

ROAD CONSTRUCTION AND MAINTENANCE

Level III

September, 2023 Curriculum Version - II



**Module Title: Road Maintenance Operation and
Surface Treatment**

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Introduction

The "Perform Road Maintenance Operation and Surface Treatment" module is a comprehensive educational program designed to impart in-depth knowledge and practical skills in all aspects of road maintenance and surface treatments. The module encompasses fundamental units comprising sealing operations and tasks, pre-maintenance operations, assessment and repair of damaged surfaces, effective execution of tasks, detailed reporting on task execution, and the vital process of post-maintenance cleanup. This module adeptly equips learners with the necessary competencies for maintaining and enhancing the functionality and longevity of road surfaces, thereby contributing to improved infrastructure and road safety.

Perform Road Maintenance Operation and Surface Treatment

This module covers the units:

- Sealing operations
- Sealing tasks
- Pre-maintenance operation
- Damaged surfaces
- Execution of tasks
- Report on the execution of tasks
- Clean up

Learning Objective of the Module

- Plan and Prepare for Sealing Operations
- Initiate Sealing Tasks
- Check Pre-Maintenance Operation
- Repair Damaged Surfaces
- Oversee the Execution of Tasks
- Report on the Execution of Tasks

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- Clean up

Module Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Read the information written in the information Sheets
3. Accomplish the Self-checks
4. Perform Operation Sheets
5. Do the “LAP test”

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Unit One: Sealing Operations and sealing tasks

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Concepts of Road Maintenance Operation and Surface Treatment
- Compliance documentation
- Type of asphalt treatment
- Type of plant and equipment
- Specific task information requirements
- Job plan
- Acquiring and making available necessary resources
- Clear and timely instructions to team members
- Setting out tasks

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Understand Concepts of Road Maintenance Operation and Surface Treatment
- Access ,interpret and apply compliance documentation
- Identify the types of asphalt treatment
- Identify the plant and equipment requirements
- Access and share specific task information and requirements
- Prepare a job plan
- Acquire and make available necessary resources
- Issue clear and timely instructions to team members
- Set out tasks

1.1 Sealing Operations

1.1.1 Concepts of Road Maintenance Operation and Surface Treatment

Road maintenance operations and surface treatment are vital for maintaining the safety and longevity of road networks. These activities involve regular inspections, repairs, and improvements to address wear and tear caused by traffic and weather conditions. Surface treatments, such as sealants and asphalt emulsions, are applied to protect and extend the life of pavement surfaces. Proper planning, coordination, and expertise in engineering and project management are crucial for effective implementation. Investing in road maintenance operations and surface treatments helps reduce long-term costs, extend infrastructure lifespan, and enhance user experience. Overall, these activities are essential for the functionality and safety of road networks.

Basic terminology in Road Maintenance Operation and Surface Treatment

1. **Road maintenance:** The process of preserving and repairing existing road infrastructure to ensure safe and efficient travel.
2. **Surface treatment:** A protective layer applied to the surface of a road to improve its durability and longevity.
3. **Pavement:** The durable surface layer of a road that provides a smooth and safe driving surface.
4. **Crack sealing:** The process of filling cracks in the pavement to prevent water infiltration and further damage.
5. **Patching:** Repairs made to localized areas of the pavement where deterioration has occurred, usually due to potholes or other damage.
6. **Resurfacing:** Applying a new layer of asphalt or other material to the existing pavement to restore its smoothness and integrity.
7. **Seal coating:** Spraying a thin layer of liquid asphalt onto the surface of the pavement to protect it from the damaging effects of sun, water, and traffic.
8. **Striping:** Applying visible markings, such as lines and symbols, to the road surface to guide traffic and improve safety.
9. **Shoulder maintenance:** Maintaining and repairing the shoulder area of a road, which provides additional space for emergency stopping or vehicle breakdowns.
10. **Culvert maintenance:** Clearing and repairing culverts, which are drainage structures that allow water to flow under the road, to prevent waterlogging and road instability.
11. **Drainage maintenance:** Ensuring that the road has a proper drainage system to allow rainwater to drain away from the pavement and prevent damage.

12. **Grading:** Leveling and shaping the road surface to ensure its smoothness and proper drainage.
13. **Snow and ice control:** Clearing snow and ice from the road surface during winter to maintain safe driving conditions.
14. **Road markings:** Lines, symbols, and patterns painted or applied to the road surface to indicate traffic flow, restrictions, and hazards.
15. **Road signs:** Images or words mounted along the road to provide information to drivers and enforce traffic regulations.
16. **Roadside vegetation management:** Trimming, pruning, and clearing vegetation along the road to improve sightlines and prevent obstruction.
17. **Guardrail maintenance:** Inspecting, repairing, and replacing guardrails to protect vehicles from leaving the road and to improve safety

1.1.2 Compliance documentation

Road maintenance operations and surface treatment are crucial for ensuring the safety and longevity of roadways. This elements and performance criteria involved in planning and preparing for sealing operations. Specifically, it will focus on accessing, interpreting, and applying compliance documentation, which includes legislative, organizational, and site requirements, manufacturer's guidelines and specifications, Ethiopian standards, employment and workplace relations legislation, and equal employment opportunity.

A. Accessing Compliance Documentation:

Accessing compliance documentation is the first step in planning and preparing for sealing operations. It involves obtaining and reviewing various documents that outline the legal and regulatory requirements, as well as the guidelines and specifications for the specific task at hand. These documents may include:

1. **Legislative Requirements:** These are laws and regulations set by the government or relevant authorities to ensure road maintenance operations are carried out safely and efficiently. Examples of legislative requirements may include traffic management regulations, environmental protection laws, and occupational health and safety regulations.
2. **Organizational and Site Requirements:** These documents outline the specific requirements and procedures set by the organization or site where the road maintenance operations will take place. They may include guidelines for equipment usage, work schedules, and reporting procedures.

3. **Manufacturer's Guidelines and Specifications:** Manufacturers provide detailed instructions on the proper use and maintenance of equipment and materials. These guidelines ensure that the sealing operations are carried out in accordance with the manufacturer's recommendations, maximizing the effectiveness of the treatment.
4. **Ethiopian Standards:** Ethiopian standards are specific guidelines and specifications set by the Ethiopian Standards Agency (ESA) to ensure quality and safety in various industries, including road construction and maintenance. These standards provide a benchmark for the quality of materials, processes, and workmanship.
5. **Employment and Workplace Relations Legislation:** These documents outline the legal requirements related to employment and workplace relations, such as minimum wage laws, working hour's regulations, and anti-discrimination policies. Adhering to these laws ensures fair and equitable treatment of workers involved in road maintenance operations.
6. **Equal Employment Opportunity:** Equal employment opportunity policies promote fairness and diversity in the workplace. These policies ensure that individuals are not discriminated against based on their race, gender, age, or other protected characteristics. Implementing equal employment opportunity practices fosters a positive work environment and enhances productivity.

B. Interpreting and Applying Compliance Documentation:

Once the compliance documentation has been accessed, it is essential to interpret and apply the information appropriately. This involves understanding the requirements and guidelines outlined in the documents and incorporating them into the planning and preparation process for sealing operations. Some key considerations include:

1. **Understanding Legal and Regulatory Requirements:** It is crucial to comprehend the legislative requirements and ensure that all necessary permits and licenses are obtained. This may involve coordinating with relevant authorities and obtaining approvals before commencing the sealing operations.
2. **Incorporating Organizational and Site Requirements:** Adhering to the specific requirements and procedures set by the organization or site is essential for maintaining consistency and ensuring smooth operations. This may involve coordinating with project managers, supervisors, and other stakeholders to align the sealing operations with the organization's goals and objectives.

- 3. Following Manufacturer's Guidelines and Specifications:** Properly interpreting and applying the manufacturer's guidelines and specifications ensures that the sealing operations are carried out using the correct techniques, equipment, and materials. This maximizes the effectiveness of the treatment and minimizes the risk of premature failure.
- 4. Adhering to Ethiopian Standards:** Ethiopian standards provide a benchmark for quality and safety. Incorporating these standards into the planning and preparation process ensures that the sealing operations meet the required quality standards and contribute to the overall improvement of road infrastructure in Ethiopia.
- 5. Implementing Employment and Workplace Relations Legislation:** Compliance with employment and workplace relations legislation is crucial for maintaining a safe and fair work environment. This may involve ensuring proper training and certification for workers, providing appropriate safety equipment, and promoting equal opportunities for all employees.

Planning and preparing for sealing operations in road maintenance require accessing, interpreting, and applying compliance documentation. This includes understanding legislative, organizational, and site requirements, manufacturer's guidelines and specifications, Ethiopian standards, employment and workplace relations legislation, and equal employment opportunity policies. By incorporating these elements and performance criteria, road maintenance operations can be carried out efficiently, safely, and in accordance with the highest standards.

1.1.3 Asphalt treatments

Road maintenance operations and surface treatment are crucial for ensuring the longevity and functionality of roadways. This focus on identifying the types of asphalt treatment required as per the design specification.

A. Types of Asphalt Treatment:

When planning for sealing operations, it is essential to identify the specific types of asphalt treatment required. These treatments are determined based on the design specifications and the condition of the road surface.

The following are some common types of asphalt treatments:

- 1. Single, Double, or Triple Asphalt Surface Treatment:** Single, double, or triple asphalt surface treatments involve the application of multiple layers of asphalt emulsion and aggregate to the road surface. These treatments are typically used to restore and protect the existing pavement, improve skid resistance, and extend the service life of the road. The number of

layers applied depends on the severity of the road's condition and the desired level of protection.



Figure 1-1 Asphalt Surface Treatment

2. **Otta Seal:** Otta Seal is a specialized surface treatment that combines the use of graded aggregate and bitumen emulsion. It is commonly used on low-traffic roads to provide a durable and cost-effective solution. Otta Seal helps to seal the road surface, reduce water infiltration, and enhance skid resistance.



Figure 1-2 Otta Seal

3. **Sand Seal:** Sand seal is a preventive maintenance treatment that involves the application of a thin layer of asphalt emulsion followed by a layer of fine aggregate (sand). This treatment

helps to seal cracks, protect the underlying pavement from oxidation and moisture, and improve surface friction.



Figure 1-3 Sand Seal

4. **Slurry Seal:** Slurry seal is a mixture of fine aggregate, asphalt emulsion, and water. It is applied as a thin layer to the road surface to seal cracks, restore surface texture, and improve skid resistance. Slurry seal is commonly used on low-volume roads and residential streets.



Figure 1-4 Slurry Seal

B. Functions of surface treatment:

- To provide long lasting economical surface for granular base road having light and medium traffic volume.

- To prevent entry of surface water into old pavement that have been weathered or cracked.
- It improve the skid resistance of bitumen surface where the surface has polished under traffic.
- To provide temporary cover in case of delayed incomplete pavement.
- In Highway Maintenance, For good surface treatment it is necessary that;

Base course is well prepared to its profile and is made free from pot holes and ruts.

- Excellence of surface dressing depends upon the correct proportion of binder aggregate.
- Before laying that first surface dressing coat, the base should be made free from all dust loose soil etc.
- In all bituminous construction it is necessary that the newly surface posses a bond with the existing base at the interface. It is also necessary that the base is nearly impervious.

1.1.4 Types of Plant and Equipment

Performing road maintenance operations and surface treatment is crucial for ensuring the longevity and safety of roadways. To effectively carry out these tasks, a wide range of plant and equipment is required. Various types of plant and equipment commonly used in road maintenance and surface treatment operations.

A. Road Maintenance Unit (Truck) and Attachments: The road maintenance unit, often a truck, serves as the primary vehicle for transporting equipment and materials to the worksite. It is equipped with various attachments, including:

- Hoses: Used for water supply and spraying purposes.
- Watering Cans: Essential for manual watering and dampening of surfaces.
- Hand Lances: Used for precise application of materials, such as sealants or adhesives.
- Rakes, Shovels, and Brooms: These tools are necessary for cleaning debris, leveling surfaces, and ensuring proper adhesion of materials.



Figure 1-5Truck

- B. Asphalt Distributor:** An asphalt distributor is a specialized vehicle designed to apply a uniform layer of asphalt to the road surface. It ensures an even distribution of the asphalt material, enhancing the quality and durability of the road.



Figure 1-6Asphalt Distributor

- C. Pavers:** Pavers are machines used to lay asphalt or concrete on the road surface. They ensure a smooth and consistent application of the material, resulting in a well-constructed road.



Figure 1-7Pavers

- D. Gravel Spreader:** A gravel spreader is used to distribute gravel or other aggregate materials on the road surface. It helps to improve traction and prevent skidding, particularly in wet or icy conditions.



Figure 1-8 Gravel Spreader

- E. Grader:** A grader is a heavy-duty machine equipped with a blade that is used to level and shape the road surface. It helps to remove irregularities and create a smooth and even road profile.
- F. Rollers and Roller Mats:** Rollers are essential for compacting the road surface after the application of materials. They ensure proper bonding and consolidation, resulting in a stronger and more durable road. Roller mats, made of rubber or steel, are attached to the rollers to provide additional compaction and a smooth finish.



Figure 1-9 Rollers and Roller Mats

- G. Dump Trucks and Loader:** Dump trucks are used for transporting materials, such as asphalt, gravel, or soil, to and from the worksite. Loaders are heavy machinery used for loading and moving materials, making them indispensable in road construction and maintenance operations.
- H. Spare Water Jets:** Spare water jets are backup equipment used for cleaning and preparing the road surface before applying sealants or other treatments. They ensure that the surface is free from dust, debris, and contaminants, promoting better adhesion of the materials.

- I. Basic Tool Kit:** A basic tool kit includes a range of hand tools, such as wrenches, screwdrivers, hammers, and pliers. These tools are essential for routine maintenance, repairs, and adjustments on the equipment and machinery used in road maintenance operations.
- J. Slurry Sealing Machines, Slurry Boxes, and Squeegees:** Slurry sealing machines are specialized equipment used for applying slurry seal, a mixture of asphalt emulsion, fine aggregate, and additives. Slurry boxes are attached to the machines and are used to distribute the slurry onto the road surface. Squeegees are then used to spread and level the slurry, ensuring a smooth and uniform finish.
- K. Hessian/Canvas Drags:** Hessian or canvas drags are used for final finishing touches on the road surface. They help to smooth out any irregularities and ensure a consistent texture and appearance.

1.1.5 Specific task information and requirements

Performing road maintenance operations and surface treatments require careful planning and preparation to ensure the successful completion of the task. Several specific task information and requirements need to be considered in order to carry out the sealing operations effectively.

A. Site geological and geotechnical data

This understanding the rock types and characteristics present in the area where the road maintenance operation will take place. Different rock types may require specific techniques or materials for the sealing process. Additionally, knowledge of soil types and characteristics is essential as it can affect the stability and durability of the road surface.

B. Site hydrological data.

This information about surface water and groundwater levels. The hydrological conditions is crucial as it can impact the effectiveness of the sealing operation. For example, if the groundwater level is high, it may affect the adhesion of the asphalt to the road surface.

C. Site meteorological data

This information about rainfall, humidity, temperature, and wind conditions. These factors can influence the curing time of the asphalt and the overall quality of the surface treatment. For instance, high humidity levels can slow down the curing process, while extreme temperatures can affect the viscosity of the asphalt.

D. Site engineering survey data

This data provides information about the existing road conditions, such as the pavement thickness, slope, and alignment. These factors help in determining the appropriate sealing techniques and materials required for the task. Known and potential site hazards, constraints, and conditions should also be taken into account. Identifying any existing or potential hazards that may affect the safety and efficiency of the sealing operation. For example, if there are underground utilities or structures near the road, special precautions need to be taken to avoid any damage during the operation.

E. Site cultural and heritage information

Identifying any cultural or heritage sites in the area that may require special protection or considerations during the road maintenance operation. It is crucial to respect and preserve these sites while carrying out the necessary tasks.

F. Task specifications and drawings

Provide detailed instructions and guidelines for the sealing operation. These specific requirements, such as the thickness of the asphalt layer, the type of aggregate to be used, and any special considerations for the project. Following these specifications ensures that the road maintenance operation meets the required standards. Sources of materials should be identified to ensure the availability of the necessary resources for the sealing operation. This determines the suppliers or contractors who can provide the required asphalt and aggregate materials.

It is essential to choose high-quality materials that meet the specified standards to ensure the longevity and durability of the road surface.

G. Understanding the types of asphalt

Different types of asphalt have varying properties and characteristics, such as durability, flexibility, and resistance to weathering. Choosing the appropriate type of asphalt for the specific road maintenance operation is crucial to achieve the desired results.

H. Coordination, timing, and budgeting requirements

Coordinating with other organizations and contractors involved in the task or related tasks. It is important to establish clear timelines and budget allocations to ensure the smooth execution of the sealing operation.

1.1.6 Signs and Safety Equipment

When working on the roadside or carriageway, traffic from both directions must be alerted. The following signs and barriers are useful for this purpose:

- Reversible 'Stop / Go' signs
- Speed limit signs (30 km/hr)
- 'Men working' signs
- 'No overtaking' signs
- 'Road narrows' sign
- 'End of restriction' signs
- lane closure barriers and
- traffic cones

These signs should be available as many as required. In addition to reflective vests, workers should be issued with various personal protective equipment depending on the work being undertaken, such as gloves, helmets, boots, overalls, dust masks, goggles and ear muffs.



Figure 1-10 Road signs used in maintenance works

A. Temporary Signposting

Temporary signs should be placed well ahead of the site from both directions to warn traffic and reduce the speed, both for work on the roadside and in the carriageway. It is important to install sufficient measures to ensure that the speed of traffic is reduced before it arrives at the work site.

At the work site, all damages to the road which pose a danger to the traffic should be properly marked so that the traffic is guided away at a safe distance. Equally, the traffic should be properly separated from where works take place. The work site needs to be protected so that the traffic does not pose any danger to the workers, materials or equipment.

Simple and inexpensive safety equipment such as traffic cones can improve safety for both the road users as well as the maintenance workers. Cones are useful for

1. alerting the traffic of road works ahead,
2. guiding the traffic into diversions and
3. Keeping traffic at a safe distance from the work site.

Cones are easy to place and can be quickly moved when the works progress to another location. Should be issued with various personal protective equipment depending on the work being undertaken, such as gloves, helmets, boots, overalls, dust masks, goggles and ear muffs.

Passing traffic pose a major risk to the safety of workers on road maintenance sites. It is therefore important that maintenance workers are clearly seen by the traffic. Work uniforms or vests in clear bright colors should be worn at all times on work sites to protect the workers from passing traffic.

When carrying out surface works on roads, traffic needs to be guided into a single lane and meeting traffic needs to be regulated only allowing traffic to pass in one direction at the time. The most common method of regulating traffic on roads is to employ flagmen with stop/ go signs at both ends of the diversion.

On narrow roads, traffic may need to be halted for an extended period of time when major pavement works takes place. When this takes place, the road users need to be alerted already at the start of the road, also providing information on when the road will be reopened.

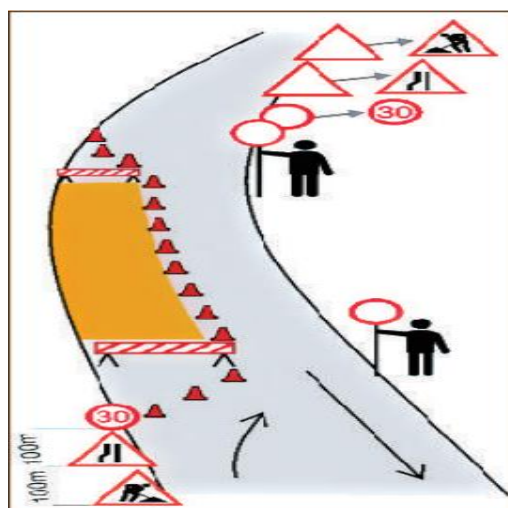


Figure 1-11 Placement of temporary road signs

1.1.7 Job plan

A. Importance of a Job Plan:

A job plan serves as a roadmap for the successful execution of road maintenance operations and surface treatment. It outlines the necessary steps, resources, and timelines required to complete the task efficiently. By preparing a well-thought-out job plan, the team can minimize delays, reduce costs, and ensure the quality of work.

B. Involvement of Relevant Team Members

To create an effective job plan, it is crucial to involve relevant team members who possess the necessary expertise and knowledge. These team members include:

1. **Other members of the organization's management team:** Their input is valuable in terms of aligning the road maintenance operation with the overall organizational goals and objectives.
2. **Supplier's representatives:** Collaboration with suppliers is essential to ensure the availability of required materials and equipment. Their expertise can also help in selecting the most suitable products for surface treatment.
3. **Sub-contractors representatives:** If sub-contractors are involved in the road maintenance operation, their input is vital for coordinating their activities with the overall plan. This ensures seamless integration and avoids any conflicts or delays.
4. **Supervisors or managers of other organizations involved in related tasks:** In cases where multiple organizations are involved in the road maintenance operation, coordination with their supervisors or managers is necessary to synchronize efforts and avoid any disruptions.
5. **Experienced members of the team directly involved in the task:** The inclusion of experienced team members who have previously worked on road maintenance operations and surface treatment is crucial. Their insights and expertise can contribute to the development of an efficient and effective job plan.

Collaborative Process: The process of preparing a job plan for road maintenance operations and surface treatment should be collaborative. It involves regular meetings and discussions with the relevant team members to gather input, share ideas, and address any concerns. This collaborative approach ensures that the job plan incorporates diverse perspectives and expertise, leading to a more comprehensive and effective plan.

1.2 Sealing tasks

1.2.1 Acquire and make available the necessary resources

To ensure the successful execution of road maintenance operations and surface treatment, it is imperative to acquire and provide the necessary resources as required by the design and specifications. This ensures the safety, effectiveness, and efficiency of the tasks at hand. There are the key steps involved in acquiring and making available the essential resources:

- A. Resource assessment:** Begin by assessing the specific resources required for the road maintenance operation and surface treatment. This may include machinery, equipment, tools, materials, workforce, and expertise. Evaluate the design and specification requirements to accurately determine the resources needed.
- B. Procurement:** Once the resource requirements are identified, initiate the procurement process. This involves selecting reliable suppliers or contractors who can provide the necessary resources within the given timeframe. Ensure that the procured resources comply with safety standards and quality specifications.
- C. Mobilization:** Once the resources are procured, initiate the mobilization process. This entails transporting the machinery, equipment, tools, and materials to the designated site. Ensure timely delivery to avoid any unnecessary delays in the task execution.
- D. Deployment:** After the resources reach the site, deploy the workforce to handle and operate the acquired machinery and equipment effectively. If specialized expertise is required, ensure that the personnel with the required skills and knowledge are present during the task execution.
- E. Training and certification:** Prioritize the safety aspect by providing necessary training to the workforce on the proper handling of the resources and adherence to safety protocols. This minimizes the chances of accidents or injuries during the operation. Certify the personnel if needed to ensure their competency in using specific machinery or equipment.
- F. Quality control:** Regularly monitor the acquired resources to ensure that they are functioning optimally throughout the task execution. Conduct inspections, maintenance, and repairs as necessary to prevent any unforeseen issues or breakdowns that could hamper the operation.
- G. Resource management:** Efficiently manage the resources throughout the operation. Monitor usage, control inventory, and promptly address any resource shortages or discrepancies to maintain uninterrupted progress. This includes ensuring the availability of backup resources in case of emergencies or unexpected situations.

1.2.2 Clear and timely instruction

Clear and timely instructions play a crucial role in ensuring the safe, effective, and efficient conduct of road maintenance operations and surface treatment, particularly during the initiation of sealing tasks. Issuing clear instructions, the team members and others involved in the project can work together toward achieving the desired outcomes while prioritizing safety.

- To begin with, the instructions should outline the objectives and scope of the road maintenance operation and surface treatment.
- It is essential to communicate the specific tasks that need to be performed, such as prepping the road surface, repairing any existing damage, and applying the sealant.
- Furthermore, the instructions should emphasize safety precautions and procedures that need to be followed throughout the operation.
- Clear communication regarding potential hazards, such as loose gravel or machinery in operation, should also be included to prevent accidents or injuries.
- In addition to safety concerns, the instructions must ensure efficiency and effectiveness in task execution.
- This can be achieved by providing detailed guidance on the required equipment, tools, and materials.
- Timeliness is a crucial aspect of issuing instructions, particularly during the initiation of sealing tasks.
- To optimize efficiency, the instructions should be communicated well in advance, allowing team members to adequately prepare their materials and equipment.
- By providing sufficient notice, the team can coordinate their efforts and avoid unnecessary delays in the maintenance operation.
- To facilitate effective communication, instructions can be issued in both written and verbal formats.
- Written instructions can be provided in handbooks, manuals, or digital formats to ensure that team members have a comprehensive reference

1.2.3 Set out tasks

This tasks involved in initiating sealing, including control lines, cleared width, batters, and offsets, highlighting their significance and importance in achieving a successful road maintenance operation.

Control Lines: Control lines are one of the key tasks in initiating sealing. These lines act as a guide for the entire sealing process, ensuring accurate placement of materials and maintaining consistent widths throughout the road surface. Control lines are typically marked using string lines or laser-guided equipment, providing a reference point for the application of sealant materials. Properly set control lines help in achieving uniformity and accuracy, resulting in a smooth and even road surface.

Cleared Width: Another crucial task in initiating sealing is determining the cleared width. The cleared width refers to the distance from the edge of the road to the area where sealing materials will be applied. This task involves removing any obstacles, debris, or vegetation within the specified width to ensure a clean and suitable surface for the sealing process. Clearing the width is essential to prevent any interference with the application of sealants and to maintain the integrity of the road surface.

Batters: Batters refer to the sloping sides of the road surface. In road maintenance operations, it is important to establish and maintain appropriate batters to ensure proper drainage and prevent water accumulation on the road. The task of setting out batters involves shaping the sides of the road to the desired angle, typically using graders or other specialized equipment. Well-maintained batters facilitate efficient water runoff, reducing the risk of water-related damage to the road surface.

Offsets: Offsets are another critical task in initiating sealing. Offsets involve creating a gap or space between the road surface and any adjacent structures, such as curbs, gutters, or buildings. This task ensures that the sealing materials are applied evenly and do not come into contact with adjacent structures, preventing any potential damage. Offsets are typically determined based on the specifications provided by road design engineers and are crucial for maintaining the structural integrity of both the road and surrounding structures.

Self-check-1: Written Test

Test-I choose

Instruction: Select the correct answer for the give choice. You have given 1 Minute for each question.

Each question carries 2 Point.

1. What is the purpose of road maintenance operations and surface treatment?
 - A. To improve traffic flow
 - B. To enhance road aesthetics
 - C. To ensure road safety and longevity
 - D. To reduce noise pollution
2. What is crack sealing in road maintenance?
 - A. Filling cracks in the pavement to prevent water infiltration
 - B. Applying a new layer of asphalt to the existing pavement
 - C. Spraying a thin layer of liquid asphalt onto the surface of the pavement
 - D. Clearing and repairing culverts to prevent waterlogging
3. What is the function of surface treatment in road maintenance?
 - A. To provide a smooth driving surface
 - B. To improve skid resistance
 - C. To protect the road from sun and water damage
 - D. All of the above
4. What are some common types of asphalt treatments?
 - A. Single, double, or triple asphalt surface treatment
 - B. Otto Seal
 - C. Sand Seal
 - D. All of the above
5. What is the purpose of an asphalt distributor?
 - A. To transport equipment and materials to the worksite
 - B. To apply a uniform layer of asphalt to the road surface
 - C. To level and shape the road surface
 - D. To distribute gravel or other aggregate materials on the road surface
6. What is the role of a grader in road maintenance?
 - A. To compact the road surface
 - B. To distribute gravel or other aggregate materials
 - C. To level and shape the road surface
 - D. To apply a uniform layer of asphalt
7. What is the purpose of a slurry sealing machine?
 - A. To transport materials to the worksite
 - B. To apply slurry seal to the road surface
 - C. To level and shape the road surface
 - D. To distribute gravel or other aggregate materials

- 8.** What is the function of spare water jets in road maintenance?
- A. To clean and prepare the road surface C. To level and shape the road surface
B. To compact the road surface D. To distribute gravel or other aggregate materials
- 9.** What is the purpose of hessian/canvas drags in road maintenance?
- A. To transport materials to the worksite C. To smooth out irregularities on the road surface
B. To apply a uniform layer of asphalt to the road D. To distribute slurry seal onto the road surface
surface
- 10.** Why is it important to access and apply compliance documentation in road maintenance operations?
- A. To ensure the safety and efficiency of road maintenance operations C. To follow manufacturer's guidelines and specifications
B. To comply with legislative and organizational requirements D. All of the above
- 11.** What is the first step in acquiring and making available the necessary resources for road maintenance operations and surface treatment?
- A. To improve traffic flow C. To ensure road safety and longevity
B. To enhance road aesthetics D. To reduce noise pollution
- a) Mobilization b) Resource assessment c) Procurement d) Deployment
- 12.** Why is it important to provide clear and timely instructions for road maintenance operations and surface treatment?
- A. To ensure the safety of workers and motorists C. To clarify roles and responsibilities of team members
B. To optimize efficiency and effectiveness in task execution D. All of the above
- 13.** What is the purpose of control lines in initiating sealing?
- A. To guide the placement of sealant materials C. To achieve a smooth and even road surface
B. To maintain consistent widths throughout the road surface D. All of the above
- 14.** What does the cleared width refer to in initiating sealing?
- A. The distance from the edge of the road to the area where sealing materials will be applied C. The width of the road surface before sealing

- B. The width of the road surface after sealing D. The width of the road surface including adjacent structures

15. Why is it important to set out batters in road maintenance operations?

- A. To ensure proper drainage and prevent water accumulation C. To reduce the risk of water-related damage to the road surface
B. To shape the sides of the road to the desired angle D. All of the above

16. What is the purpose of offsets in initiating sealing?

- A. To create a gap or space between the road surface and adjacent structures C. To maintain the structural integrity of both the road and surrounding structures
B. To prevent damage to adjacent structures during the sealing process D. All of the above

17. Which task involves removing obstacles, debris, or vegetation within the specified width before sealing?

- A. Control lines C. Batters
B. Cleared width D. Offsets

18. What is the significance of clear and timely instructions in road maintenance operations?

- A. To ensure the successful completion of the project C. To optimize efficiency and effectiveness in task execution
B. To prioritize safety and adherence to protocols D. All of the above

19. What is the purpose of training and certification in acquiring and making available necessary resources?

- A. To ensure the competency of personnel in using specific machinery or equipment C. To ensure road safety and longevity
B. To minimize the chances of accidents or injuries during the operation D. All of the above

20. Why is resource management important in road maintenance operations?

- A. To monitor usage and control inventory C. To maintain uninterrupted progress
B. To address any resource shortages or discrepancies promptly D. All of the above

Say true or false

1. Road maintenance operations and surface treatments are important for maintaining the safety and longevity of road networks.
2. Surface treatments, such as sealants and asphalt emulsions, are applied to protect and extend the life of pavement surfaces.
3. Proper planning, coordination, and expertise in engineering and project management are crucial for effective implementation of road maintenance operations and surface treatments.
4. Investing in road maintenance operations and surface treatments helps reduce long-term costs, extend infrastructure lifespan, and enhance user experience.
5. Road maintenance operations and surface treatments are not essential for the functionality and safety of road networks.
6. Acquiring and providing necessary resources is not important for the successful execution of road maintenance operations and surface treatment.
7. Clear and timely instructions are not necessary for the safe and efficient conduct of road maintenance operations and surface treatment.
8. Control lines are not important for the initiation of sealing in road maintenance operations
9. Cleared width refers to the distance from the edge of the road to the area where sealing materials will not be applied.
10. Offsets are not necessary in road maintenance operations and surface treatment.

Fill in the blank space

1. Road maintenance operations and surface treatment are crucial for ensuring the _____ and _____ of roadways.
2. Surface treatments, such as sealants and asphalt emulsions, are applied to protect and extend the life of _____ surfaces.
3. Proper planning, coordination, and expertise in engineering and project management are crucial for effective _____.
4. Investing in road maintenance operations and surface treatments helps reduce _____ costs, extend infrastructure lifespan, and enhance user experience.
5. Road maintenance operations involve regular inspections, repairs, and improvements to address wear and tear caused by _____ and _____ conditions.
6. The first step in acquiring and making available the necessary resources for road maintenance operations and surface treatment is conducting a _____ to determine the specific requirements.

7. During the mobilization process, it is important to ensure _____ delivery of the acquired resources to avoid delays.
8. To ensure the safety of the workforce, it is essential to provide _____ on the proper handling of machinery and equipment.
9. Regular _____ of the acquired resources is necessary to prevent any unforeseen issues or breakdowns during the operation.
10. Clear and timely instructions should outline the objectives, scope, and specific _____ that need to be performed during road maintenance operations and surface treatment.

Operation Sheet 1

Operation title:

- Task: Set out the control lines, cleared width, batters, and offsets for a road maintenance operation.

Purpose:

- To practice and demonstrate the knowledge and skill required to setting out maintenance work

Instruction:

- Use given tools and equipment for setting out
- For this operation you have given 6 Hour and you are expected to provide the answer on the given table.

Precautions:

- Use the appropriate tools and equipment for the job.
- Be careful not to damage the road surface or adjacent structures.
- Follow the safety procedures specified by the manufacturer of the tools and equipment.
- Monitor the weather conditions and adjust the setting out process as needed.

Tools and requirement:

- String lines or laser-guided equipment
- Broom
- Shovel
- Grader or other specialized equipment

Procedures for setting out

1. Mark the control lines using string lines or laser-guided equipment.
2. Ensure that the lines are straight and evenly spaced.
3. Use the control lines as a reference point for the rest of the setting out process.
4. Remove any obstacles, debris, or vegetation within the specified width.
5. Use a broom or other cleaning tool to sweep the area clean.
6. Make sure that the surface is free of any loose material that could interfere with the road maintenance operation.
7. Shape the sides of the road to the desired angle using a grader or other specialized equipment.
8. Ensure that the batters are uniform in height and slope.
9. The batters should be sufficient to allow for proper drainage of water away from the road surface.

10. Create a gap or space between the road surface and any adjacent structures using a shovel or other hand tools.
11. The offset should be wide enough to prevent the sealant materials from coming into contact with the adjacent structures.
12. The offset should be determined based on the specifications provided by road design engineers.

Quality Criteria:

- Take measurements carefully to ensure that the control lines, cleared width, batters, and offsets are accurate.
- Use stakes or other markers to mark the locations of the control lines and offsets.
- Make sure that the road surface is dry before starting the setting out process.
- Be patient and take your time to complete the setting out tasks properly.

Lap Test

Name: _____

Date: _____

Time started: _____

Time finished: _____

Allotted Time: 8 Hours

Instruction: For this operation you have given 6 Hour and you are expected to finish in required time

Task 1 Set out the control lines, cleared width, batters, and offsets for a road maintenance operation.

Unit two: Check pre-maintenance operation

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Road maintenance operation.
- pre-operational road maintenance unit
- operating components of truck
- Checking the tank for prevention of contamination
- Filling the tank
- Standard mix of emulsion and/or type of asphalt.

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare road maintenance operation.
- Carry out pre-operational road maintenance unit.
- Check operating components of truck
- Check the tank for prevention of contamination
- Fill the tank with required materials
- Determine standard mix of emulsion and/or type of asphalt.

2.1 Road maintenance operation

Before undertaking any maintenance operation, it is essential to conduct a thorough pre-maintenance check to assess the condition of the road and determine the necessary repairs or treatments. The pre-maintenance check involves a comprehensive inspection of the road surface, including identifying any cracks, potholes, or other signs of damage. This assessment helps in understanding the extent of the maintenance required and aids in planning the appropriate road maintenance operations. Road maintenance operations may encompass various tasks, depending on the specific needs of the road. Activities involved in road maintenance operations include:

1. **Loading and unloading materials:** This step involves the transportation of necessary materials, such as asphalt, bitumen, or other repair materials, to the work site. Proper handling and storage of these materials are essential to maintain their quality and effectiveness.
2. **Cleaning damaged areas:** Before any repair or treatment can be applied, it is crucial to clean the damaged areas thoroughly. This includes removing debris, loose asphalt, or any other foreign materials that may hinder the repair process.
3. **Digging out and replacing asphalt or bitumen surfaces:** In cases where the road surface is severely damaged, it may be necessary to dig out the damaged section and replace it with new asphalt or bitumen. This ensures a smooth and durable road surface.
4. **Hand spreading asphalt:** Hand spreading asphalt is a technique used to repair smaller areas or fill in cracks and potholes. It involves manually applying the asphalt mixture to the damaged area, ensuring proper compaction and adhesion.
5. **Hand screeding:** Hand screeding is the process of leveling and smoothing the applied asphalt or bitumen using handheld tools. This step is crucial to achieve a uniform and even road surface.
6. **Jack hammering:** Jack hammering is employed when removing sections of damaged concrete or asphalt that cannot be repaired. It involves using specialized equipment to break up the existing surface for replacement.
7. **Edge preparation ready for replacement surface:** Proper edge preparation is essential to ensure a seamless transition between the existing road surface and the replacement surface. This involves cleaning and shaping the edges to facilitate proper adhesion and prevent future damage.

8. **Hand lancing emulsion:** Hand lancing emulsion is a technique used to apply a thin layer of emulsion to the road surface. This helps in improving adhesion between the existing surface and the new treatment or overlay.

9. **Compacting with a vibrating plate:** After the repair or treatment is applied, it is crucial to compact the surface to ensure proper density and stability. Vibrating plates are commonly used for this purpose, as they help in achieving optimal compaction.

10. **Cleaning the truck sticking surfaces with distillate:** To maintain the efficiency of the equipment used in road maintenance operations, it is essential to clean the truck sticking surfaces regularly. Distillate is commonly used for this purpose, as it effectively removes any sticky residue and prevents clogging.



Figure 2-1 Road maintenance operation

2.1.1 Types of road maintenance

A. Routine Maintenance: Routine maintenance refers to regular, recurring activities that are performed to keep roads in good condition.

These activities are essential for preventing minor issues from escalating into major problems. Typical routine maintenance activities include:

- **Surface Cleaning:** Regular sweeping and cleaning of road surfaces to remove debris, leaves, and other materials that can impair traction and drainage.



Figure 2-2 Surface Cleaning

- **Signage and Marking:** Inspection, repair, and replacement of road signs, pavement markings, and traffic control devices to ensure visibility and compliance with regulations.



Figure 2-3 Signage and Marking:

- **Vegetation Control:** Trimming and removal of overgrown vegetation along roadways to maintain clear sightlines and prevent obstruction.



Figure 2-4Vegetation Control

B. Preventive Maintenance: Preventive maintenance aims to extend the lifespan of roads and prevent deterioration. It involves proactive measures to address potential issues before they become significant problems.

Typical preventive maintenance activities include:

- **Crack Sealing:** Filling cracks in the pavement to prevent water infiltration, which can lead to further damage and pavement failure.
- **Surface Treatment:** Applying protective coatings, such as sealants or thin overlays, to the road surface to enhance durability and waterproofing.

Task: Prepare the road surface for asphalt surface treatment.

Materials:

- Asphalt broom
- Pressure washer
- Asphalt emulsion applicator
- Aggregate spreader
- Pneumatic-tired roller

Procedure:

1. Clear the road surface of any debris, such as rocks, dirt, and leaves. Use an asphalt broom to remove any loose debris.
2. Pressure wash the road surface to remove any loose dirt or debris.
3. Allow the road surface to dry completely.

4. Activate the asphalt emulsion according to the manufacturer's instructions.
5. Apply the asphalt emulsion to the road surface using the asphalt emulsion applicator.
6. Immediately spread the aggregate over the asphalt emulsion using the aggregate spreader.
7. Compact the aggregate into the asphalt emulsion using the pneumatic-tired roller.

Safety Precautions:

- Wear safety glasses and gloves when working with asphalt surface treatment.
- Be careful not to slip on the wet asphalt surface treatment.
- Do not apply asphalt surface treatment in wet or icy conditions.
- Do not apply asphalt surface treatment over loose or damaged pavement.

Quality criteria

- Make sure that the aggregate is the correct size for the application.
- Follow the manufacturer's instructions for activating and applying the asphalt emulsion.
- Monitor the weather conditions and adjust the application process as needed.



Figure 2-5 Road surface for asphalt surface treatment.

Task: Prepare the road surface for Otto Seal application.

Materials:

- Asphalt broom
- Pressure washer
- Otto Seal mixing machine
- Aggregate spreader
- Pneumatic-tired roller

Procedure:

1. Clear the road surface of any debris, such as rocks, dirt, and leaves. Use an asphalt broom to remove any loose debris.
2. Pressure wash the road surface to remove any loose dirt or debris.
3. Allow the road surface to dry completely.
4. Prepare the Otto Seal mixture in the Otto Seal mixing machine according to the manufacturer's instructions.
5. Spread the aggregate over the road surface using the aggregate spreader.
6. Apply the Otto Seal mixture over the aggregate using the Otto Seal mixing machine.
7. Compact the aggregate into the Otto Seal mixture using the pneumatic-tired roller.

Safety Precautions:

- Wear safety glasses and gloves when working with Otto Seal.
- Be careful not to slip on the wet Otto Seal.
- Do not apply Otto Seal in wet or icy conditions.
- Do not apply Otto Seal over loose or damaged pavement.

Quality criteria

- Make sure that the aggregate is the correct size for the application.
- Follow the manufacturer's instructions for mixing and applying the Otto Seal mixture.
- Monitor the weather conditions and adjust the application process as needed.

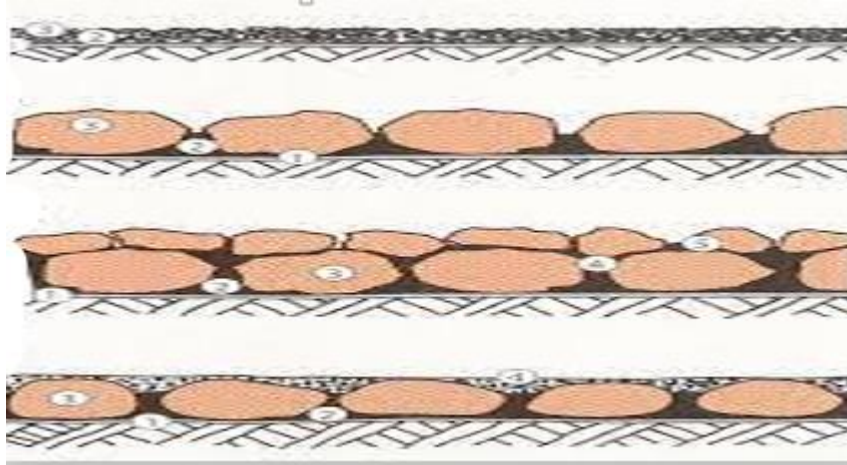


Figure 2-6 road surface for Otto Seal application

Task: Prepare the road surface for sand seal application.

Materials:

- Asphalt broom
- Pressure washer
- Sand seal mixing machine
- Aggregate spreader
- Pneumatic-tired roller

Procedure:

1. Clear the road surface of any debris, such as rocks, dirt, and leaves. Use an asphalt broom to remove any loose debris.
2. Pressure wash the road surface to remove any loose dirt or debris.
3. Allow the road surface to dry completely.
4. Prepare the sand seal mixture in the sand seal mixing machine according to the manufacturer's instructions.
5. Spread the aggregate over the road surface using the aggregate spreader.
6. Apply the sand seal mixture over the aggregate using the sand seal mixing machine.
7. Compact the aggregate into the sand seal mixture using the pneumatic-tired roller.

Safety Precautions:

- Wear safety glasses and gloves when working with sand seal.
- Be careful not to slip on the wet sand seal.
- Do not apply sand seal in wet or icy conditions.
- Do not apply sand seal over loose or damaged pavement.

Quality criteria

- Make sure that the aggregate is the correct size for the application.
- Follow the manufacturer's instructions for mixing and applying the sand seal mixture.
- Monitor the weather conditions and adjust the application process as needed.
- **Shoulder Maintenance:** Regular grading and shaping of road shoulders to prevent erosion, maintain stability, and provide a safe area for vehicles to pull over if necessary.



Figure 2-7road surface for sand seal application

C. Corrective Maintenance: Corrective maintenance focuses on addressing existing road defects and restoring the road to its intended condition. These activities are typically more extensive and require specialized equipment and expertise.

Typical corrective maintenance activities include:

- **Patching and Pothole Repair:** Filling potholes and repairing localized pavement failures to restore a smooth and safe driving surface.



Figure 2-8 Patching and Pothole Repair

- **Resurfacing:** Removing the top layer of damaged pavement and replacing it with a new layer to improve ride quality and structural integrity.
- **Bridge and Culvert Maintenance:** Inspecting, repairing, and strengthening bridges and culverts to ensure their structural integrity and prevent potential hazards.



Figure 2-9 Bridge and Culvert Maintenance

2.2 Pre-operational road maintenance unit

Pre-operational checks are an essential part of road maintenance operations. These checks ensure that the road maintenance unit is in proper working condition and equipped with all the necessary tools and materials required for repairing pavement defects.

2.2.1 Importance of Pre-Operational Checks:

Performing pre-operational checks is crucial for the successful execution of road maintenance operations. These checks help identify any potential issues or deficiencies in the road maintenance unit, ensuring that it is safe and efficient to use. By conducting thorough pre-operational checks, road maintenance crews can prevent accidents, equipment failures, and delays during the maintenance process.

2.2.2 Components of a Road Maintenance Unit:

A road maintenance unit is typically a purpose-built truck that is equipped with various tools, equipment, and materials necessary for repairing pavement defects. The following components are commonly found in a road maintenance unit:

- A. Hopper:** The hopper is a storage compartment located on the truck that holds the aggregate material used for pavement repairs. It is designed to provide a continuous supply of aggregate to the conveyor belt or spreader.
- B. Conveyor Belt:** The conveyor belt is responsible for transferring the aggregate material from the hopper to the desired location on the road surface. It ensures a consistent and even distribution of the aggregate material during the repair process.
- C. Tank:** The tank is used to store bitumen emulsion or cutback bitumen, which are commonly used for surface treatments. It ensures that the road maintenance crew has a readily available supply of these materials during the repair operations.
- D. Spreader:** The spreader is a mechanism attached to the truck that evenly distributes the bitumen emulsion or cutback bitumen onto the road surface. It ensures that the surface treatment is applied uniformly, enhancing the durability and longevity of the repaired pavement.
- E. Tools and Equipment:** Road maintenance units are equipped with various tools and equipment required to prepare, fill, level, and compact pavement defects. These may include shovels, rakes, brooms, tampers, and compactors. These tools enable the road maintenance crew to effectively repair and restore the pavement to its original condition.

Pre-operational checks are an integral part of road maintenance operations. They ensure that the road maintenance unit is properly equipped and ready to carry out pavement repairs efficiently and safely. By conducting these checks, road maintenance crews can identify any issues or deficiencies in the unit and take necessary corrective actions, minimizing the risk of accidents and equipment failures. Performing pre-operational checks is a proactive approach that contributes to the overall success of road maintenance operations.

2.3 Operating components of the truck

Road maintenance operations play a crucial role in ensuring the safety and functionality of our transportation infrastructure. One important aspect of road maintenance is conducting pre-maintenance operations, which involve checking the serviceability of the operating components of the truck used for road maintenance.

Significance of pre-maintenance operations and elaborate on the various operating components of the truck that need to be checked for serviceability.

2.3.1 Significance of Pre-Maintenance Operations:

Pre-maintenance operations are essential to ensure that the truck used for road maintenance is in optimal working condition. By conducting these operations, road maintenance crews can identify any potential issues or malfunctions in the truck's operating components, allowing them to address them before commencing the maintenance work.

This proactive approach helps prevent unexpected breakdowns or accidents during the maintenance operation, ensuring the safety of the crew and the efficiency of the maintenance process.

2.3.2 Operating Components of the Truck:

1. **Engine:** The engine is the heart of the truck, providing the power necessary for various operations. During pre-maintenance operations, the engine should be checked for any signs of leaks, abnormal noises, or excessive smoke emissions. Additionally, the engine's fluid levels, such as oil and coolant, should be inspected and topped up if necessary. Regular maintenance and servicing of the engine are crucial to ensure its optimal performance and longevity.

2. **Transmission System:** The transmission system is responsible for transferring power from the engine to the wheels. It is important to check the transmission fluid level and condition, ensuring that it is at the recommended level and free from any contaminants. Additionally, the gears should be tested for smooth shifting and any signs of slippage or abnormal noises.

3. **Braking System:** The braking system is vital for the safe operation of the truck. During pre-maintenance operations, the brake pads, rotors, and drums should be inspected for wear and tear. The brake fluid level should also be checked, and any leaks or abnormalities should be addressed promptly. Proper functioning of the braking system is crucial to ensure the truck's ability to stop effectively and prevent accidents.

4. **Suspension System:** The suspension system plays a significant role in providing a smooth and comfortable ride while maintaining stability. During pre-maintenance operations, the suspension components, such as shocks, struts, and springs, should be inspected for any signs of damage or wear. Additionally, the alignment and balance of the wheels should be checked to ensure proper handling and tire wear.

5. **Electrical System:** The electrical system of the truck includes various components such as the battery, alternator, and wiring. It is important to check the battery's charge level and terminals for any corrosion. The alternator should be inspected for proper charging, and all electrical connections should be secure and free from any damage. A well-functioning electrical system ensures the proper operation of lights, signals, and other electrical components.

Pre-maintenance operations are a crucial part of road maintenance operations. By checking the serviceability of the operating components of the truck, road maintenance crews can ensure the safety and efficiency of the maintenance process. The engine, transmission system, braking system, suspension system, and electrical system are some of the key components that should be thoroughly inspected during pre-maintenance operations. Regular maintenance and prompt addressing of any issues identified during these operations are essential for the optimal functioning of the truck and the successful completion of road maintenance tasks.

2.4 Checking the tank for prevention of contamination

2.4.1 Importance of Pre-Maintenance Tank Contamination Prevention Check:

Road maintenance vehicles often utilize tanks to hold various materials such as asphalt, emulsions, and other chemicals necessary for surface treatments. These tanks need to be thoroughly inspected before each operation to prevent contamination. Failure to perform the pre-maintenance tank contamination prevention check can lead to subpar results, compromised safety, and increased costs in the long run.

2.4.2 Procedure for Pre-Maintenance Tank Contamination Prevention Check:

The following steps are typically involved in conducting a thorough pre-maintenance tank contamination prevention check:

A. Tank Cleaning and Flushing:

Before starting the check, ensure that the tank is cleaned and flushed properly to remove any residues or remnants from previous operations. This step prevents cross-contamination between different materials used for road maintenance.

B. Visual Inspection:

Inspect the interior and exterior of the tank for any signs of damage, such as cracks, leaks, or corrosion. This inspection helps detect potential contamination sources and ensures the tank's structural integrity.

C. Checking Valves and Connections:

Examine all valves, gaskets, and connections for leakage, damage, or deterioration. Replace any faulty components to avoid potential contamination during the operation.

D. Verifying Seals and Locking Mechanisms:

Ensure that all seals and locking mechanisms on the tank are in proper working condition. This step prevents accidental spillage or leaks, guaranteeing the containment of the maintenance materials.

E. Sampling and Analysis:

Take samples from the tank and conduct on-site or laboratory analysis to verify the absence of contaminants. This step is particularly crucial when switching between different types of materials to guarantee the purity and integrity of the substances being used.

The pre-maintenance tank contamination prevention check is a vital part of road maintenance operations to maintain optimal effectiveness, safety, and cost-efficiency. By following the above steps and ensuring cleanliness, inspecting for damage, verifying connections, and analyzing samples, road maintenance teams can enhance the quality of their surface treatments while minimizing the risk of contamination.

2.5 Filling the tank with required materials

Before embarking on any maintenance operation, it is essential to conduct a pre-maintenance check to assess the condition of the road and determine the necessary repairs. This focus on the pre-maintenance operation of filling the tank with the required materials for repair operations, which include bitumen emulsions, asphalts, aggregates, water, and cleaning agents. One of the key materials used in road maintenance operations is bitumen emulsions.

2.5.1 Bitumen emulsions are a mixture of bitumen, water, and emulsifying agent

They are commonly used in surface treatments such as chip seals and slurry seals. Bitumen emulsions provide a protective layer to the road surface, improving its durability and resistance to weathering and traffic loads.

A. Asphalts

Another essential material used in road maintenance operations. Asphalt, also known as bitumen, is a sticky, black, and highly viscous liquid or semi-solid form of petroleum. It is commonly used in road construction and maintenance due to its excellent binding properties. Asphalt is applied to the road surface to create a smooth and durable driving surface, protecting the underlying layers from damage and preventing water infiltration.

B. Aggregates

Play a crucial role in road maintenance operations as well. Aggregates are granular materials such as crushed stone, gravel, or sand that are mixed with bitumen to create asphalt concrete. They provide strength and stability to the road surface, enhancing its load-bearing capacity and preventing cracking and rutting.

C. Water

An essential component in road maintenance operations, particularly in the preparation and application of bitumen emulsions and asphalts. Water is used to dilute bitumen and create emulsions, which can then be sprayed onto the road surface. It also helps in the mixing and compaction of asphalt concrete, ensuring proper adhesion and cohesion of the materials.

D. Cleaning agents

Cleaning agents are necessary for maintaining the equipment used in road maintenance operations. They help remove dirt, debris, and residual bitumen from the machinery, ensuring their proper functioning and longevity. Cleaning agents can vary depending on the type of equipment and the specific cleaning requirements.

The pre-maintenance operation of filling the tank with the required materials for road repair operations is a crucial step in ensuring the effectiveness and efficiency of road maintenance. Bitumen emulsions, asphalts, aggregates, water, and cleaning agents are essential components in road maintenance operations, each serving specific purposes in preserving and enhancing the road surface.

2.6 Standard mix of asphalt and emulsion

One of the key aspects of road maintenance is surface treatment, which involves the application of emulsion and/or asphalt to enhance the road's durability and skid resistance. However, before undertaking any maintenance activity, it is essential to conduct pre-maintenance operations and determine the appropriate standard mix of emulsion and asphalt for the specific road conditions.

Determining the Standard Mix of Emulsion and Asphalt: The selection of the standard mix of emulsion and asphalt is a critical step in road maintenance operations. It involves considering various factors such as the climate, traffic volume, road type, and desired performance characteristics.

The two primary components involved in the standard mix are emulsion and asphalt.

2.6.1 Asphalt:

Asphalt, also known as bitumen, is a sticky, black, and highly viscous material derived from crude oil. It is a key component in road construction and maintenance. The selection of the appropriate asphalt type depends on factors such as the road's traffic volume, climate, and desired performance. Asphalt can be classified into different grades based on its viscosity and temperature susceptibility, such as AC-10, AC-20, and AC-30. The choice of the asphalt grade depends on the road's specific requirements and the expected traffic loads.

2.6.2 Emulsion:

Emulsion is a mixture of asphalt, water, and an emulsifying agent. It is commonly used in surface treatments to improve the road's durability and skid resistance. The selection of the appropriate emulsion type depends on factors such as the road's condition, climate, and desired performance. For instance, cationic rapid-setting emulsions are suitable for colder climates, while anionic slow-setting emulsions are more suitable for warmer climates. The emulsion's viscosity and setting time also play a crucial role in determining its effectiveness in surface treatment.

Performing road maintenance operations and surface treatment requires careful planning and consideration of various factors. Pre-maintenance operations, including a thorough assessment of the road's condition, are crucial in determining the appropriate maintenance activities. Additionally, selecting the standard mix of emulsion and asphalt involves considering factors such as climate, traffic volume, and desired performance characteristics.

Self-check-1: Written Test

Test-I written test

Instruction: write the correct answer for the give question. You have given 1 Minute for each question.

Each question carries 2 Point.

1. What is the purpose of conducting a pre-maintenance check before undertaking road maintenance operations?
 - A. To assess the condition of the road surface
 - B. To determine the necessary repairs or treatments
 - C. To plan the appropriate road maintenance operations
 - D. All of the above
2. Which of the following is NOT a common activity involved in road maintenance operations?
 - A. Loading and unloading materials
 - B. Cleaning damaged areas
 - C. Painting road markings
 - D. Hand spreading asphalt
3. What is the purpose of hand screeding in road maintenance operations?
 - A. To level and smooth the applied asphalt or bitumen
 - B. To remove sections of damaged concrete or asphalt
 - C. To prepare the edges for replacement surface
 - D. To clean the truck sticking surfaces
4. What is the purpose of jack hammering in road maintenance operations?
 - A. To assess the condition of the road surface
 - B. To determine the necessary repairs or treatments
 - C. To plan the appropriate road maintenance operations
 - D. All of the above
5. What is the purpose of hand lancing emulsion in road maintenance operations?
 - A. To level and smooth the applied asphalt or bitumen
 - B. To remove sections of damaged concrete or asphalt
 - C. To prepare the edges for replacement surface
 - D. To apply a thin layer of emulsion to the road surface
6. What is the purpose of compacting with a vibrating plate in road maintenance operations?
 - A. To level and smooth the applied asphalt or bitumen
 - B. To remove sections of damaged concrete or asphalt
 - C. To prepare the edges for replacement surface
 - D. To prepare the edges for replacement surface
7. What is the purpose of cleaning the truck sticking surfaces with distillate in road maintenance operations?

- A. To level and smooth the applied asphalt or bitumen C. To prepare the edges for replacement surface
- B. To remove sections of damaged concrete or asphalt D. To maintain the efficiency of the equipment used
8. Why are pre-operational checks important in road maintenance operations?
- A. To ensure the road maintenance unit is in proper working condition C. To ensure the safety and efficiency of the maintenance process
- B. To prevent accidents and equipment failures D. All of the above
9. What are some of the key components of a road maintenance unit?
- A. Hopper, conveyor belt, tank, spreader, tools and equipment C. Emulsion, asphalt, aggregates, water, cleaning agents
- B. Engine, transmission system, braking system, suspension system, electrical system D. All of the above
10. Why is it important to conduct a pre-maintenance tank contamination prevention check?
- A. To prevent contamination of materials used in road maintenance operations C. To minimize costs and avoid subpar results
- B. To ensure the effectiveness and safety of the maintenance process D. All of the above

Say true or false

1. Bitumen emulsions are a mixture of bitumen, water, and an emulsifying agent used in road maintenance operations.
2. Asphalt, also known as bitumen, is a sticky, black, and highly viscous liquid or semi-solid form of petroleum used in road construction and maintenance.
3. Aggregates, such as crushed stone or gravel, are mixed with bitumen to create asphalt concrete, providing strength and stability to the road surface.
4. Water is an essential component in road maintenance operations, used to dilute bitumen and create emulsions, as well as aid in the mixing and compaction of asphalt concrete.
5. Cleaning agents are necessary for maintaining the equipment used in road maintenance operations, helping to remove dirt, debris, and residual bitumen from the machinery.

Fill in the blank space

1. Bitumen emulsions are a mixture of bitumen, water, and _____ agent.

2. Asphalt is commonly used in road construction and maintenance due to its excellent _____ properties.
3. Aggregates provide strength and stability to the road surface, enhancing its load-bearing capacity and preventing _____ and rutting.
4. Water is used to dilute bitumen and create _____, which can then be sprayed onto the road surface.
5. Cleaning agents are necessary for maintaining the equipment used in road maintenance operations and help remove dirt, debris, and residual bitumen from the machinery, ensuring their proper functioning and _____.

Operation Sheet 1

Operation title:

- Prepare the road surface for slurry seal application.

Purpose:

- To practice and demonstrate the knowledge and skill required to Slurry Seal surface treatment

Instruction:

- Use given tools and equipment for Slurry Seal surface treatment
- . For this operation you have given 6 Hour and you are expected to provide the answer on the given table.

Precautions:

- Wear safety glasses and gloves when working with slurry seal.
- Be careful not to slip on the wet slurry seal.
- Do not apply slurry seal in wet or icy conditions.
- Do not apply slurry seal over loose or damaged pavement..

Tools and requirement:

- Asphalt broom
- Pressure washer
- Slurry seal truck
- Aggregate spreader
- Pneumatic-tired roller

Procedures for slurry Seal surface treatment

1. Clear the road surface of any debris, such as rocks, dirt, and leaves. Use an asphalt broom to remove any loose debris.
2. Pressure wash the road surface to remove any loose dirt or debris.
3. Allow the road surface to dry completely.
4. Mix the slurry seal material in the slurry seal truck according to the manufacturer's instructions.
5. Spread the aggregate over the road surface using the aggregate spreader.
6. Apply the slurry seal material over the aggregate using the slurry seal truck.
7. Compact the aggregate into the slurry seal using the pneumatic-tired roller.

Quality Criteria:

- Make sure that the aggregate is the correct size for the application.
- Monitor the weather conditions and adjust the application process as needed

Lap test

Name: _____

Date: _____

Time started: _____

Time finished: _____

Allotted Time: 8 Hours

Instruction: For this operation you have given 6 Hour for each and you are expected to finish in required time

Task 1 Prepare the road surface for asphalt surface treatment.

Task 2 Prepare the road surface for Otto Seal application.

Task 3 Prepare the road surface for sand seal application.

Unit Three: Repair damaged surfaces:

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Start up, park, shut down procedures
- Truck and Boom positioning
- Area preparation
- Material Patching and quantities
- Repairing operations

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Carry out start-up, park, and shut-down procedures
- Position Truck and Boom
- Blow the area to be repaired
- Apply Material Patching and Measure quantities
- Conduct, control, and monitor repairing operations

3.1 Start up, park, shut down procedures

To carry out these operations effectively, it is essential to follow proper start-up, park, and shut-down procedures in accordance with manufacturers' guidelines and site requirements.

A. Start-up procedures

- When initiating road maintenance operations, it is imperative to adhere to the start-up procedures recommended by the equipment manufacturers.
- These procedures are designed to ensure the safe and efficient operation of the machinery.
- For instance, if we consider the start-up procedure for a road milling machine, it typically involves checking the fluid levels, inspecting the cutting tools, and verifying the proper functioning of all components.
- Following these guidelines not only enhances the performance of the machine but also minimizes the risk of accidents or breakdowns during operation.

B. Park procedures

- Similarly, park procedures are equally important in maintaining the equipment's condition and preventing any potential hazards.
- Properly parking the machinery after use helps protect it from damage caused by environmental factors, such as extreme weather conditions or unauthorized access.
- This involves parking the equipment in designated areas, securing it with appropriate safety measures, and ensuring that it is in a stable position to prevent any accidental movement.
- By following these park procedures, can extend the lifespan of the equipment and reduce the need for frequent repairs or replacements.

C. Shut-down procedures

- Shut-down procedures play a crucial role in preserving the functionality and safety of the equipment.
- These procedures involve systematically turning off the machinery, securing all moving parts, and conducting necessary maintenance tasks.
- For example, when shutting down a road maintenance vehicle, it is essential to switch off the engine, clean the equipment, and inspect it for any signs of wear or damage.
- By conducting these shut-down procedures diligently, identify any potential issues early on and take appropriate measures to address them, preventing further damage and ensuring the equipment's readiness for the next operation.

3.2 Truck and Boom positioning

3.2.1 Truck positioning

Proper truck positioning, based on the range of the boom, is integral to successfully carrying out these operations. The importance of strategic truck placement, maximizing coverage and efficiency, ensuring worker safety, and emphasizing the need for training and expertise, road maintenance crews can effectively repair damaged road surfaces and contribute to overall safer and smoother transportation infrastructure

A. The Importance of Truck Positioning:

When it comes to repairing damaged road surfaces, the positioning of trucks with booms plays a significant role. The boom of a truck is the arm-like structure that extends outward, enabling workers to access inaccessible areas without obstructing or endangering the traffic flow. Thus, an accurate and strategic positioning of the truck is crucial for optimal surface repair and treatment.

B. Considering the Range of the Boom:

The range of the boom refers to the extent to which the arm can reach. In road maintenance operations, knowing and utilizing the boom's range effectively can make a substantial difference in repairing damaged surfaces promptly and efficiently. By positioning the truck strategically based on the boom's range, workers can access and treat a wider area while minimizing the need to relocate the truck frequently.

C. Maximizing Coverage and Efficiency:

Proper truck positioning allows for the maximum coverage of damaged surfaces during road maintenance operations and surface treatments. By understanding the range of the boom, workers can position the truck in a way that minimizes the overlap or missed spots. This not only improves the overall efficiency of the repair process but also ensures that all damaged areas receive the necessary treatment for long-lasting results.

D. Ensuring Worker Safety:

Truck positioning also plays a crucial role in ensuring the safety of workers. By placing the truck strategically, workers can operate within a safe zone, away from moving traffic, while still accessing the damaged surfaces effectively. This reduces the risks of accidents, injuries, or even fatalities during road maintenance operations, creating a safer working environment for all involved.

E. Importance of Training and Expertise:

To achieve optimal truck positioning for boom range, proper training and expertise are essential. Road maintenance crews should be well-versed in leveraging the boom's range and accurately positioning

the truck for repairing damaged surfaces. Regular training sessions and refresher courses can enhance workers' knowledge and skills, ensuring their ability to perform road maintenance operations effectively and safely.

3.2.2 Boom positioning

Boom Positioning: When performing road maintenance operations and surface treatment, the positioning of a boom is crucial. The boom, which can be positioned manually or automatically, is used to apply the surface treatment material accurately. There are the two methods of boom positioning:

A. Manual Boom Positioning:

In this method, trained personnel manually position the boom over the area to be repaired. They use their expertise and experience to ensure precise placement of the boom, considering factors such as the size and shape of the damaged area. Manual boom positioning requires skilled operators who can maneuver the equipment effectively.

B. Automatic Boom Positioning:

With advancements in technology, automatic boom positioning systems have been developed. These systems use sensors and GPS technology to accurately position the boom over the damaged area. Automatic positioning reduces human error and enhances the efficiency of road maintenance operations. It also ensures consistent application of surface treatment materials, resulting in a more uniform and durable road surface.

3.3 Area preparation

When roads are damaged, whether due to regular wear and tear or unexpected events, it is crucial to promptly address the issues to prevent further deterioration and potential hazards. Repairing damaged surfaces involves several steps, and one of the initial stages is to clear the area of any dust and debris. Dust and debris can accumulate on the damaged surfaces over time, hindering the effectiveness of repair efforts. Therefore, it is necessary to use equipment such as blowers to remove these unwanted particles. Blowing the area free of dust and debris, the repair team ensures a clean and proper working surface for further maintenance operations.

Clearing the area of dust and debris offers several advantages.

- Allows for better adhesion between the repaired surface and the materials applied to fix it.
- Removing dust and debris from the area enhances the visual appearance of the repaired surface.

- Getting rid of dust and debris helps improve the durability and longevity of the repaired surface.

3.4 Material Patching and quantities

3.4.1 Patching material application

Patching material refers to a mixture of asphalt, aggregate, and other additives that are specifically designed to fill and seal defects in road surfaces. It plays a vital role in road maintenance as it helps restore the structural integrity of damaged areas, preventing further deterioration and ensuring a smooth and safe driving experience for motorists.

A. Application Process:

The application of patching material to repair damaged surfaces involves several steps. One common method is the use of compressed air to clean and prepare the defective area before applying the patching material. This process is known as compressed air patching or air blow patching.

- 1. Defect Preparation:** Before applying the patching material, it is essential to prepare the defective area properly. This involves removing loose debris, dirt, and water from the damaged surface. Compressed air is used to blow away loose particles, ensuring a clean and dry surface for optimal adhesion of the patching material.
- 2. Patching Material Application:** Once the defective area is prepared, the patching material is applied using compressed air. The material is typically delivered through a specialized nozzle, which allows for precise and controlled application. The compressed air helps to evenly distribute the patching material, ensuring it fills the defect completely.
- 3. Compaction and Finishing:** After the patching material is applied, compaction is necessary to ensure proper bonding with the existing road surface. This can be achieved using various compaction techniques, such as hand tamping or mechanical compaction equipment. Additionally, a final finishing step may be required to ensure a smooth and level surface.

B. Advantages of Compressed Air Patching:

The use of compressed air in patching operations offers several advantages:

- 1. Efficient and Fast:** Compressed air patching allows for quick and efficient repair of damaged surfaces. The high-pressure air stream helps to clean the defect rapidly, reducing the time required for preparation.

2. **Enhanced Adhesion:** The use of compressed air ensures that the patching material is applied evenly and firmly adheres to the damaged surface. This improves the longevity and durability of the repair.
3. **Cost-effective:** Compressed air patching is a cost-effective method compared to traditional repair techniques. It requires fewer resources and can be completed with minimal labor, resulting in cost savings for road maintenance agencies.

3.4.2 Material quantities and additives.

- Accurate measurement and calculation of material quantities are essential in road maintenance and surface treatment.
- Precise measurements using tools like measuring tapes or rulers help determine the length, width, and depth of the damaged area.
- These measurements are then used to calculate the volume of materials required.
- For example, the volume of asphalt repairs can be calculated using the formula:

$$\text{Volume} = \text{length} \times \text{width} \times \text{depth}.$$

- Calculating the required amounts involves converting the measured dimensions into specific units, such as cubic meters or tons, depending on the material being used.
- Accurate calculations ensure that sufficient materials are ordered and delivered to the repair site, preventing delays or shortages during the repair process.
- Recording material quantities and additives is crucial for documentation and quality control purposes.
- Each repair site should maintain comprehensive records of the materials used, the type, quantity, and any additives or modifiers incorporated.
- This information helps in tracking material usage, evaluating their effectiveness, and planning future maintenance operations.

3.5 Repairing operations

- The process of repairing damaged road surfaces involves a systematic approach to ensure effectiveness and quality.
- It begins with a thorough assessment of the condition of the road surface, identifying areas in need of repair.
- Once the damaged areas are identified, appropriate repair techniques and materials are selected based on the severity and type of damage.
- During the repair process, strict quality control measures are followed.

- Once the damaged areas are repaired, surface treatment techniques are applied to protect the road surface from further deterioration and improve its overall performance.
- Regular inspections and routine maintenance are essential to maintain the desired surface treatment.
- Ongoing monitoring helps optimize the performance and longevity of the repaired road surfaces.

General categories of repairing operations

Most common repair damages surface are

- A. Patching:** This refers to the fixing of specific damaged areas in the surface. Damage may include potholes, depressions, or other areas showing signs of distress. Once the damaged area is removed, fresh material is applied, leveled, and compacted to restore the surface.



Figure 3-1 Patching

- B. Resurfacing:** Resurfacing involves applying a new layer of material to the existing surface to rectify widespread damage, improve the longevity of the surface, or alter the surface characteristics. This process can dramatically improve the look, durability, and value of an environment.



Figure 3-2 Resurfacing

- C. Crack Sealing:** This is a preventative maintenance method that involves filling cracks in a surface to prevent water from getting underneath and causing more substantial damage such as potholes or full pavement failure. Crack sealing is cost-effective and can greatly extend the life of a surface.



Figure 3-3 Crack Sealing

- D. Joint Repair:** Joints are a necessary part of many surfaces like a concrete or asphalt pavement, allowing it to expand and contract without cracking. Joint repair involves the removal of damaged material from the joint, preparing the joint for repair, and filling the joint with a

suitable repair material. This process is crucial in maintaining the life and functionality of a surface.



Figure 3-4 Joint Repair

E. Surface Grinding: This is a process that involves removing a thin layer of a hard surface using grinding tools to smoothen the surface, correct irregularities, and restore a worn-out surface. It also helps to improve grip/traction and remove surface imperfections



Figure 3-5 Surface Grinding:

A. Patch a crack in a road surface.

Tools and requirement:

- Cold patch asphalt mix
- Shovel
- Rake
- Roller
- Rubber mallet

Procedures for Patch a crack in a road surface.

1. Clear the crack of any debris or loose material.
2. Use a shovel to widen the crack slightly so that the cold patch asphalt mix can be properly compacted.
3. Rake the crack to create a smooth surface.
4. Pour the cold patch asphalt mix into the crack.
5. Use a roller to compact the cold patch asphalt mix.
6. Use a rubber mallet to tap the cold patch asphalt mix to ensure that it is properly compacted.
7. Allow the cold patch asphalt mix to cure for the recommended amount of time..

B. Resurface a road surface.

Materials:

- Asphalt emulsion
- Aggregate
- Pneumatic-tired roller
- Asphalt broom
- Pressure washer

Procedure:

1. Clear the road surface of any debris or loose material.
2. Pressure wash the road surface to remove any loose dirt or debris.
3. Allow the road surface to dry completely.
4. Activate the asphalt emulsion according to the manufacturer's instructions.
5. Apply the asphalt emulsion to the road surface using an asphalt emulsion applicator.
6. Immediately spread the aggregate over the asphalt emulsion using an aggregate spreader.
7. Compact the aggregate into the asphalt emulsion using a pneumatic-tired roller.
8. Use an asphalt broom to sweep away any excess aggregate.

C. Crack seal a road surface.

Materials:

- Crack sealer
- Crack sealer applicator
- Pneumatic-tired roller
- Asphalt broom

Procedure:

1. Clear the road surface of any debris or loose material.
2. Apply the crack sealer to the cracks using a crack sealer applicator.
3. Use a pneumatic-tired roller to compact the crack sealer into the cracks.
4. Use an asphalt broom to sweep away any excess crack sealer.

D. Repair a joint in a road surface.

Materials:

- Joint sealant
- Joint sealant applicator
- Pneumatic-tired roller

- Asphalt broom
- Pressure washer

Procedure:

1. Clear the joint of any debris or loose material.
2. Pressure wash the joint to remove any loose dirt or debris.
3. Allow the joint to dry completely.
4. Apply the joint sealant to the joint using a joint sealant applicator.
5. Use a pneumatic-tired roller to compact the joint sealant into the joint.
6. Use an asphalt broom to sweep away any excess joint sealant.

3.6 Work Area Clean Up

3.6.1 Clean-up Phase:

The clean-up phase is of utmost importance to maintain a clean and sustainable environment. The significance of clearing the work area and disposing of or recycling materials in accordance with the project's environmental management plan.

A. Clearing the Work Area:

During road maintenance operations and surface treatments, it is essential to clear the work area thoroughly.

- This process involves removing any debris, equipment, or materials that may hinder the progress of the project.
- Clearing the work area not only ensures a safe working environment for the workers but also minimizes the risk of accidents or injuries.

B. Proper Disposal of Materials:

- Once the work area is cleared, the next step is to dispose of the materials responsibly.

- This plan may include specific instructions on segregating different types of waste, such as asphalt, concrete, or other construction materials.

3.6.2 Recycling in Accordance with the Environmental Management Plan:

In addition to proper disposal, road maintenance operations should prioritize recycling materials whenever possible.

- Recycling not only reduces the environmental impact of the project but also promotes sustainability.
- Reusing materials, conserve natural resources and minimize the need for new materials, thus reducing energy consumption and greenhouse gas emissions.

- **Benefits of Environmental Management Plan Compliance:**

Adhering to the project's environmental management plan brings several benefits.

- ✓ Ensures compliance with local, state, and federal regulations regarding waste disposal and recycling.
- ✓ Following the environmental management plan demonstrates a commitment to environmental stewardship.
- ✓ It showcases the project's dedication to sustainable practices, which can enhance its reputation and foster positive community relations.
- ✓ The clean-up phase of road maintenance operations and surface treatments is a critical component of the overall project.
- ✓ Clearing the work area and disposing of or recycling materials in accordance with the project's environmental management plan are essential for maintaining a safe and sustainable environment.
- ✓ adhering to these practices, we can ensure the longevity of our roadways while minimizing the environmental impact of these operations

3.7 Plant, Tools, and Equipment Maintenance

Performing road maintenance operations and surface treatments requires meticulous attention to detail and adherence to proper cleaning, checking, maintenance, and storage procedures for plant, tools, and equipment.

Importance of cleaning, checking, maintaining, and storing these items in accordance with manufacturers' recommendations and standard work practices.

- Cleaning the plant, tools, and equipment used in road maintenance operations and surface treatments is crucial to ensure their optimal performance and longevity.
- When cleaning the plant, tools, and equipment, it is essential to follow the manufacturers' recommendations and standard work practices.
- Cleaning, regular checking of plant, tools, and equipment is necessary to identify any potential issues or defects.
- After cleaning, checking, and maintaining the plant, tools, and equipment, proper storage is essential to protect them from environmental factors and potential damage.
- cleaning, checking, maintaining, and storing plant, tools, and equipment in accordance with manufacturers' recommendations and standard work practices are vital for road maintenance operations and surface treatments.

Self-check-1: Written Test

Test-I choose

Instruction: Select the correct answer for the give choice. You have given 1 Minute for each question.

Each question carries 2 Point.

1. What is the purpose of following start-up procedures in road maintenance operations?
 - A. To enhance the performance of the machinery
 - B. To minimize the risk of accidents or breakdowns
 - C. Both a) and b)
 - D. None of the above
2. Why is proper truck positioning important in road maintenance operations?
 - A. To maximize coverage and efficiency
 - B. To ensure worker safety
 - C. Both a) and b)
 - D. None of the above
3. What are the two methods of boom positioning in road maintenance operations?
 - A. Manual and automatic
 - B. Compressed air and mechanical
 - C. Patching and overlaying
 - D. None of the above
4. What is the purpose of blowing the area to be repaired in road maintenance operations?
 - A. To remove dust and debris
 - B. To improve adhesion between the repaired surface and materials
 - C. Both a) and b)
 - D. None of the above
5. What is the purpose of applying patching material to a defective area in road maintenance operations?
 - A. To restore the structural integrity of damaged areas
 - B. To prevent further deterioration
 - C. Both a) and b)
 - D. None of the above
6. What is one advantage of using compressed air patching in road maintenance operations?
 - A. Efficient and fast repair process
 - B. Enhanced adhesion of patching material
 - C. Cost-effective compared to traditional repair techniques
 - D. All of the above
7. Why is accurate measurement of material quantities important in road maintenance operations?
 - A. To ensure sufficient materials are available for repairs
 - B. To prevent delays or shortages during the repair process
 - C. Both a) and b)
 - D. None of the above
8. What is the purpose of recording material quantities and additives in road maintenance operations?

- A. Documentation and quality control purposes C. Both a) and b)
B. Tracking the usage of materials D. None of the above
9. What is the first step in conducting repairing operations in road maintenance?
A. Assessing the condition of the road surface C. Implementing safety precautions
B. Selecting appropriate repair techniques and materials D. None of the above
10. Why is ongoing monitoring important in road maintenance operations?
A. To identify and repair signs of wear or damage C. Both a) and b)
B. To optimize the performance and longevity of repaired road surfaces D. None of the above

Say true or false

1. Proper start-up procedures for road maintenance equipment help enhance performance and minimize the risk of accidents or breakdowns during operation.
2. Park procedures for road maintenance equipment are important for protecting it from damage caused by environmental factors and unauthorized access.
3. Shut-down procedures for road maintenance equipment help identify potential issues early on and prevent further damage.
4. Proper truck positioning is integral to successfully carrying out road maintenance operations and surface treatments.
5. The use of compressed air in patching operations offers advantages such as enhanced adhesion and cost-effectiveness.

Fill in the blank space

1. When initiating road maintenance operations, it is imperative to adhere to the _____ procedures recommended by the equipment manufacturers.
2. Properly parking the machinery after use helps protect it from damage caused by _____ factors.
3. By conducting these shut-down procedures diligently, we can identify any potential _____ early on.
4. The positioning of trucks with booms plays a significant role in _____ road surfaces.
5. The boom, which can be positioned manually or automatically, is used to apply the surface treatment material _____

Operation Sheet 1

Operation title:

- Task: Surface grind a metal part to a specified dimension..

Materials:

- Surface grinder
- Grinding wheel
- Coolant
- Safety glasses
- Gloves

Procedure:

1. Secure the metal part to the worktable of the surface grinder.
2. Select the correct grinding wheel for the material being ground.
3. Turn on the surface grinder and allow the grinding wheel to reach its operating speed.
4. Apply coolant to the grinding wheel and the metal part.
5. Feed the metal part into the grinding wheel until the desired dimension is reached.
6. Turn off the surface grinder and remove the metal part.

Purpose:

- To practice and demonstrate the knowledge and skill required to Surface grind a metal part to a specified dimension.

Instruction:

- Use given tools and equipment for Surface grind a metal part to a specified dimension
- . For this operation you have given 6 Hour and you are expected to provide the answer on the given table.

Precautions:

- Always wear safety glasses and gloves when operating a surface grinder.
- Be careful not to touch the grinding wheel.
- Do not grind the metal part too close to the edge of the grinding wheel.
- Use the correct type of coolant for the material being ground.

Tools and requirement:

- Cold patch asphalt mix
- Shovel
- Rake

- Roller
- Rubber mallet

Procedures for Surface grind a metal part to a specified dimension

8. Clear the crack of any debris or loose material.
9. Use a shovel to widen the crack slightly so that the cold patch asphalt mix can be properly compacted.
10. Rake the crack to create a smooth surface.
11. Pour the cold patch asphalt mix into the crack.
12. Use a roller to compact the cold patch asphalt mix.
13. Use a rubber mallet to tap the cold patch asphalt mix to ensure that it is properly compacted.
14. Allow the cold patch asphalt mix to cure for the recommended amount of time..

Quality Criteria:

- Use a slow feed rate when grinding the metal part to the desired dimension.
- Apply a light touch to the metal part when grinding.
- Inspect the metal part frequently to ensure that it is being ground to the desired dimension.

Lap test

Name: _____

Date: _____

Time started: _____

Time finished: _____

Allotted Time: 8 Hours

Instruction: For this operation you have given 8 Hour and you are expected to finish in required time

Task 1: Patch a crack in a road surface

Task 2: Resurface a road surface.

Task 3: Perform Crack seal a road surface

Task 4: Repair a joint in a road surface

Unit Four: Oversee the execution of tasks

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Performance of sealing operations
- Sealing works practice or job plan
- Plant, equipment and tools maintenance and recording requirements

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Monitor the performance of sealing operations
- Initiate adjustments to sealing works practice or job plan
- Ensure plant equipment and tools maintenance and recording requirements

4.1 Performance of sealing operations

To ensure that sealing operations achieve the desired outcomes, it is essential to monitor their performance closely. This will discuss the various aspects involved in monitoring the performance of sealing operations, including ongoing risk assessment, engineering surveys, sampling and testing, recording and observation of construction practice, and the required outcomes such as task specifications, drawings, coordination, scheduling, unit cost, overall task cost, and waste management.

4.1.1 Ongoing Risk Assessment:

Monitoring the performance of sealing operations begins with conducting ongoing risk assessments. This involves identifying potential hazards and evaluating the associated risks throughout the project. By continuously assessing risks, project managers can implement appropriate control measures to mitigate any potential issues that may arise during the execution of the tasks. Ongoing risk assessment ensures that safety measures are in place and that the sealing operations are carried out in a secure environment.

4.1.2 Engineering Survey:

An essential component of monitoring sealing operations is conducting engineering surveys. These surveys involve the collection of data related to the road's condition, including its surface characteristics, such as roughness and texture. By conducting engineering surveys before and after the sealing operations, project managers can evaluate the effectiveness of the treatment and determine if it meets the required outcomes. This data-driven approach helps in making informed decisions regarding the performance of sealing operations.

4.1.3 Sampling and Testing:

Another crucial aspect of monitoring sealing operations is sampling and testing. This involves collecting samples of the sealing material and subjecting them to various tests to assess their quality and performance. These tests may include measuring the material's viscosity, adhesion, and resistance to environmental factors. By conducting comprehensive sampling and testing, project managers can ensure that the sealing material meets the specified requirements and will provide the desired outcomes.

4.1.4 Recording and Observation of Construction Practice:

To monitor the performance of sealing operations, it is essential to record and observe the construction practices employed during the project. This includes documenting the techniques, equipment, and materials used, as well as observing the application process. By closely monitoring the construction practices, project managers can identify any deviations from the specified requirements and take

corrective actions promptly. This helps in maintaining the quality and effectiveness of the sealing operations.

4.1.5 Required Outcomes:

Monitoring the performance of sealing operations also involves ensuring that the project meets the required outcomes. These outcomes may include task specifications, drawings, coordination, scheduling, unit cost, overall task cost, and waste management requirements. Adhering to these requirements ensures that the sealing operations are carried out efficiently, within budget, and in compliance with environmental regulations.

4.2 Sealing works practice or job plan

As part of overseeing the execution of these tasks, it is essential to initiate adjustments to sealing works practice or job plans to ensure the safe execution of work and the achievement of required outcomes. This delve into the importance of making adjustments, the factors to consider, and the benefits they bring to the overall road maintenance process.

4.2.1 Importance of Adjustments to Sealing Works Practice:

- A. Ensuring Safety:** Adjustments to sealing works practice are vital for ensuring the safety of both workers and road users. By initiating adjustments, potential hazards can be identified and mitigated, reducing the risk of accidents and injuries during the execution of road maintenance operations.
- B. Enhancing Efficiency:** Adjustments allow for the optimization of resources, equipment, and materials, leading to increased efficiency in the execution of sealing works. This, in turn, helps to minimize disruptions to traffic flow and reduce the overall duration of road maintenance projects.
- C. Meeting Quality Standards:** Adjustments to sealing works practice ensure that the desired outcomes, such as the quality of the road surface, are achieved. By closely monitoring the execution of tasks and making necessary adjustments, the required standards can be met, resulting in a durable and long-lasting road surface.

4.2.2 Factors to Consider when Initiating Adjustments:

- A. Weather Conditions:** Weather plays a crucial role in the success of sealing works. Adjustments should be made to account for variations in temperature, humidity, and precipitation, as these factors can significantly impact the effectiveness of the sealing process. For example, in colder temperatures, adjustments may involve modifying the type or composition of the sealing material to ensure proper adhesion and curing.

- B. Traffic Volume and Patterns:** Adjustments should also consider the volume and patterns of traffic in the area where the sealing works are being carried out. This helps in planning the timing of the operations to minimize disruptions and ensure the safety of road users and workers.
- C. Site-specific Conditions:** Each road maintenance project may have unique site-specific conditions that require adjustments. Factors such as road geometry, existing road surface condition, and the presence of utilities or structures near the worksite should be taken into account to ensure the safe execution of tasks and the achievement of desired outcomes.

4.2.3 Benefits of Initiating Adjustments:

- A. Improved Safety:** By initiating adjustments, potential hazards can be identified and mitigated, ensuring the safety of workers and road users. This leads to a reduction in accidents and injuries during the execution of sealing works.
- B. Enhanced Durability:** Adjustments to sealing works practice contribute to the overall durability of the road surface. By ensuring proper material selection, application techniques, and curing processes, the road surface can withstand heavy traffic loads, weather variations, and other environmental factors, resulting in a longer lifespan.
- C. Cost-effectiveness:** Adjustments that optimize resources, equipment, and materials can lead to cost savings in road maintenance projects. By minimizing wastage and maximizing efficiency, adjustments contribute to the overall cost-effectiveness of the sealing works.

4.3 Plant, equipment and tools maintenance requirements

In road maintenance operations and surface treatment, the proper maintenance of plant equipment and tools is crucial for the successful execution of tasks. This discusses the importance of ensuring that maintenance requirements for plant equipment and tools are carried out and recorded. By adhering to maintenance protocols, road maintenance teams can enhance operational efficiency, extend the lifespan of equipment, and ensure the safety of workers.

4.3.1 Importance of Plant Equipment and Tools Maintenance

Maintaining plant equipment and tools is essential for several reasons:

- A. Operational Efficiency:** Regular maintenance ensures that equipment operates at optimal performance levels, minimizing downtime and maximizing productivity. Well-maintained machinery and tools are less likely to experience breakdowns or malfunctions, allowing road maintenance operations to proceed smoothly.

- B. Safety:** Properly maintained equipment reduces the risk of accidents and injuries. Regular inspections and maintenance help identify potential hazards or faulty components, allowing for timely repairs or replacements. This ensures the safety of workers and promotes a secure working environment.
- C. Cost-Effectiveness:** Neglecting maintenance can lead to costly repairs or premature replacements. By adhering to maintenance requirements, road maintenance teams can extend the lifespan of equipment, reducing the need for frequent replacements and saving on operational costs.

4.3.2 Maintenance Procedures for Plant Equipment and Tools:

To ensure the effective maintenance of plant equipment and tools, the following procedures should be implemented:

- A. Regular Inspections:** Conduct routine inspections to identify any signs of wear and tear, damage, or malfunction. Inspections should cover all components, including engines, hydraulics, electrical systems, and safety features. Inspections can be scheduled based on equipment usage or manufacturer recommendations.
- B. Preventive Maintenance:** Implement a preventive maintenance schedule to address routine tasks such as lubrication, filter replacements, belt adjustments, and cleaning. This proactive approach helps prevent major breakdowns and ensures equipment operates optimally.
- C. Repairs and Replacements:** Promptly address any identified issues or defects through repairs or component replacements. Maintain a record of repairs performed, including the date, nature of the repair, and the technician responsible. This documentation helps track maintenance history and informs future maintenance decisions.
- D. Calibration and Testing:** Regularly calibrate and test equipment to ensure accuracy and reliability. This is particularly important for equipment used in surface treatment, such as sprayers or spreaders, to achieve consistent and precise application of materials.
- E. Training and Education:** Provide training to equipment operators and maintenance personnel on proper handling, operation, and maintenance procedures. This ensures that maintenance tasks are carried out correctly and that operators are aware of potential risks or signs of equipment malfunction.

4.3.3 Recording Maintenance Activities:

Maintaining accurate records of maintenance activities is crucial for accountability, tracking equipment performance, and compliance purposes.

The following information should be recorded:

- A. Maintenance Logs:** Document all maintenance activities, including inspections, repairs, replacements, and calibrations. Include details such as dates, tasks performed, parts replaced, and personnel involved. This log serves as a reference for future maintenance and helps identify patterns or recurring issues.
- B. Equipment History:** Maintain individual equipment files that include purchase information, maintenance records, and any modifications made. This comprehensive history provides valuable insights into equipment performance, costs, and lifespan.
- C. Compliance Documentation:** Keep records of maintenance activities to comply with regulatory requirements and industry standards. This documentation may be necessary for audits, inspections, or legal purposes.

Self-check-1: Written Test

Test-I choose

Instruction: Select the correct answer for the give choice. You have given 1 Minute for each question.

Each question carries 2 Point.

1. What is the purpose of ongoing risk assessment in monitoring sealing operations?
 - A. To ensure the safety of workers and road users
 - B. To evaluate the effectiveness of the treatment
 - C. To meet the required outcomes of sealing operations
 - D. To optimize resources, equipment, and materials
2. What is the role of engineering surveys in monitoring sealing operations?
 - A. To identify potential hazards and evaluate associated risks
 - B. To collect data on road surface characteristics
 - C. To assess the quality and performance of sealing material
 - D. To record and observe construction practices
3. Why is sampling and testing important in monitoring sealing operations?
 - A. To ensure the safety of workers and road users
 - B. To evaluate the effectiveness of the treatment
 - C. To meet the required outcomes of sealing operations
 - D. To optimize resources, equipment, and materials
4. What is the purpose of recording and observing construction practice in monitoring sealing operations?
 - A. To identify potential hazards and evaluate associated risks
 - B. To collect data on road surface characteristics
 - C. To assess the quality and performance of sealing material
 - D. To identify deviations from specified requirements
5. What are the required outcomes that need to be monitored in sealing operations?
 - A. Task specifications, drawings, and coordination
 - B. Scheduling, unit cost, and overall task cost
 - C. Waste management requirements
 - D. All of the above
6. Why is it important to initiate adjustments to sealing works practice or job plans?
 - A. To ensure the safety of workers and road users
 - B. To enhance the efficiency of sealing works
 - C. To meet the required quality standards
 - D. All of the above
7. What factors should be considered when initiating adjustments to sealing works?
 - A. Weather conditions
 - B. Traffic volume and patterns
 - C. Site-specific conditions
 - D. All of the above

8. What are the benefits of initiating adjustments to sealing works practice?
 - A. Improved safety
 - B. Enhanced durability of the road surface
 - C. Cost-effectiveness
 - D. All of the above
9. Why is proper maintenance of plant equipment and tools important in road maintenance operations?
 - A. To ensure operational efficiency
 - B. To ensure the safety of workers
 - C. To reduce operational costs
 - D. All of the above
10. What should be recorded when carrying out plant equipment and tools maintenance?
 - A. Maintenance logs
 - B. Equipment history
 - C. Compliance documentation
 - D. All of the above

Say true or false

1. Ongoing risk assessment is not necessary for monitoring the performance of sealing operations.
2. Engineering surveys are conducted before and after sealing operations to evaluate their effectiveness.
3. Sampling and testing of sealing material is not necessary for ensuring the desired outcomes.
4. Recording and observation of construction practice is not important for monitoring sealing operations.
5. Adjustments to sealing works practice are not important for ensuring safety and efficiency.

Fill in the blanks:

1. Adjustments to sealing works practice are important for ensuring the _____ of both workers and road users.
2. Weather conditions, traffic volume and patterns, and site-specific conditions are factors to consider when initiating _____ to sealing works.
3. Initiating adjustments to sealing works practice can lead to improved _____, enhanced durability, and cost-effectiveness.
4. Proper maintenance of plant equipment and tools is crucial for operational efficiency, _____, and cost-effectiveness.
5. Regular inspections, preventive maintenance, repairs and replacements, calibration and testing, and training and education are important procedures for the _____ of plant equipment and tools.

Unit Five: Report the Execution of Tasks

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Completing and submitting required reports
- Recommending changes to tasks

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Complete and submit required reports
- Recommend changes to tasks

5.1 Completing and submitting reports

It is essential to document and report on the execution of tasks to ensure accountability, transparency, and effective communication. This to discuss the importance of completing and submitting reports as required in road maintenance operations and surface treatment projects.

5.1.1 Importance of Reports in Road Maintenance Operations:

- A. Documentation:** Reports serve as an essential tool for documenting the execution of tasks during road maintenance operations. They provide a detailed account of the work performed, including the materials used, equipment utilized, and the methods employed. This documentation is crucial for future reference, analysis, and decision-making processes.
- B. Accountability:** Reports help establish accountability within road maintenance operations. By documenting the tasks completed, reports provide a clear record of the work carried out by the maintenance crew. This accountability ensures that all tasks are executed according to established standards and guidelines, minimizing the risk of errors or negligence.
- C. Performance Evaluation:** Reports allow for the evaluation of the performance of road maintenance operations. By documenting the progress made, challenges faced, and outcomes achieved, reports provide valuable insights into the efficiency and effectiveness of the maintenance activities. This evaluation helps identify areas for improvement and facilitates informed decision-making for future projects.
- D. Communication and Collaboration:** Reports serve as a means of effective communication and collaboration among various stakeholders involved in road maintenance operations. By sharing detailed information about the tasks executed, reports enable better coordination between maintenance crews, project managers, and other relevant parties.

5.1.2 Submission of Reports:

- A. Timeliness:** Reports should be completed and submitted in a timely manner. Adhering to predetermined deadlines ensures that the information is fresh and relevant, enabling prompt action and decision-making. Timely submission also demonstrates professionalism and commitment to the project.
- B. Accuracy and Detail:** Reports should be accurate and provide sufficient detail to convey a comprehensive understanding of the tasks executed. Including specific information such as the location of the maintenance operation, the duration of the work, the materials used, and any challenges faced enhances the report's value and usefulness.

- C. Standardized Format:** Reports should follow a standardized format to ensure consistency and ease of understanding. This format may include sections such as an executive summary, project overview, task description, challenges encountered, and recommendations for future improvements. Adhering to a standardized format facilitates efficient review and analysis of the report.

5.2 Recommending changes to tasks

Road maintenance operations and surface treatments are critical for ensuring the safety, efficiency, and effectiveness of our roadways. As part of the ongoing efforts to enhance these aspects, it is essential to identify and recommend changes that can further improve the execution of civil works tasks. This recommended changes to enhance the safety, efficiency, and effectiveness of road maintenance operations and surface treatment projects.

5.2.1 Improving Safety:

- A. Enhanced Training Programs:** Implementing comprehensive training programs for road maintenance personnel can significantly improve safety. These programs should cover topics such as proper handling of equipment, adherence to safety protocols, and awareness of potential hazards. Regular training sessions and refresher courses should be conducted to ensure that all personnel are up-to-date with the latest safety practices.
- B. Increased Use of Personal Protective Equipment (PPE):** Emphasizing the importance of wearing appropriate PPE, such as helmets, high-visibility vests, gloves, and safety shoes, can significantly enhance the safety of civil works tasks. Strict enforcement of PPE requirements and regular inspections can help ensure compliance and minimize the risk of accidents and injuries.
- C. Traffic Management Measures:** Implementing effective traffic management measures is crucial to ensure the safety of both road maintenance personnel and road users. This may include the use of signage, barriers, and flaggers to divert traffic safely and provide clear instructions.

Regular inspections and adjustments to traffic management plans should be conducted to address changing conditions and minimize risks. Improving Efficiency:

1. Equipment Maintenance and Upgrades: Regular maintenance and timely upgrades of equipment used in road maintenance operations can significantly improve efficiency. Ensuring that equipment is in optimal working condition reduces downtime and enhances productivity. Additionally, investing in

advanced technology and equipment, such as automated pavement marking systems or intelligent compaction devices, can further improve efficiency and accuracy.

2. Streamlined Work Processes: Identifying and eliminating unnecessary steps or bottlenecks in work processes can improve efficiency. Conducting time-motion studies to analyze the sequence of tasks and identify areas for improvement can lead to more streamlined and efficient operations.

5.2.2 Improving Effectiveness:

- A. Data-Driven Decision Making:** Utilizing data collection and analysis tools can enhance the effectiveness of road maintenance operations. By collecting and analyzing data on pavement conditions, traffic patterns, and maintenance history, informed decisions can be made regarding the timing and type of surface treatments required. This data-driven approach ensures that resources are allocated effectively and treatments are applied where they are most needed.
- B. Collaboration and Knowledge Sharing:** Encouraging collaboration and knowledge sharing among road maintenance professionals can lead to improved effectiveness. Establishing platforms for sharing best practices, lessons learned, and innovative techniques can help identify successful strategies and promote continuous improvement. Regular meetings, workshops, and conferences can facilitate this exchange of knowledge and experiences.

Self-check-1: Written Test

Test-I choose

Instruction: Select the correct answer for the give choice. You have given 1 Minute for each question.

Each question carries 2 Point.

1. What is the primary purpose of completing and submitting reports in road maintenance operations?
 - A. To document the execution of tasks
 - B. To establish accountability
 - C. To evaluate performance
 - D. To facilitate communication and collaboration
2. Why is accountability important in road maintenance operations?
 - A. To ensure adherence to standards and guidelines
 - B. To minimize the risk of errors or negligence
 - C. To establish a clear record of work carried out
 - D. All of the above
3. How can reports contribute to performance evaluation in road maintenance operations?
 - A. By documenting progress made
 - B. By identifying areas for improvement
 - C. By facilitating informed decision-making
 - D. All of the above
4. What is the significance of timely submission of reports?
 - A. Fresh and relevant information for prompt action
 - B. Demonstrates professionalism and commitment
 - C. Enables efficient review and analysis
 - D. All of the above
5. What should reports in road maintenance operations include to enhance their value?
 - A. Details about the materials used and challenges faced
 - B. To establish accountability
 - C. Recommendations for future improvements
 - D. All of the above
6. How can training programs enhance safety in road maintenance operations?
 - A. By providing knowledge about equipment handling
 - B. By promoting adherence to safety protocols
 - C. By raising awareness of potential hazards
 - D. All of the above
7. What is the role of personal protective equipment (PPE) in improving safety?
 - A. Minimizes the risk of accidents and injuries
 - B. Ensures compliance with safety requirements
 - C. Enhances visibility and protection for personnel
 - D. All of the above
8. How can traffic management measures contribute to safety in road maintenance operations?

- A. Divert traffic safely and provide clear instructions C. Ensure effective management of changing conditions
- B. Minimize risks for both road maintenance personnel and road users D. All of the above
9. How can equipment maintenance and upgrades improve efficiency in road maintenance operations?
- A. Reduce downtime and enhance productivity C. Increase accuracy and effectiveness of tasks
- B. Ensure optimal working condition of equipment D. All of the above
10. What is the benefit of data-driven decision making in road maintenance operations?
- A. Allocating resources effectively C. Enhancing the effectiveness of maintenance activities
- B. Applying treatments where they are most needed D. All of the above

Say true or false

1. Reports in road maintenance operations serve as a tool for documenting the execution of tasks.
2. Reports help establish accountability within road maintenance operations.
3. Reports allow for the evaluation of the performance of road maintenance operations.
4. Timely submission of reports demonstrates professionalism and commitment to the project.
5. Reports should provide accurate and detailed information about the tasks executed.

Fill in the blank

1. Reports serve as an essential tool for _____ the execution of tasks during road maintenance operations.
2. Implementing comprehensive training programs for road maintenance personnel can significantly improve _____.
3. Emphasizing the importance of wearing appropriate personal protective equipment (PPE) can significantly enhance the safety of _____ tasks.
4. Regular maintenance and timely upgrades of equipment used in road maintenance operations can significantly improve _____.
5. Utilizing data collection and analysis tools can enhance the ___ of road maintenance operations.

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Developer profile

Name	Qualification (Level)	Field of study	Institute	Phone number	Email
ASHAGRE BIBISO	B	Road construction(B.sc)	Wolaita sodo PTC	0912304708	Ashagrebibiso@gmail.com
BEKALU YIBELTAL	A	Structural engineer(M.sc) Civil engineering (B.sc)	FTVTI	0911271096	fikruiyibetal@gmail.com
BELETE AWEKE	B	Road construction(B.sc)	Bahirdar PTC	0910974355	beleteyc@gmail.com
HABIB SURUR	B	Road construction	Hawasa P.T.C	0979798778/ 0909669919	habibsurur0@gmail.com
MOHAMMED SEID	A	Surveying (B.sc) COTM(M.sc)	FTVTI	0914053274	Muha.seid@gmail.com
NIGUSSIE TESHOME	A	Geotechnical enginer(M.sc) Civil engineering (B.sc)	Arbaminch PTC	0913767770	teshomeng@gmail.com
WONDWESN GIRMA	A	COTM(M.sc) Civil engineering (B.sc)	Harar polytechnic College	0912778365 0703608365	wondwesngirma@gmail.com
ZEKARIAS GEBRE	B	Civil engineering (B.sc)	General wingate polytechnic College	0912421317	thekey1502@gmail.com