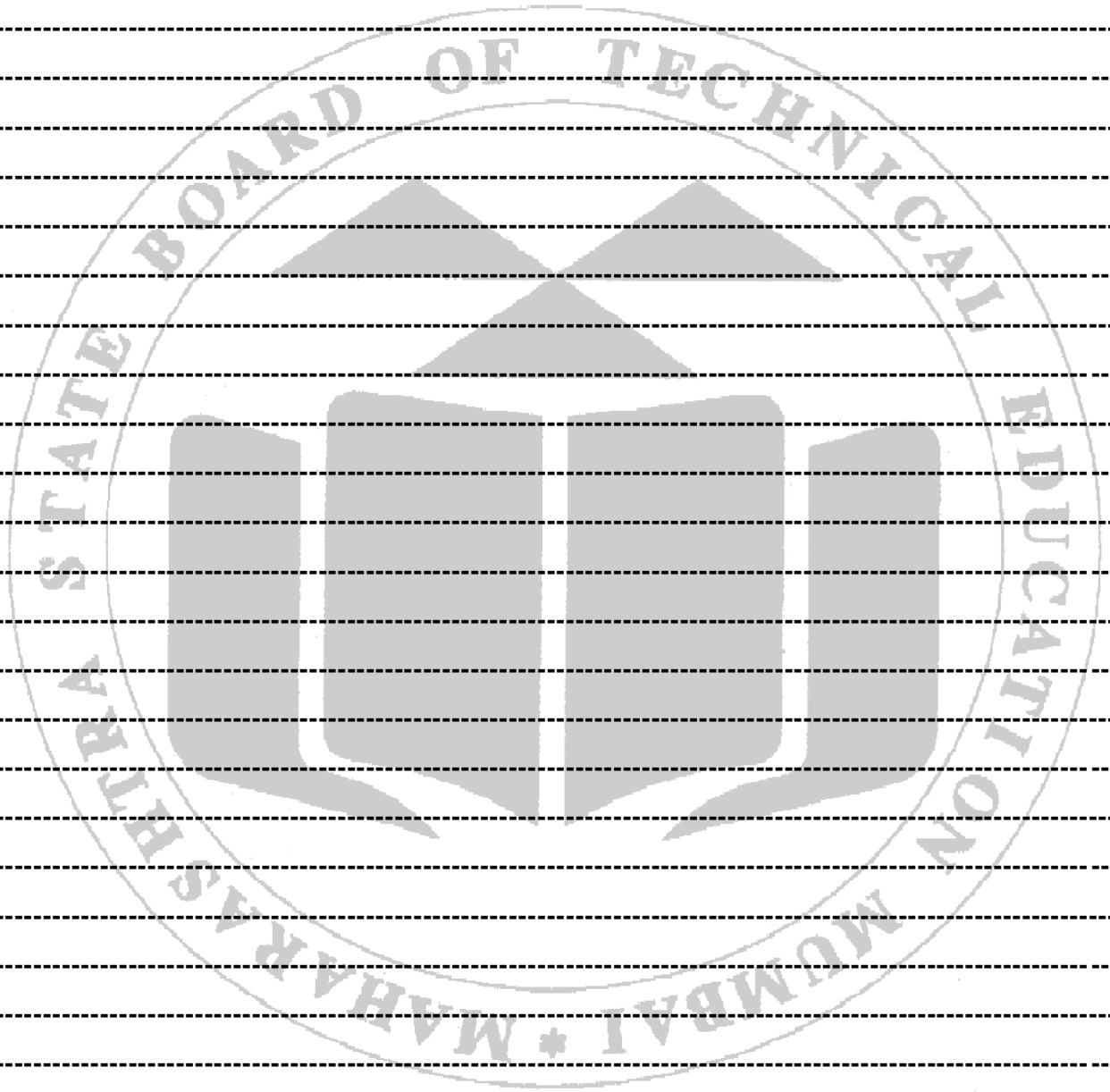
XIV. Conclusions:

XV. Practical Related Questions:

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the difference between normal roads and hill roads in terms of its geometric design.
2. Enlist the various practical difficulties in hill road construction as compared to normal roads.
3. Enlist the types of side drains provided along hill road. Which is most effective in heavily rainfall regions?
4. The ruling gradient is not feasible to provide in hill road. Justify the statement.
5. State any four typical causes of landslides and also suggest the preventive measures to be taken against each of the cause you stating.

Space for Answer



XVI. References/ suggestions for further Reading

Sr. No.	Links	Description
1	www.youtube.com/watch?v=TbMVgCtbaxo	Hill Roads with its Components
2	https://www.youtube.com/watch?v=HI1FuLbKOME	Hill Roads with its Components

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process related: 15 Marks	60%
1.	Identifying the components.	25%
2.	Understanding the functions of components.	25%
3.	Working in team.	10%
B.	Product related: 10 Marks	40%
4.	Conclusions with suggestions.	20%
5.	Answer to practical related questions.	10%
6.	Submission of report in time	10%
C.	Total : 25 Marks	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 10 ***Carry out Traffic Volume Study (minimum two hours of peak period) for an important road intersection or roadway in your city/ town/ village.**

I. Practical Significance:

Traffic volume studies provide essential insights for transportation planning, infrastructure design, and traffic management. By understanding traffic patterns and volumes, authorities can optimize road layouts, signal timings, and public transportation routes to improve efficiency and safety. This particular practical will help you to know the actual traffic flow during peak hours and non-peak hours. Based on traffic volume count the most possible and feasible solutions can be drawn to minimize the common problems in traffic engineering.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the traffic flow pattern.
- Observe the moving vehicles continuously at road intersections. Understand the function of various components.
- Record the traffic volume.

III. Course Level Learning Outcome (COs):

- CO 4- Suggest the traffic control devices and intersections based on traffic flow survey data.

IV. Laboratory Learning Outcome (LLO):

- LLO 10.1 Perform traffic volume survey for a road intersection.

V. Relevant Affective Domain related Outcome(s): Follow safe practices.

- Demonstrate working as a leader/a team member.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Traffic Volume Study: It is the survey of number of different vehicles crossing a section of road per unit time during selected period, is called as Traffic Volume Study. The study is done at selected points called as Count Posts or Traffic Count Stations. This study is made twice a year depending on the importance of road. If the office works between 10 am to 5 pm, then peak traffic will occur 9 am to 12 pm and 4 to 7 pm. Therefore, this traffic survey should be done in these hours to get correct information of traffic.

This survey is carried for 4, 8, 12, 16 or 24 hours at predetermined station for selected road intersection

Objectives of Traffic Volume Study:

This traffic volume study is done purposefully to achieve following objectives.

1. Establish relative importance of roads and traffic control devices i.e. signs, signals, markings and islands.

2. Decide the priority for improvement and expansion of a road to allot the funds accordingly.
3. Plan and design the existing and new traffic control devices.
4. Analyze the traffic flow pattern and trends on the road.
5. Design the structural pavements and geometrical parameters of road based on traffic load.
6. Make the modification in regulatory measures like one way, lane separation, route diversion etc., through traffic volume distribution study.
7. Design the side walk, cross walk, pedestrian signals, and signal timings by knowing pedestrian volume.

VII. Actual diagram with equipment specification.

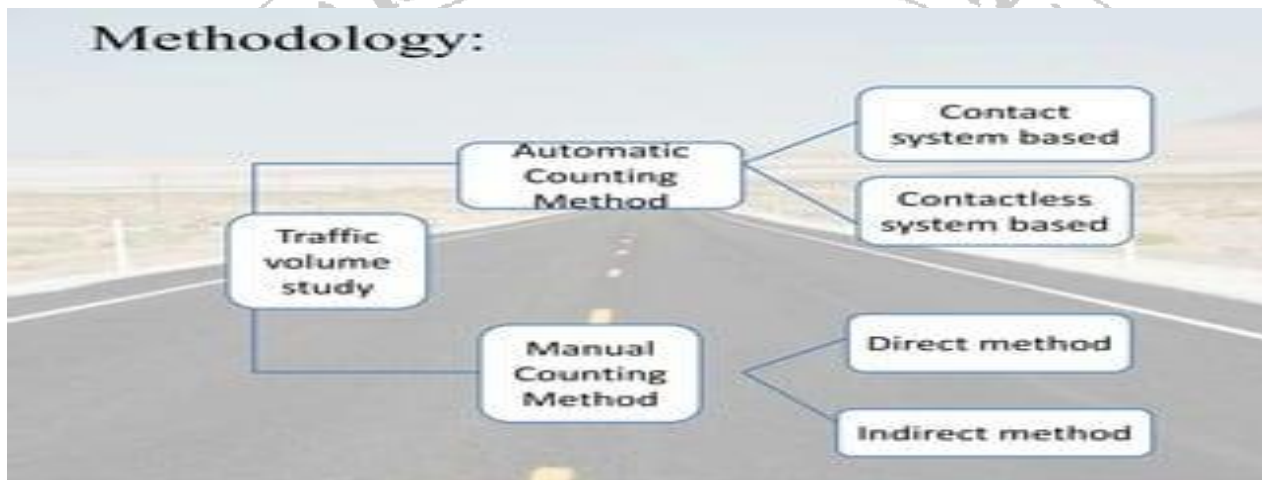


Figure 10.1: Traffic Volume Study Methods



Figure 10.2: Manual Counting Method

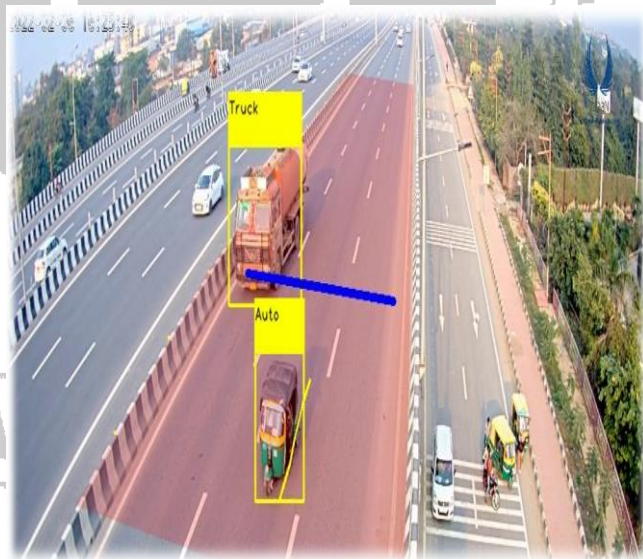


Figure 10.3: Automatic Counting Method

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
1.	Traffic Enumerators form	As specified in observations	1set

IX. Precautions to be followed:

1. Observe the vehicles without disturbing the traffic flow.
2. There should be mutual coordination between team members throughout this practical.
3. The said work should be divided to group of minimum two members at each count posts, so that no vehicle will remain uncounted.
4. The extra care should be taken during peak hours and record the same in appropriate columns of enumerators form.

X. Procedure:

1. Select road intersection/roadway in your city
2. Select the time slot for traffic volume count.
3. Take the permission of Traffic police / Municipality.
4. Fill the enumerators form for the selected road intersection.
5. Define the count post or traffic count stations at various points of your intersection.
6. Observe the various types vehicles i.e. two wheelers, three wheelers, four wheelers and heavy or multi-axle vehicles moving actually on road section.
7. Record the left turning, straight going and right turning vehicles and pedestrians in the enumerators form using Roman Counting Method. The extra care should be taken during peak hours and record the same in appropriate columns of enumerators form.

XI. Observation:

Sample Enumerators Form:

Traffic Volume Survey at road Intersection.

1. Location of intersection: -----
2. Type of road and route number: -----
3. Name of approach road: -----
4. Date and Time of commencement: -----
5. Date and Time of completion: -----

Type of Vehicle	Left Turning		Straight Going		Right Turning	
	Enumeration	Total	Enumeration	Total	Enumeration	Total
Two-Wheeler						
Bi-cycle						
Scooter						
Motor Cycle						
Three Wheeler						
Auto Rickshaw						
Tempo						
Four Wheeler						
Car						
Jeep						
Van						
Heavy/multi-axle						
Bus						
Truck						
Containers						
Others						
Animal/Hand Driven						
Vehicles for Physically Impaired						
Pedestrians						

Format for Traffic Volume Study on Roadway

1. Name of Road:
2. Direction of Road:
3. Date:
4. Time Start: Time Ends:

Types of Vehicles	Vehicle Count	Total
Two-Wheeler		
Bi-cycle		
Scooter		
Motor Cycle		
Three Wheeler		
Auto Rickshaw		
Tempo		
Four Wheeler		
Car		
Jeep		
Van		
Heavy/multi-axle		
Bus		
Truck		
Containers		
Others		
Animal/Hand Driven		
Vehicles for Physically Impaired		
Pedestrians		

XII. Result:

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XIII. Interpretation of Results:

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XIV. Conclusions:

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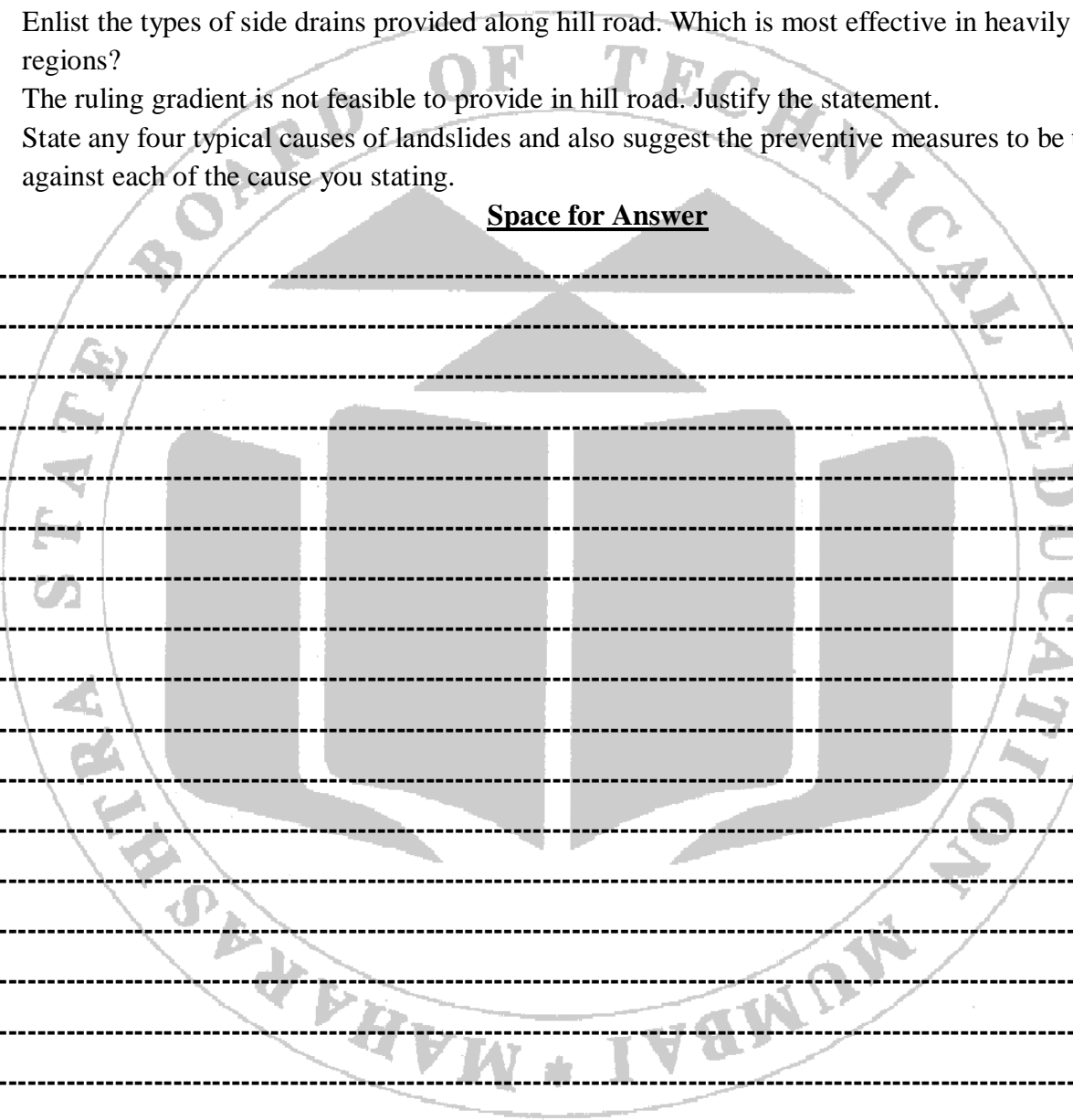
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XV. Practical Related Questions:

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. State the difference between normal roads and hill roads in terms of its geometric design.
2. Enlist the various practical difficulties in hill road construction as compared to normal roads.
3. Enlist the types of side drains provided along hill road. Which is most effective in heavily rainfall regions?
4. The ruling gradient is not feasible to provide in hill road. Justify the statement.
5. State any four typical causes of landslides and also suggest the preventive measures to be taken against each of the cause you stating.

Space for Answer



A large watermark of the Maharashtra State Board of Technical Education logo is centered on the page. The logo is circular with the text 'MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION' around the perimeter and 'MUMBAI * 1963' at the bottom. In the center of the logo is a stylized emblem featuring a book and a lamp. Below the watermark, the page contains a series of horizontal dashed lines intended for writing answers.

XVI. References/ suggestions for further Reading

Sr. No.	Links	Description
1	https://www.youtube.com/watch?v=0yZgMc110po	Traffic Volume Study
2	https://www.youtube.com/watch?v=0yZgMc110po&t=1674s	Traffic Enumerators form
3	https://www.youtube.com/watch?v=0yZgMc110po&t=866s	Manual Counting Method

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Survey work with proper observations	25%
2.	Recording of accurate type of vehicles	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusions	20%
5.	Answers to practical related questions	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 11 Analysis of Traffic volume data Study.

I. Practical Significance:

The traffic volume study gives us numerical data of actual traffic flow. The total number of vehicles passing the road intersection shows the overall usability of that particular road. It is necessary to take judgment of traffic regulatory measures, so that the traffic related problems can be minimized at certain extent. The traffic flow characteristics like traffic density, traffic capacity can be determined through collected data. The analysis of such data gives us idea about improvement in traffic flow through necessary modification.

II. Industry/Employer Expected Outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- Understand the traffic flow pattern.
- Understand the function of various components.
- Record the traffic volume Draw the traffic flow chart for given road intersection.
- Suggest the possible solution for smooth traffic flow.

III. Course Level Learning Outcome (COs):

- CO4 - Suggest the traffic control devices and intersection based on traffic flow survey data.

IV. Laboratory Learning Outcome (LLO):

- LLO 11.1 Analysis traffic volume data and Interpret data.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Demonstrate working as a leader/a team member.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

1. Passenger Car Unit (PCU): It is the standard vehicle unit which is considered to convert the other vehicle classes, is called as Passenger Car Unit i.e. PCU. In case of mixed or heterogeneous traffic flow, vehicles have wide range of static and dynamic characteristics such as length, width, speed, acceleration. Such characteristics are complex to analyze, hence PCU may be considered as a measure of the relative space requirement of a vehicle class as compared to a passenger car.

2. Table for conversion of vehicles into PCU:

Passenger Car Unit (PCU) is a metric used in Transportation Engineering, to assess traffic-flow rate on a highway. A Passenger Car Unit is a measure of the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single standard passenger car. This is also known as passenger car equivalent. For example, typical values of PCU or PCE are as follows.

Table 1: Values of PCU

Types of Vehicles	PCU Equivalent
Car	1.0
Motorcycle	0.5
Bicycle	0.2
LCV	2.2
Bus, Truck	3.5
3-Wheeler	0.8

- Traffic Density:** It is defined as the number of vehicles occupying a unit length of lane of roadway at a given instant, is called as traffic density and usually expressed as vehicles per kilometer.
- Traffic Capacity:** It is defined as the ability of a road way to accommodate traffic volume, is called as traffic capacity and is expressed as the maximum number of vehicles in a lane or road that can pass a given point in unit time, usually an hour.
- Traffic flow diagram:** It is the graphical representation of data collected in traffic volume study, is called as traffic flow diagram.

VII. Actual diagram with equipment specification.

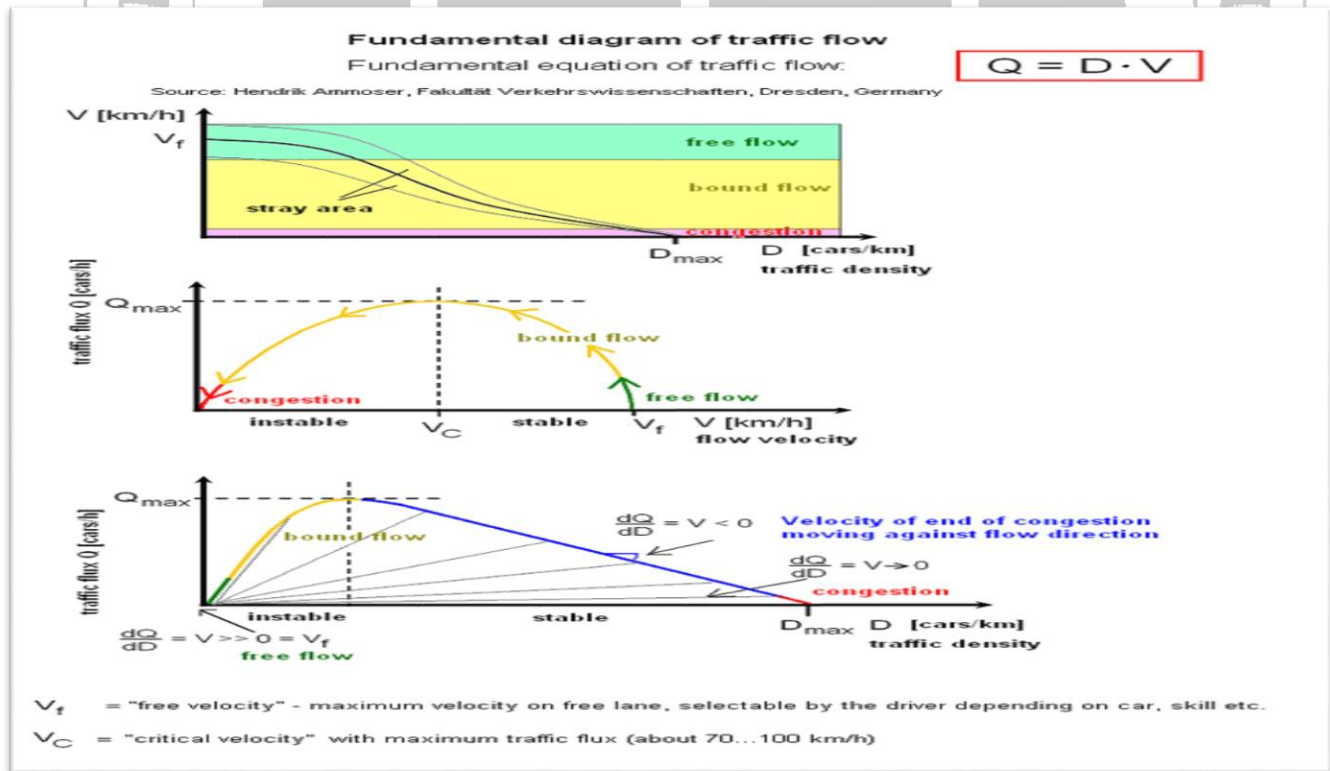


Figure 11.1: Fundamental Diagram of traffic Flow

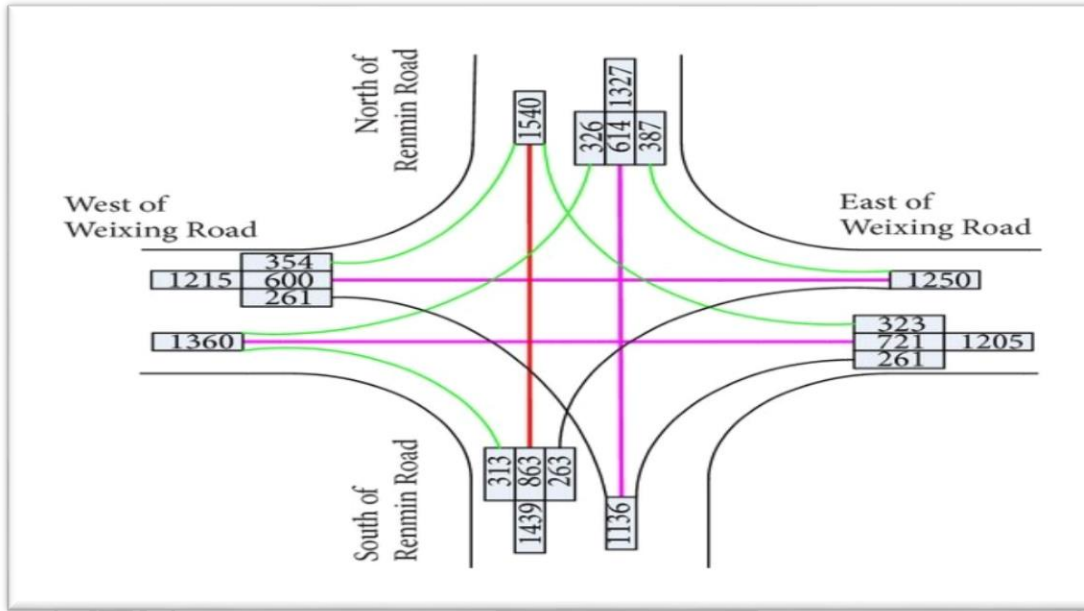


Figure 11.2: Conceptual Diagram of Traffic flow pattern

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Traffic Enumerators form	As filled in Previous Experiment	1 nos.

IX. Precautions to be followed:

1. There should be mutual coordination between team members throughout this practical
2. The said work should be divided to group of minimum two members at each count posts, so that no vehicle will remain uncounted.
3. The extra care should be taken during peak hours.

X. Procedure:

1. Make the summation of total number of left turning, straight going and right turning vehicle at all locations separately.
2. Take the addition of vehicles in both directions for traffic volume of study on roadway.
3. Also make the summation of the total number vehicles incoming and outgoing from particular road section.
4. Finally calculate the total number of vehicles at selected road intersection by adding the total vehicles at various traffic count stations.
5. Draw the traffic volume diagram indicating number of vehicles at various sections.

XI. Observation

Analysis of Traffic Volume Observed at Intersection

From First approach of Intersection.

- 1. The total number of turning vehicles.....
- 2. The total number straight going vehicles.....
- 3. The total number of turning vehicles.....
- 4. Inward traffic intersection from approach.....
- 5. Outward traffic from intersection approach.....

From Second approach of Intersection.

- 1. The total number of turning vehicles.....
- 2. The total number straight going vehicles.....
- 3. The total number of turning vehicles.....
- 4. Inward traffic intersection from approach.....
- 5. Outward traffic from intersection approach.....

From Third approach of Intersection.

- 1. The total number of turning vehicles.....
- 2. The total number straight going vehicles.....
- 3. The total number of turning vehicles.....
- 4. Inward traffic intersection from approach.....
- 5. Outward traffic from intersection approach.....

From Four approach of Intersection.

- 1. The total number of turning vehicles.....
- 2. The total number straight going vehicles.....
- 3. The total number of turning vehicles.....
- 4. Inward traffic intersection from approach.....
- 5. Outward traffic from intersection approach.....

Analysis of Traffic Volume observed on Roadway

- 1. Name of Road:
- 2. Number of vehicles rightward direction lane.....
- 3. Number of vehicles in leftward direction lane.....
- 4. Total traffic in PCU per hour on roadway.....
- 5. Traffic Composition observed on roadway.....

XII. Result:

XIII. Interpretation of Results:

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Calculation	25%
2.	Data Analysis	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusion of practical	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 12 *Draw and identify the traffic signs, road markings, islands, intersections in your city/ town/ village and prepare the photographic report.

I. Practical Significance:

In any city, traffic signs, road markings, and islands play vital roles in ensuring safety, guiding traffic flow, and efficient operation of the transportation system in any city, ensuring that road users can navigate streets with clarity and confidence while minimizing the risk of accidents and congestion. While intersections are essential elements of city infrastructure that impact traffic flow, safety, accessibility, and urban development. Proper design, management, and maintenance of intersections are essential for ensuring the functionality and livability of urban areas.

II. Industry/Employer Expected Outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).
This practical is expected to develop the following skills for the Industry identified.

- Understand the traffic flow pattern.
- Understand the function of various components.
- Record the traffic volume Draw the traffic flow chart for given road intersection.
- Suggest the possible solution for smooth traffic flow.

III. Course Level Learning Outcome (COs):

- CO4 - Suggest the traffic control devices and intersections based on traffic flow survey data.

IV. Laboratory Learning Outcome (LLO):

- LLO 12.1- Examine and relate the meaning of the traffic signs, road markings, and islands in your city.

V. Relevant Affective Domain related Outcome(s):

- Demonstrate working as a leader/a team member.
- Practice good housekeeping.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

1. **Traffic Signs:** Traffic signs provide essential information to drivers, pedestrians, and cyclists, helping them navigate roads safely and efficiently. They convey regulations, warnings, directions, and other important information, such as speed limits, lane usage, and upcoming hazards.
2. **Road Markings:** Road markings, including lane dividers, crosswalks, and directional arrows, help define lanes, regulate traffic flow, and indicate safe areas for pedestrians. They enhance visibility and clarity on the road, reducing the risk of accidents and promoting orderly movement of vehicles.
3. **Traffic Islands:** Traffic islands serve various purposes, including controlling turning movements, separating opposing traffic streams, and providing pedestrian refuge areas. They contribute to intersection safety by managing traffic conflicts and improving pedestrian

VII. Actual diagram with equipment specification.



Figure 12.1: Traffic Control Device

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Camera	As per availability	1 No.
02	Note pad, Pencil etc.		1No. each students

IX. Precautions to be followed:

1. There should be mutual coordination between team members throughout this practical.
2. The said work should be divided to group of minimum two members.
3. The extra care should be taken during peak hours.
4. Summarize the photographs taken during the site visit.
5. Paste the photographs of each of the identified components and write the functions of the same in the specified format given below.

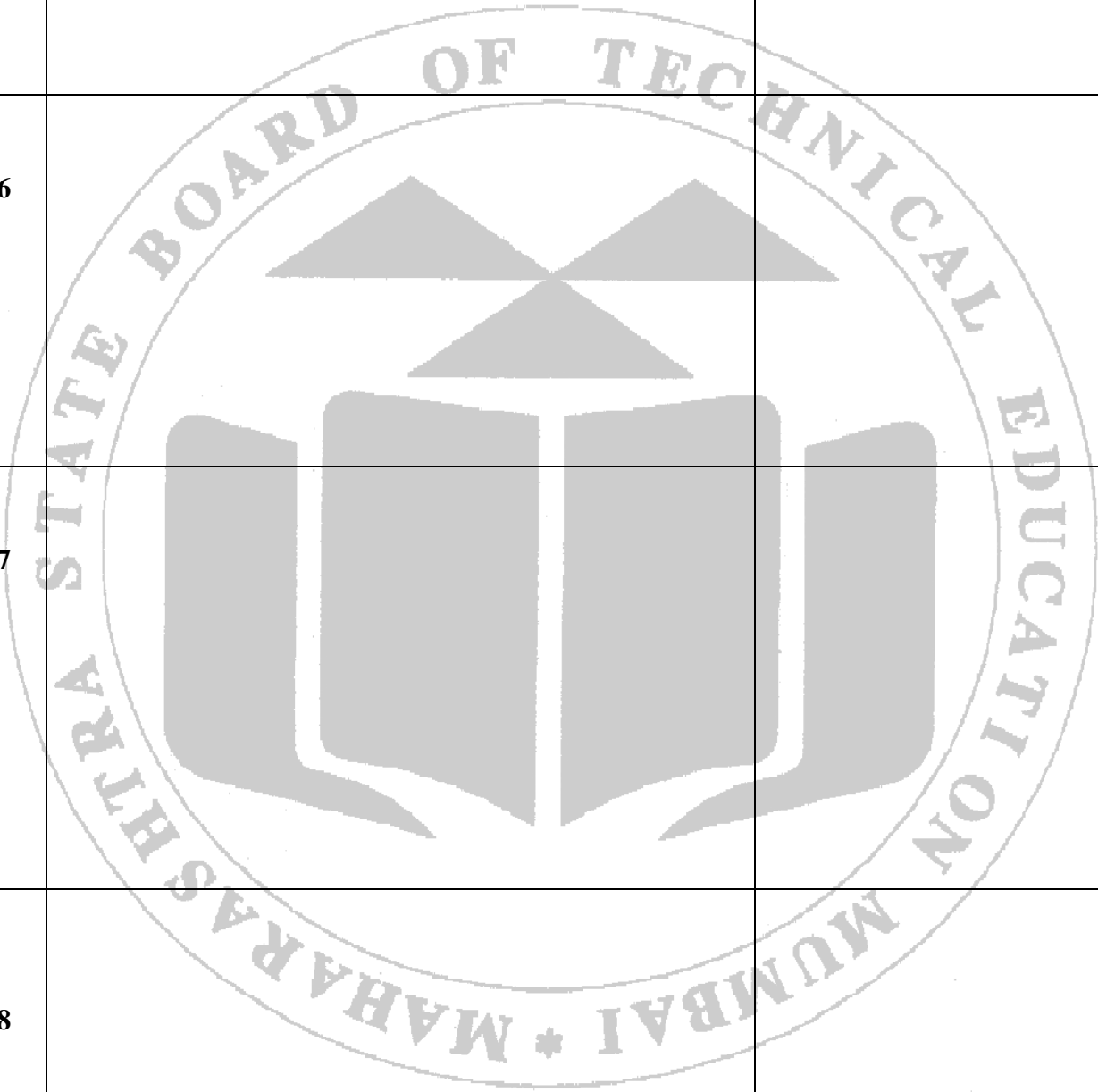
X. Procedure:

1. Identify the traffic signs, road markings, islands, intersections and the clear photographs should be taken.
2. The group photograph of site visit should be also attached at the end of this assignment.

XI. Observation Table:

Sr. No	Draw Observed Road Sign, Markings, Islands, Intersections	Function of Each
1		
2		
3		
4		

5		
6		
7		
8		



XVI. References/Suggestions for further Reading

Sr. No	Links	Description
1	https://www.youtube.com/watch?v=tgPBYXgTECA	Traffic control devices
2	https://www.youtube.com/watch?v=fI79h9kc90E	Traffic control devices
3	https://www.youtube.com/watch?v=oFi-UrPUgpE	Road Intersection

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Identify Traffic Signs, markings	25%
2.	Identify island and intersections	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusion of practical	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 13 Visit the road of any one type flexible or rigid to know the road drainage system.

I. Practical Significance:

It is very essential that road surface and sub-surface should remain dry for longer period so as to avoid any possible defects in it. Hence it becomes necessary to study the drainage system of proposed road under construction. This particular assignment brought to know the various parameters regarding the effective working of drainage in various roads. The site visit will be able to provide all such details to understand the knowledge regarding road drainage.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- A student should be understanding the necessity of road drainage.
- Identify the parameters of road drainage conditions.
- Verify the present drainage condition of given road.

III. Course Level Learning Outcome (COs):

- CO 1 -Identify the roads based on recommendations of IRC.
- CO 2- Implement geometrical features of different Highways.
- CO 5-Suggest the relevant precautionary measures to control the drainage based on inspection to maintain the given section of roads.

IV. Laboratory Learning Outcome (LLO):

- LLO 13.1 inspect the existing road drainage system in your area and identify its type.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Road Drainage It is the road system which collect, transport and disposed of the surface and sub-surface water away from the road as early as possible.

Types of road drainage system- Depending upon the sources of water coming to road, the drainage system is classified in two categories.

1. **Surface Drainage System** in this system the surface water from direct sources i.e. rainfall and runoff is drained off away from road way.

2. **Sub-Surface Drainage System-** In this system, the sub-surface water i.e. ground water table, percolated and water from water logged areas is drained off away from road bed.

Types of Drains- Depending upon the type of road drainage system, the following type of Drainage structures should be constructed.

Drains provided in Surface Drainage System-

1. Side drain- It is generally provided for the road constructed on fairly leveled ground i.e. in case of moral roads. It is also required in hill road drainage. It is required along either sides of alignment of road.

2. Catch water drain- It is most commonly provided in case of upper side of hill roads. It catches the rainwater coming on hill road surface.

Drains provided in Sub-Surface Drainage System-

1. Longitudinal drain (L-Drain) - It is provided along either sides of alignment sufficiently below the sub-surface of road. It is located just below the road edge to collect the sub-surface water from cross drain pipe.

2. Cross water drain (C-Drain) - It is provided along width of road i.e. perpendicular to longitudinal drains. It has some spec

VII. Actual diagram with equipment specification.

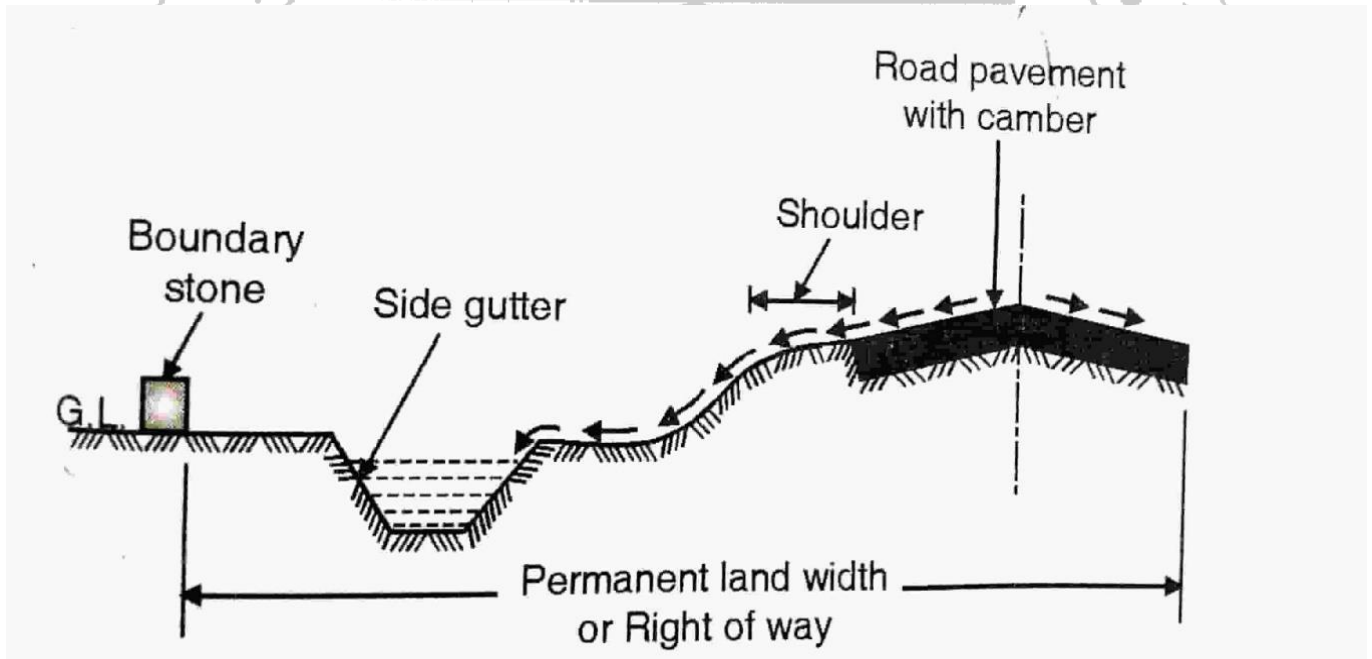


Figure 13.1: Surface Drainage System

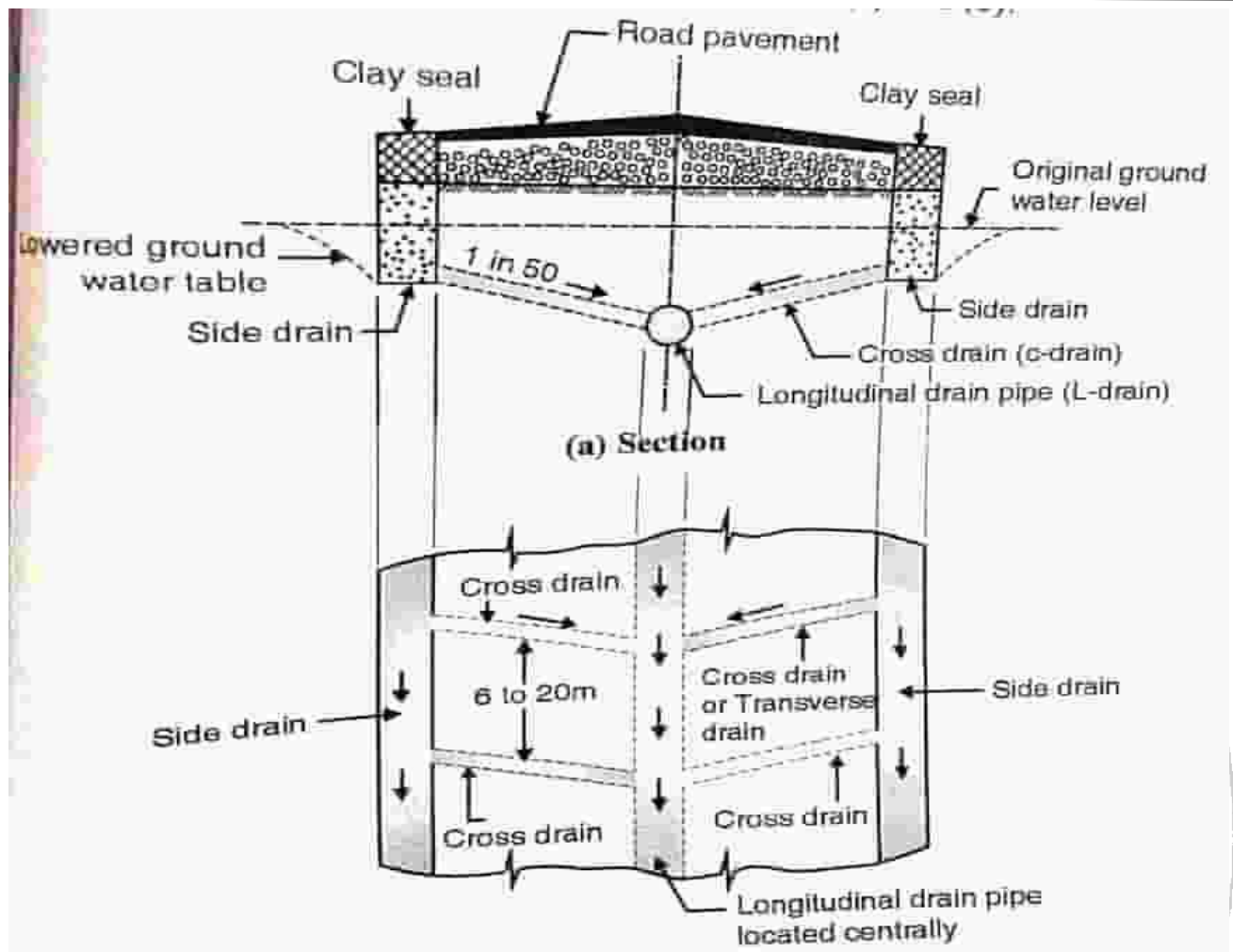


Figure 13.2: Sub- Surface Drainage System with Transverse Drains

VII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Camera	As per availability	1 No.
02	Note pad, Pencil etc.		1No each students

VIII. Precautions to be followed:

1. There should be mutual coordination between team members throughout this practical.
2. The said work should be divided to group of minimum two members.
3. The extra care should be taken during peak hours.
4. Summarize the photographs taken during the site visit.
5. Maintain discipline during Visit.

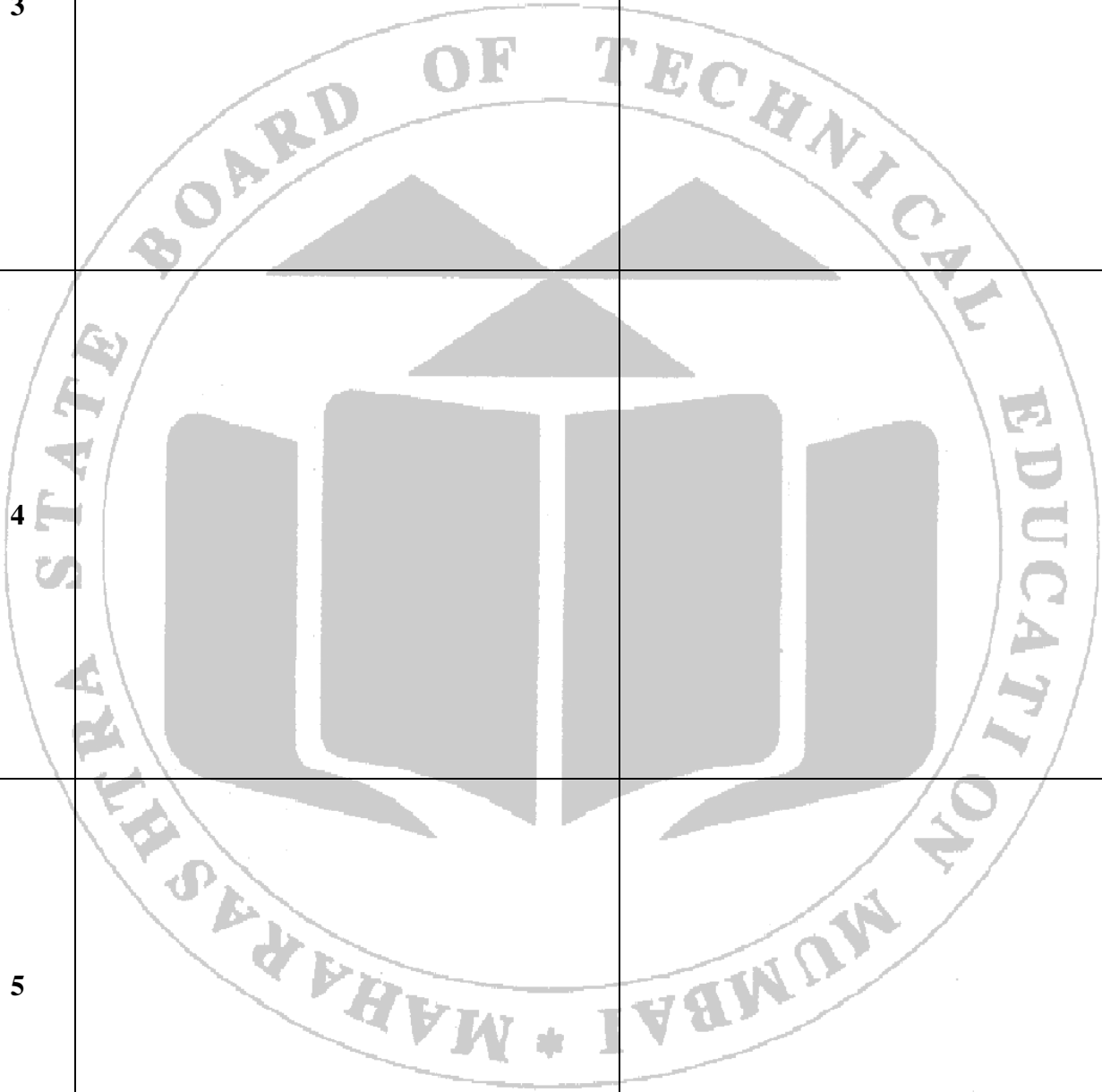
IX. Procedure:

1. Identify the road site working drainage system and the clear photographs should be taken.
2. Summarize the photographs of road drainage taken during the site visit.
3. Paste the photographs of each of the identified components and write the functions of the same in the specified format given below.
4. The group photograph of site visit should be also attached at the end of this assignment.

X. Observation:

Sr. No	Identified components with photograph	Function of Identified components
1		
2		

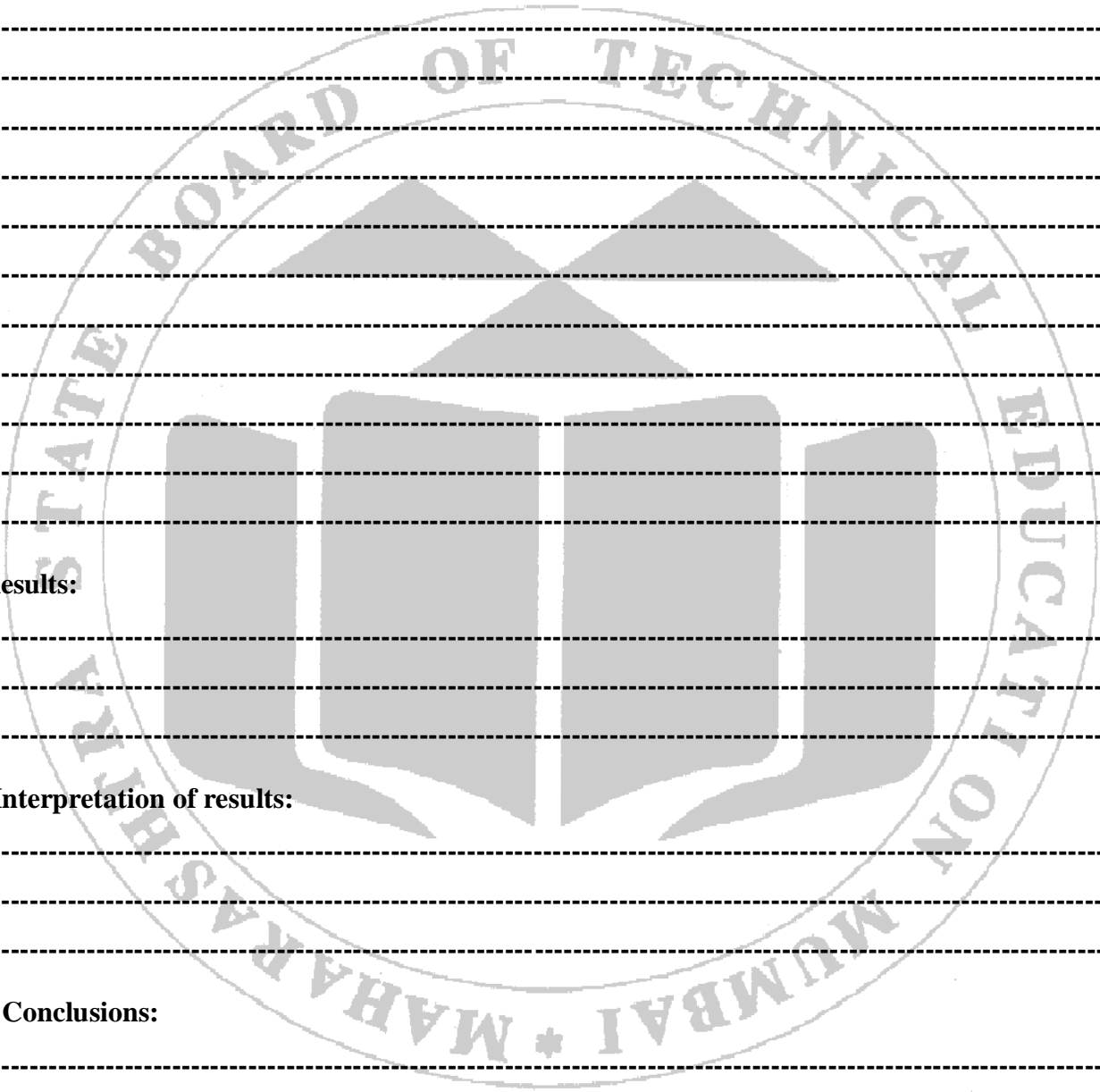
3		
4		
5		



XI. Results:

XII. Interpretation of results:

XIII. Conclusions:

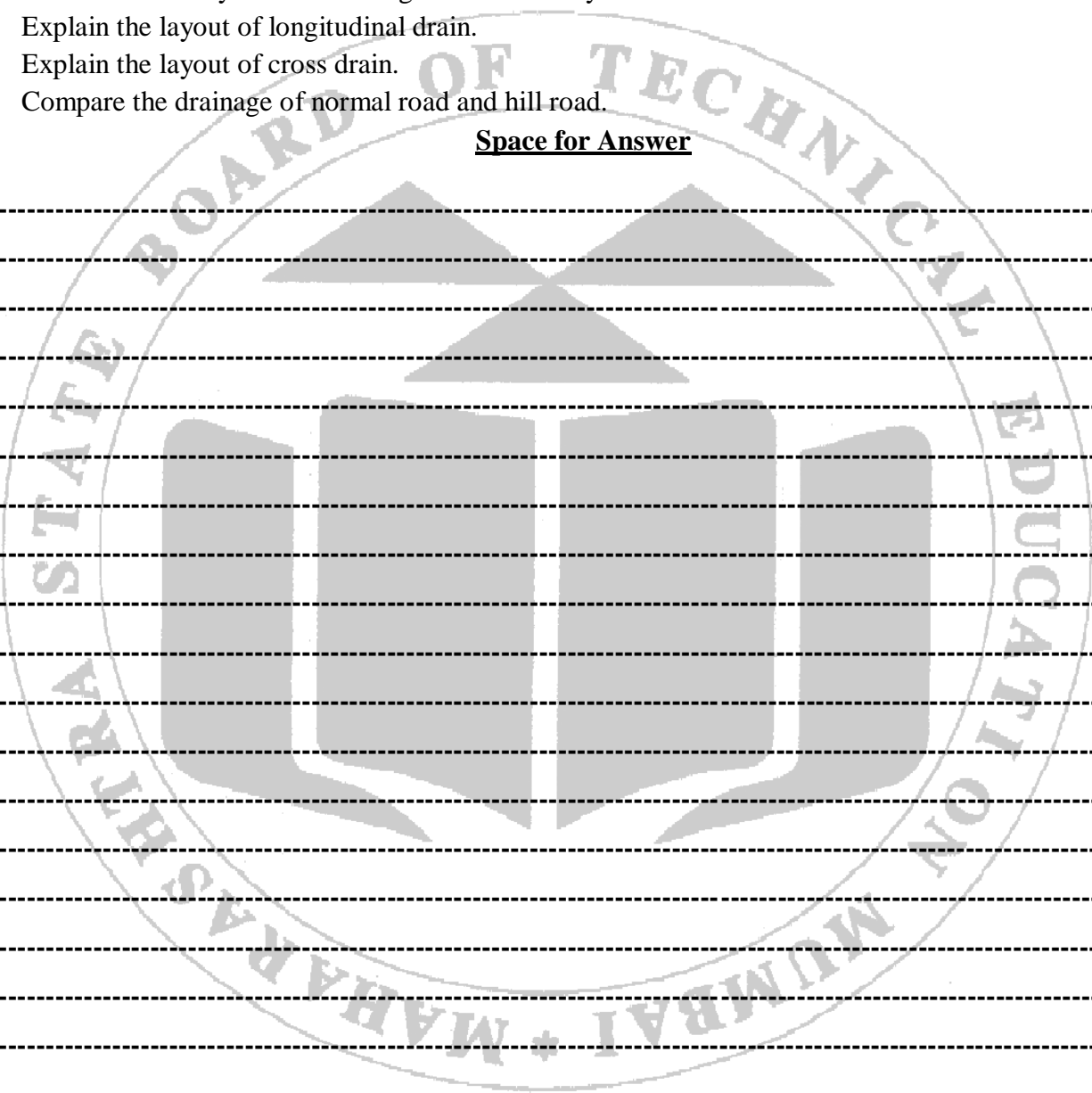


XIV. Practical Related Questions:

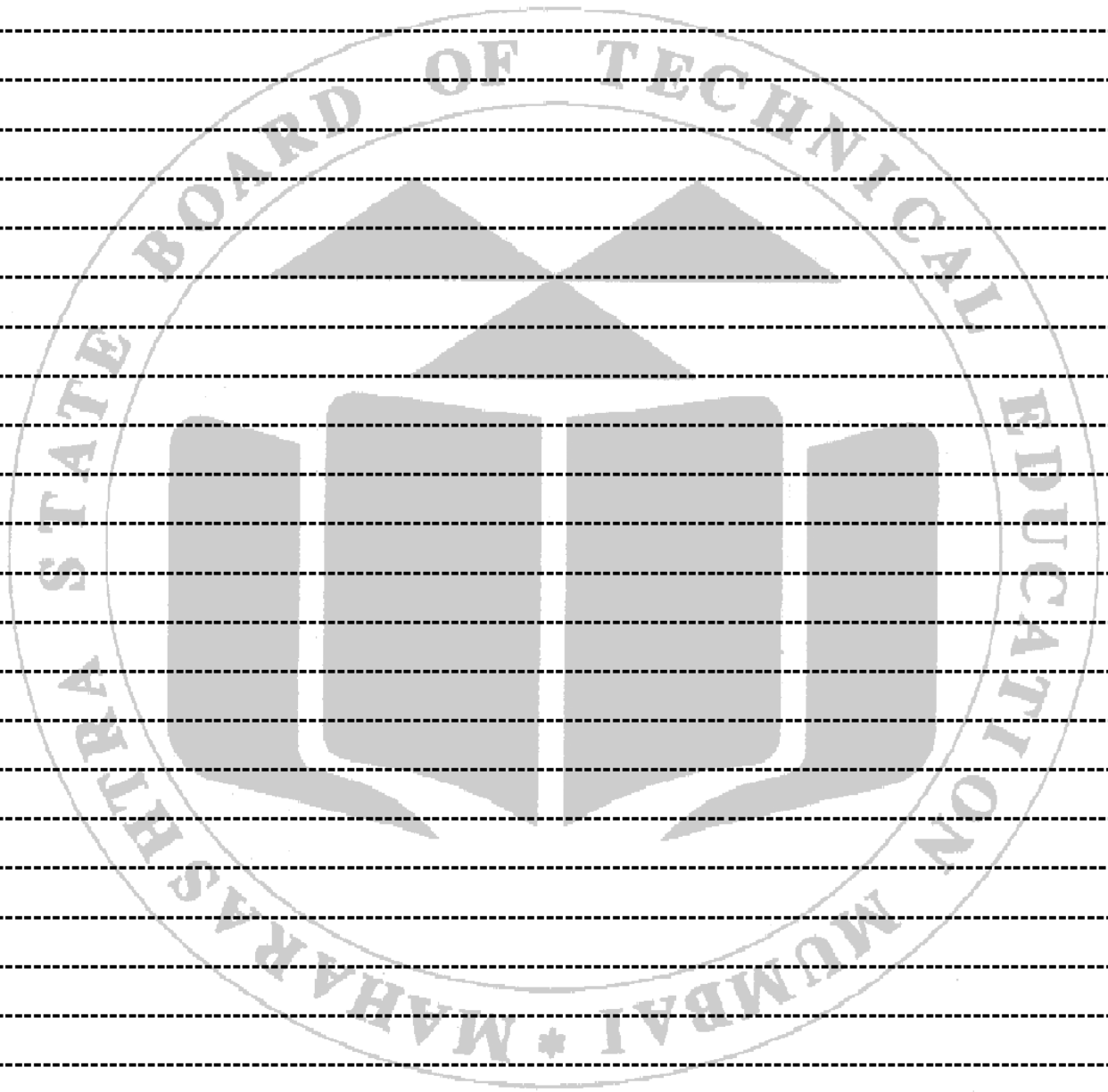
Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions

1. State the types of drains in surface and sub-surface drainage system.
2. State the necessity of road drainage for its stability.
3. Explain the layout of longitudinal drain.
4. Explain the layout of cross drain.
5. Compare the drainage of normal road and hill road.

Space for Answer



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XVI. References/Suggestions for further Reading

Sr. No	Link	Description
1	https://www.youtube.com/watch?v=NESzsAw1r78	Subsurface Drainage
2	https://www.youtube.com/watch?v=kRvA_k1z6ls	Road Drainage

XVII. Assessment Scheme.

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Observation of drainage	25%
2.	Identifying the components	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusion of practical	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 14 *Visit the road to identify the defects in road and suggest the possible remedial measures for it and prepare photographic report.

I. Practical Significance:

Road defects can be caused by various factors such as weather, constant vehicle traffic flow, inadequate construction techniques, weak or unstable soil beneath the road, vegetation, and utility cuts.etc. Due to above factors Road defects can include a range of issues such as potholes, cracks, uneven surface, drainage problems etc. When visiting a road noticing defects and mark is significant for safety and maintains reasons. They can cause accidents, vehicle damage. For smoother traffic flow and safer road conditions for everyone identify defects reporting them and timely repair.

II. Industry/Employer expected outcome(s):

Undertake the construction of the given type of pavements including its maintenance (Roads).

This practical is expected to develop the following skills for the Industry identified.

- A student should be identifying the road defects in various roads.
- To observe road defects and suggest possible remedial.

III. Course Level Learning Outcome (COs):

- CO 1 -Identify the roads based on recommendations of IRC.
- CO 2- Implement geometrical features of different Highways.
- CO 5-Suggest the relevant precautionary measures to control the drainage based on inspection to maintain the given section of roads.

IV. Laboratory Learning Outcome (LLO):

- LLO 14.1 Identify the defects in road.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Demonstrate working as a leader/a team member.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Typical Flexible Pavement Failures

- (i) Alligator (map) cracking
- (ii) Consolidation of pavement layers
- (iii) Shear failure
- (iv) Longitudinal cracking
- (v) Frost heaving
- (vi) Lack of binding (keying) to the lower course.
- (vii) Reflection cracking

Typical Rigid Pavement Failures

- (i) Scaling of cement concrete

- (ii) Shrinkage cracks
- (iii) Sapling of joints
- (iv) Warping cracks
- (v) Mud pumping
- (vi) Structural cracks

VII. Actual diagram with equipment specification

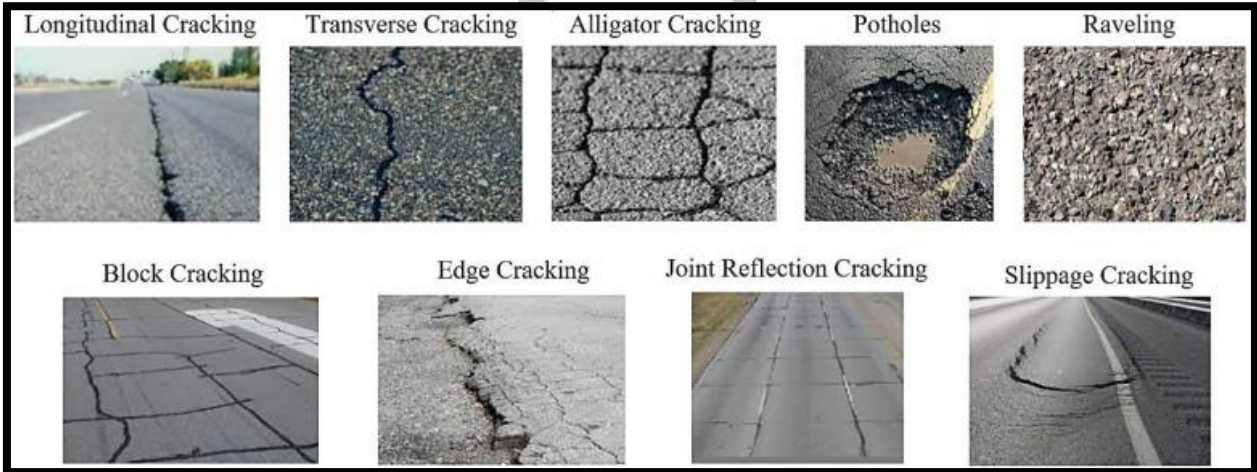


Figure 14.1: Typical Flexible Pavement Failures

VIII. Required Resources:

Sr. No.	Resource required	Particulars	Quantity
01	Camera	As per availability	1 No.
02	Note pad, Pencil etc.		1No each students

IX. Precautions to be followed:

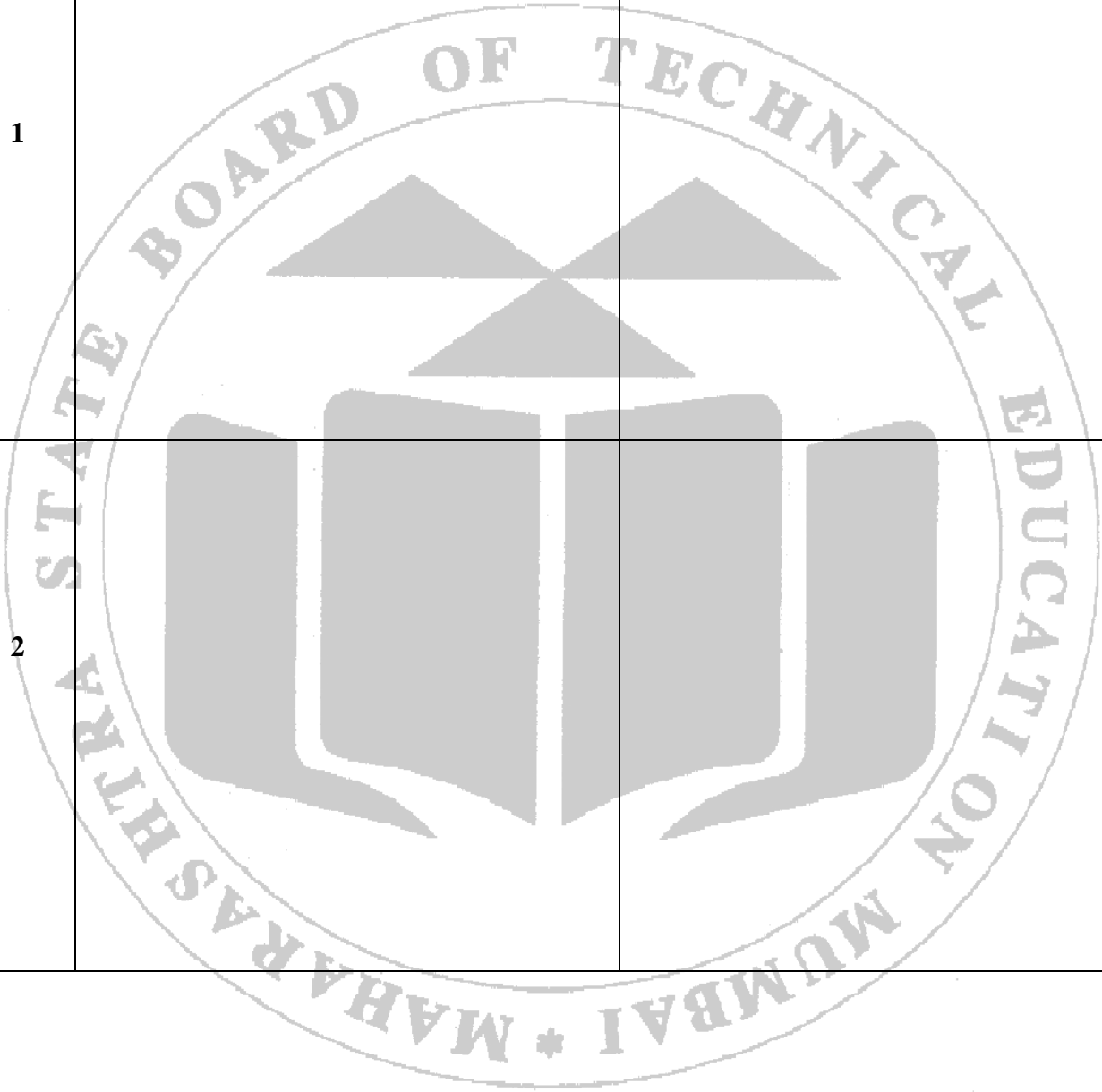
1. There should be mutual coordination between team members throughout this practical.
2. The said work should be divided to group of minimum two members.
3. The extra care should be taken during peak hours.
4. Summarize the photographs taken during the site visit.
5. Maintain discipline during Visit.
6. While marking the cracks checks the cracks extent.

X. Procedure:

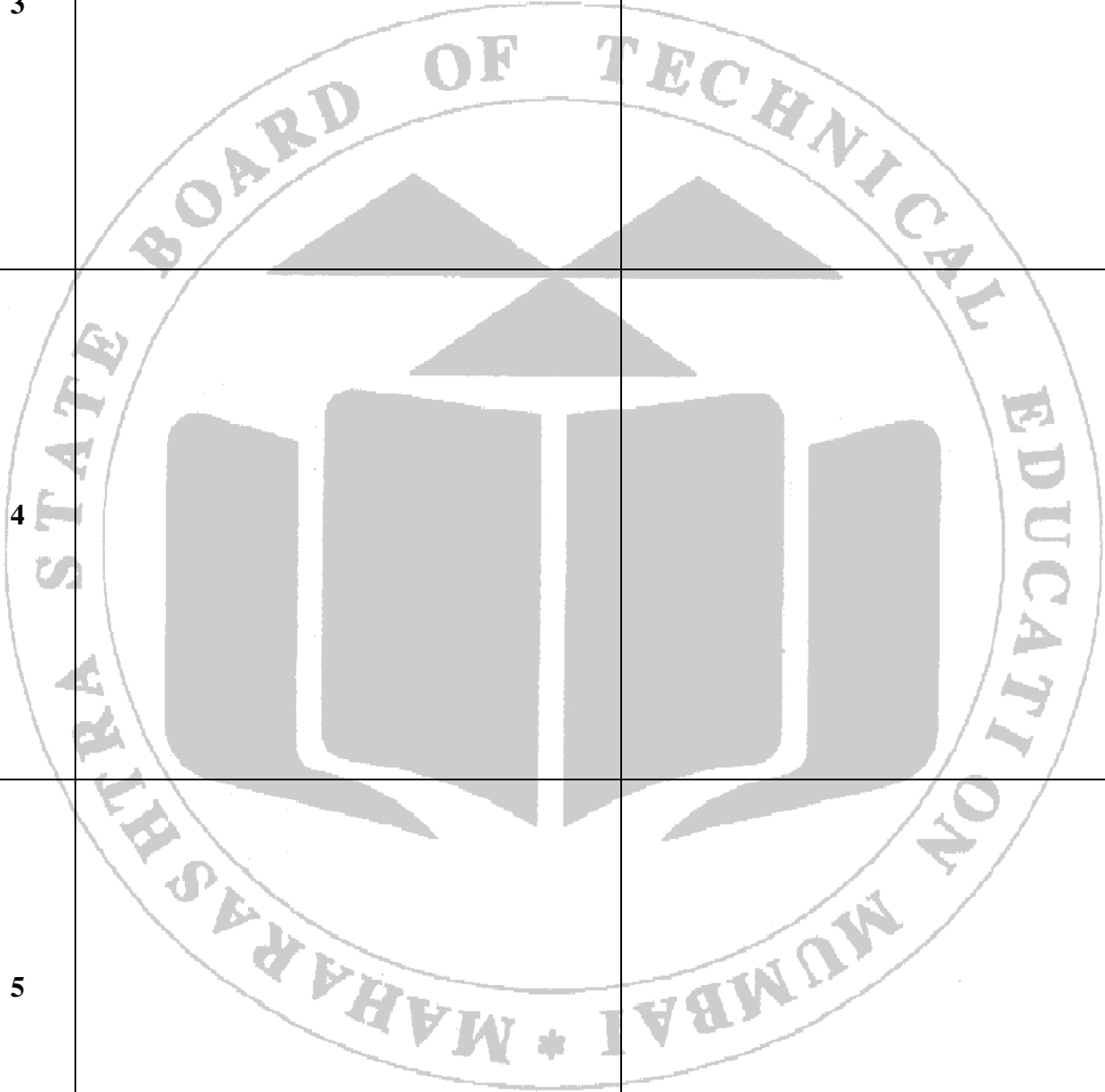
1. Identify the accessible site location of the defective road (WBM/Bituminous/Concrete) for the visit.
2. Identify the defects on road and the clear photographs should be taken.
3. Summarize the photographs of road defects taken during the site visit.
4. Paste the photographs of each of the identified defects and write the causes and remedial measures of the same in the specified format given below.
5. The group photograph of site visit should be also attached at the end of this assignment.

X. Observation Table:

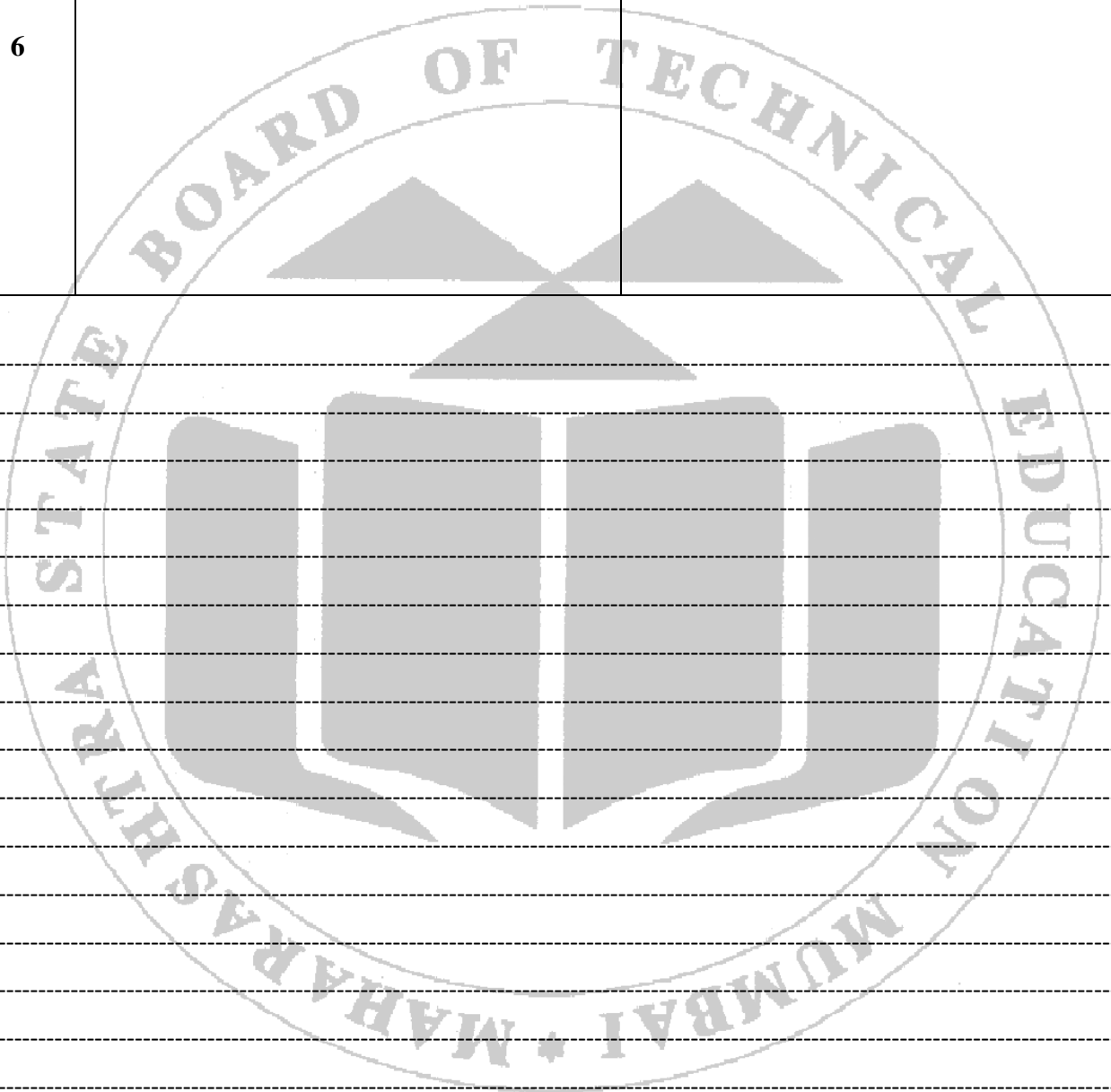
Sr. No	Types of defect observed with photograph	Suggestions regarding Remedial measures
1		
2		



3		
4		
5		



6		
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XI. Results:

XII. Interpretation of results:

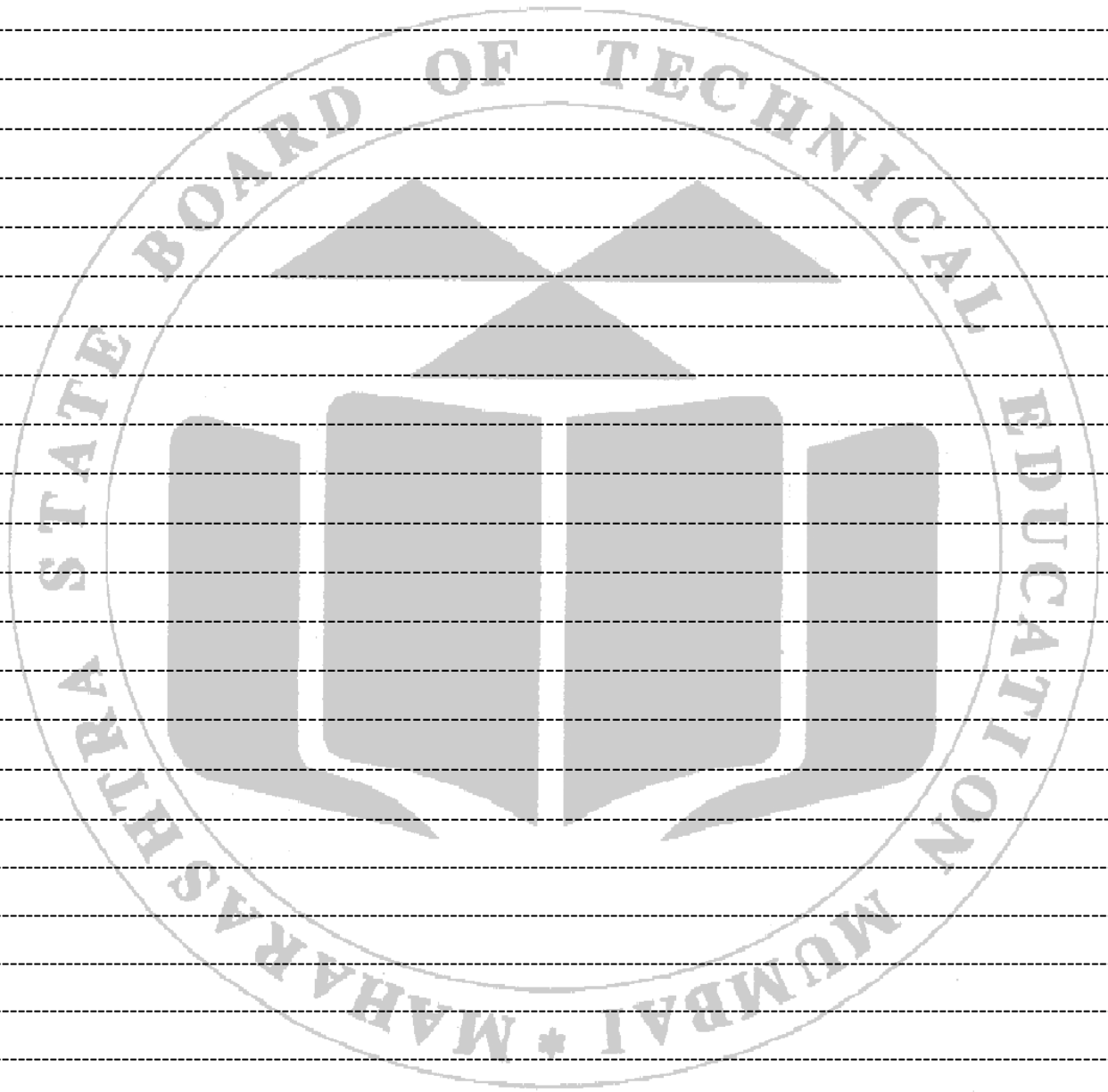
XIII. Conclusions:

XV. Practical Related Questions:

Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Enlist the chief causes of different defects or failure of rigid pavement.
2. Enlist the chief causes of different defects or failure of flexible pavement.
3. Compare the defects in flexible and rigid pavement.
4. List the precautions to be taken while road construction to minimize the occurrence of road defects.

Space for Answer



XVI. References/Suggestions for further Reading

Sr. No	Links	Description
1	https://www.youtube.com/watch?v=4ymS_x_Dfi0	Road Defects and maintenances
2	https://www.youtube.com/watch?v=d-Jm0Eh7etk	Rigid pavement Defects
3	https://www.youtube.com/watch?v=fHgIKFBEjBs	Flexible pavement Defects

XVII. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Identify the defects in various road	25%
2.	Suggest possible remedial	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusion of practical	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No: 15 *Suggest possible repairs and maintenance of the road visited in your city/ town/ village.

I. Practical Significance:

After knowing the various defects that may cause pavement failures, it is necessary to study the different measures that one adopted to maintain and upkeep the pavement for their excellent functions. As a basic principle, it may be observed that a highway which is designed based on scientific standing would resist the various detrimental force would need the minimum maintenance. This report study helps us to know the present road condition and measures to be taken to increase the life of road.

II. Industry/Employer expected outcome(s)

Undertake the construction of the given type of pavements including its maintenance (Roads).
This practical is expected to develop the following skills for the Industry identified.

- A student should be able to know various types of defects on various roads.
- Execute the process of repair and maintains
- To know the process of maintenance of highway.

III. Course Level Learning Outcome (COs):

- CO 2- Implement geometrical features of different Highways.
- CO 5- Suggest the relevant precautionary measures to control the drainage based on inspection to Maintain the given section of roads.

IV. Laboratory Learning Outcome (LLO):

- LLO 15.1 Suggest possible repair and maintenance of the road.

V. Relevant Affective Domain related Outcome(s):

- Using Safe behaviors effectively.
- Maintain high standards of hygiene.
- Efficient application of tools, equipment's and machinery.
- Professional and ethical standards.

VI. Relevant Theoretical Background:

Various maintenance operations are:

- (i) Routine maintenance
- (ii) Periodic maintenance
- (iii) Special repairs

VII. Actual diagram with equipment specification

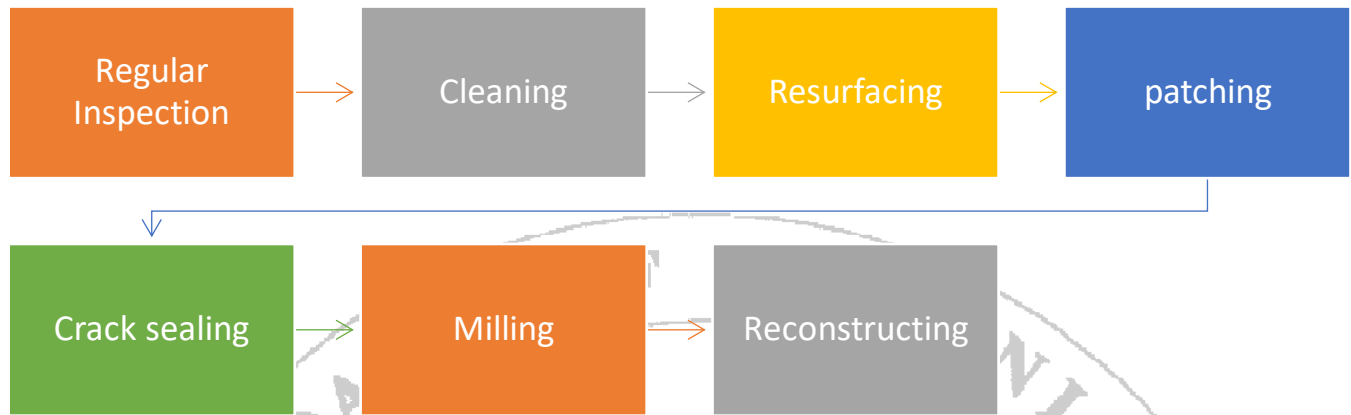


Figure 15.1: Maintenances and Repair of Bituminous Road



Figure 15.2: Road Repair Work

VII. Required resources/equipment:

Sr. No.	Resource required	Particulars	Quantity
1	Camera	As per availability	1 No.
2	Note pad, Pencil etc.		1No each students

VIII. Precautions to be followed:

1. There should be mutual coordination between team members throughout this practical.
2. The said work should be divided to group of minimum two members.
3. The extra care should be taken during peak hours.
4. Summarize the photographs taken during the site visit.
5. Maintain discipline during Visit.
6. While marking the cracks checks the cracks extent.

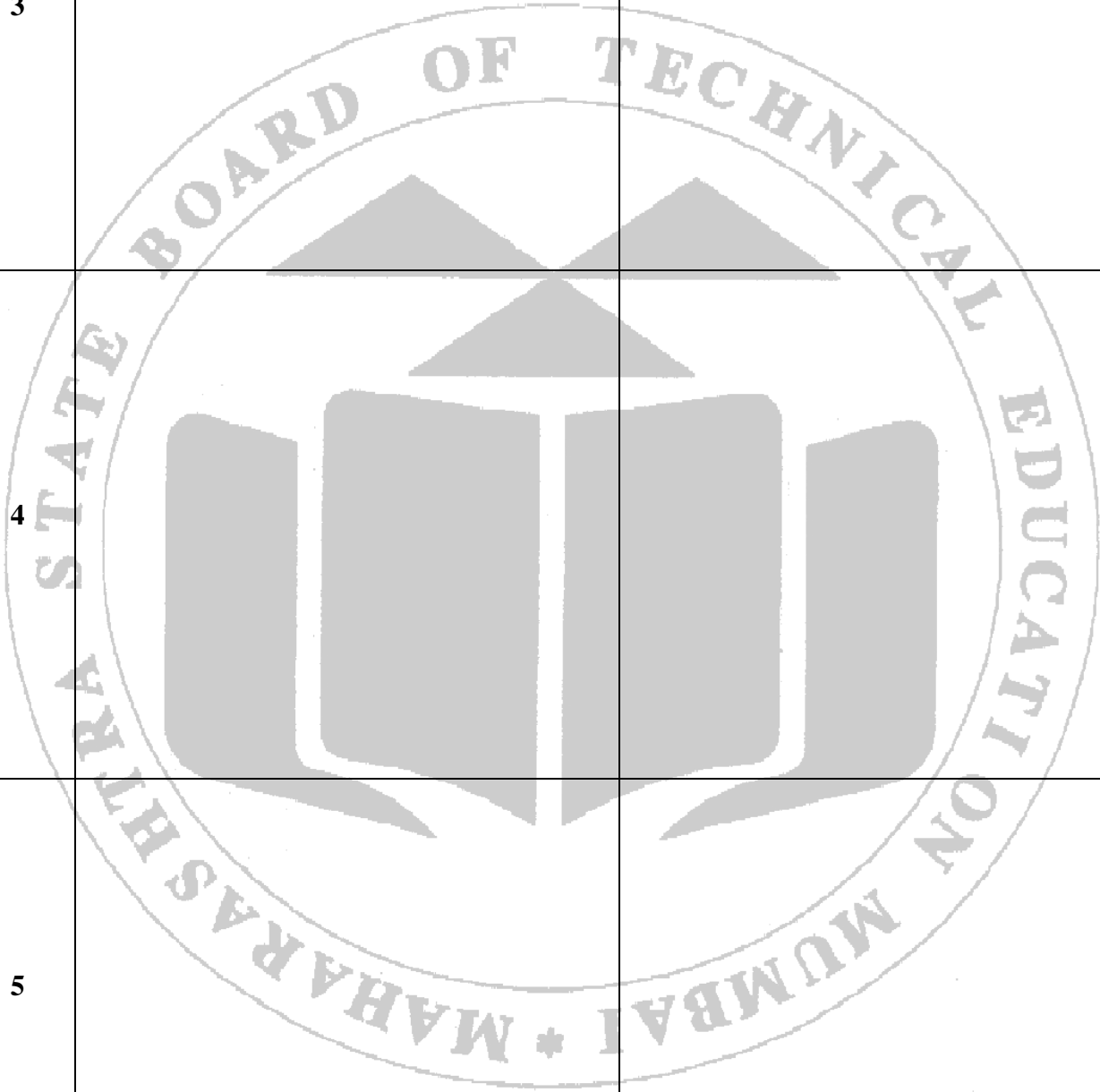
IX. Procedure:

1. Identify the accessible site location of the defective road (WBM/Bituminous/Concrete) for the visit.
2. Identify the defects on road and the clear photographs should be taken.
3. Summarize the photographs of road defects taken during the site visit.
4. Paste the photographs of each of the identified defects and write the causes and suggest the possible repair and maintenance required to increase the life of road.
5. The group photograph of site visit should be also attached at the end of this assignment.

X. Observation

Sr. No	Types of defect observed with photograph	Suggest possible repairs and maintenance
1		
2		

3		
4		
5		

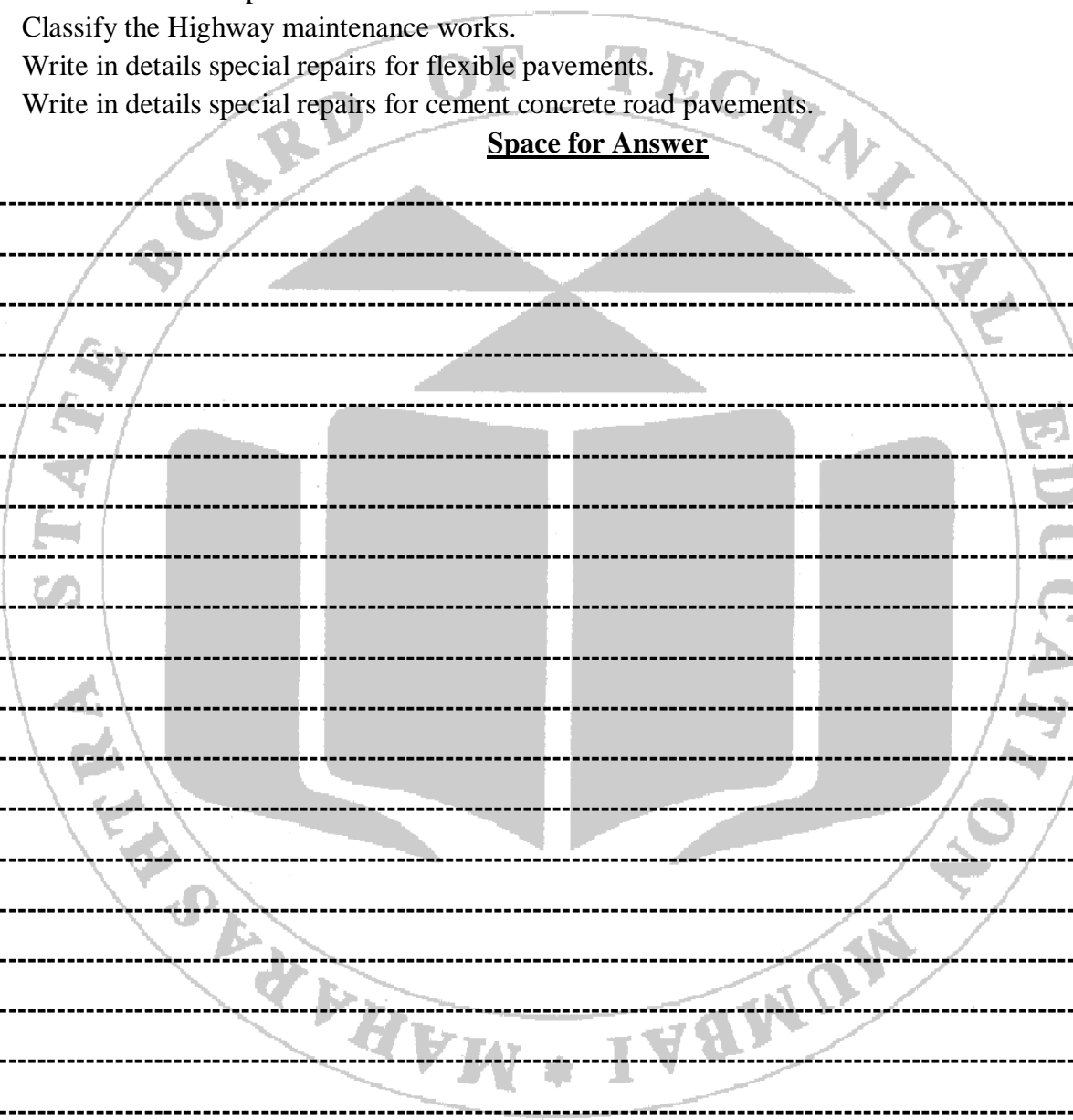


XIII. Practical Related Questions:

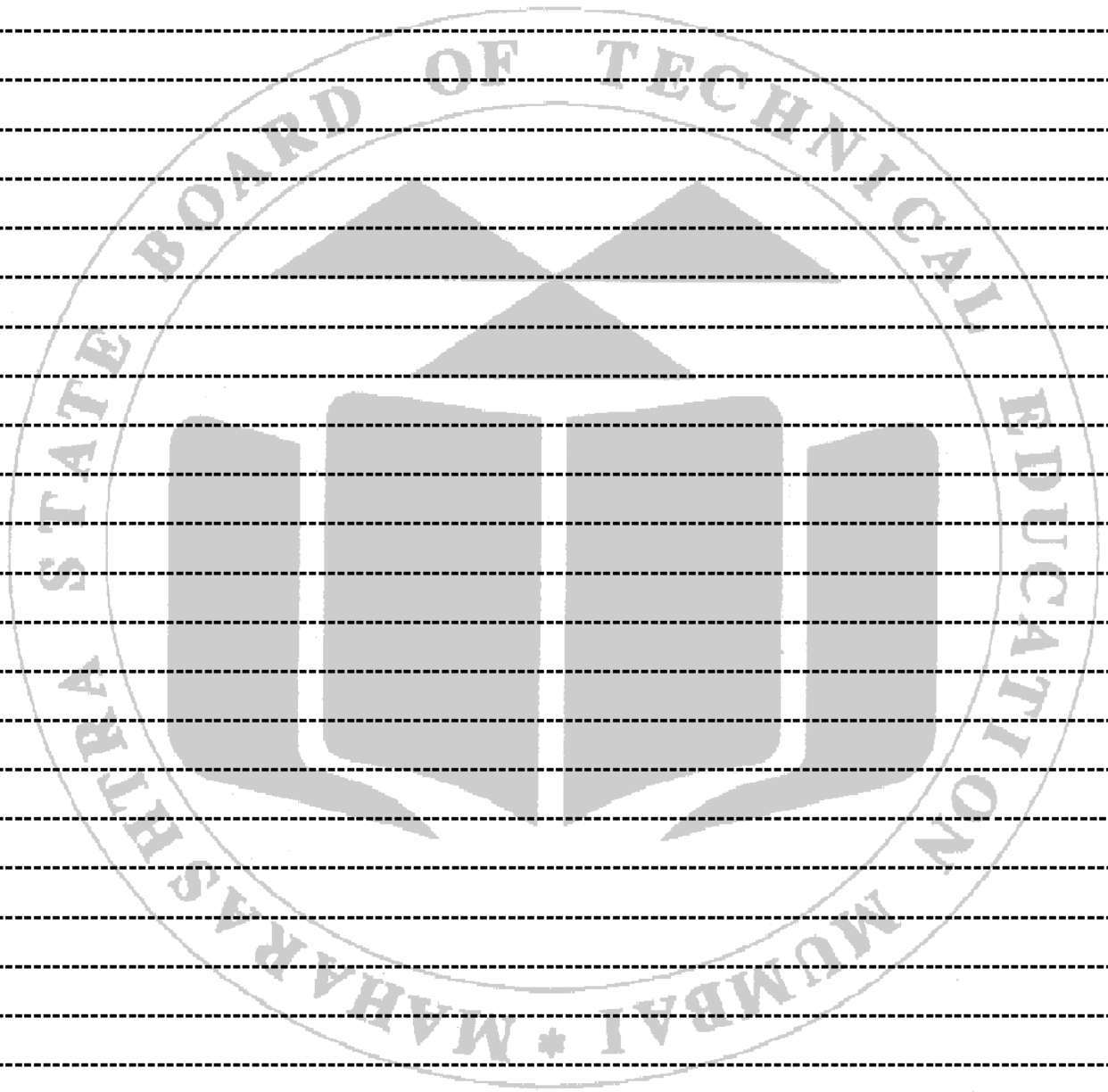
Note: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.

1. Explain the need for Highway Maintenance.
2. State the causes of pavement failures.
3. Classify the Highway maintenance works.
4. Write in details special repairs for flexible pavements.
5. Write in details special repairs for cement concrete road pavements.

Space for Answer



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XIV. Assessment Scheme

Sr. No.	Performance Indicators	Weightage
A.	Process Related (15 marks)	60%
1.	Identify the defects in various road	25%
2.	Suggest possible remedial	25%
3.	Working of team	10%
B.	Product Related (10 marks)	40%
4.	Conclusion of practical	20%
5.	Practical Question Answer	10%
6.	Submission of report in time	10%
C.	Total marks (25 marks)	100%

Marks Obtained			Dated sign of Teacher
Process Related (15)	Product Related (10)	Total (25)	