Road Construction and Maintenance

LEVEL – III

Based on September 2023, Curriculum Version 2

Module Title: **Concrete Kerb, Channel, & Road Side Fixtures**

Module Code: **EIS RCM M11 0923**

Nominal Duration: **80 Hours**

Prepared by: **Ministry of Labor and Skill**

September, 2023

Addis Ababa, Ethiopia

ACKNOWLEDGEMENTS

The **Ministry of Labor and Skill (MoLS), HELVETAS Swiss Intercooperation,** and **Bridges to Prosperity** wish to thank MoLS experts, HELVETAS leaders and experts, regional labor and skill bureaus, TVT trainers, university lecturers, and industry experts who contribute their time and professional experience to the development of this **Training module** for Road Construction and Maintenance.

We would like to express our appreciation to the **Ministry of Labor and Skill, HELVETAS Swiss Intercooperation,** and **Bridges to Prosperity** for their technical and financial support and workshop facilitation of this training module development.

ACRONYMS

AAWSA	Addis Ababa Water and Sewage Authority
ASTM	American Standard for Testing Material
AASHTO	American Association of State Highway and Transportation Officials
EBCS	Ethiopian Building Code Standard
EIS	Economy Infrastructure Subsector
EMP	Environmental Management Plan
ERA	Ethiopian Road Authority (Currently: Ethiopian Road Administration)
ISO	International Organization for Standardization
LAP Test	Learning Activity Performance Test
LG	Learning Guide
M	Module
OS	Occupational Standard
OSH	Occupational Safety and Health
PPE	Personal Protective Equipment
RCM	Road Construction and Maintenance
TTLM	Teaching, Training and Learning Materials

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INTRODUCTION TO THE MODULE

This module is prepared to support training of specific unit of competence, which contains knowledge, skills and attitude required to install concrete kerb, channel, and road side fixtures. Concrete kerbs, channels, and road side fixtures are essential components of roadway infrastructure. They are designed to provide a barrier between the road and other areas, such as sidewalks, grassy areas, or drainage systems. These fixtures have multiple functions. In this module concrete kerb, channel, & road side fixtures requirement, cast in-situ concrete unit, pre-cast concrete units, and repairing concrete units will be presented.

MODULE UNITS

- Concrete Kerb, Channel, & Road Side Fixtures Requirement
- Cast In-situ Concrete Unit
- Pre-Cast Concrete Units
- Repairing Concrete Units

LEARNING OBJECTIVES OF THE MODULE

At the end of this session, the students will able to:

- Identify concrete kerb, channel, & road side fixtures requirement
- Install cast in-situ concrete unit
- Install pre-cast concrete units
- Repair concrete units

MODULE LEARNING INSTRUCTIONS

1. Read the specific objectives of this learning guide (LG).
2. Follow the instructions described below.
3. Read the information written in the information sheet.
4. Accomplishment the self-check questions.
5. Accomplishment operation sheet.
6. Accomplishment learning activity performance (LAP) test

Unit One: Concrete Kerb, Channel, & Road Side Fixtures Requirement

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

- Basic Concept of Concrete Kerb, Channel, and Road Side Fixtures
- Compliance Document
- Safety Requirement
- Signage Requirement
- Tools and Equipment
- Environmental Protection Requirement

This unit 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:

- Introduce concrete kerb, channel, and road side fixtures
- Identify compliance document
- Select and apply safety requirement
- Identify and apply signage requirement
- Identify and apply tools and equipment
- Identify environmental protection requirement

1.1 Basic Concept of Concrete Kerb, Channel, and Road Side Fixtures

1.1.1 Concrete Kerb

A concrete kerb (concrete curb or curbstone) is a solid, raised edge constructed along the sides of roads, sidewalks, parking lots, and other public areas. It is typically made of concrete and serves various purposes such as separating pedestrian walkways from vehicular traffic, providing stability and support to the pavement, and guiding water runoff. Concrete kerbs are often installed during road construction or as part of maintenance and improvement projects to enhance safety and the overall aesthetics of the area. They can come in different shapes, sizes, and designs depending on the specific requirements and preferences of the project.

Figure 1. 1 Concrete kerb

1.1.2 Channel

A concrete channel refers to a linear structure made of concrete that is designed to convey and control the flow of water. It is commonly used in urban areas and flat landscapes to prevent flooding and manage stormwater runoff. Concrete channels are often constructed with a trapezoidal cross-section to efficiently transport water while providing stability and erosion resistance. These channels can be found alongside roads, in drainage systems, and in engineered waterways.

Figure 1. 2 Channel

1.1.3 Road Side Fixtures

Roadside fixtures refer to any permanent structures or objects that are found along the side of a road or highway. These fixtures can include various items such as street lights, traffic signs, utility poles, guardrails, benches, bus stops, and pedestrian crosswalks. They are installed to enhance safety, provide information, and improve the overall functionality of the road network.

A. Gutters: is a depression that runs parallel to a road and is designed to collect rainwater that flows along the street diverting it into a storm drain. A gutter alleviates water buildup on a street, allows pedestrians to pass without walking through puddles, and reduces the risk of hydroplaning by road vehicles.

Figure 1. 3 Gutters

B. Median: is the area between opposing lanes of traffic, excluding turn lanes. Medians in urban and suburban areas can be defined by pavement markings, raised medians, or islands to separate motorized and non-motorized road users.

Figure 1. 4 Median

C. **Barrier Strips:** are used to protect traffic from roadside obstacles or hazards, such as slopes steep enough to cause rollover crashes, fixed objects like bridge piers, and bodies of water. Roadside barriers can also be used with medians, to prevent vehicles from colliding with hazards within the median.

Figure 1. 5 Barrier Strips

D. **Driveways:** is a piece of hard ground that leads from the road to the front of a house or other building.

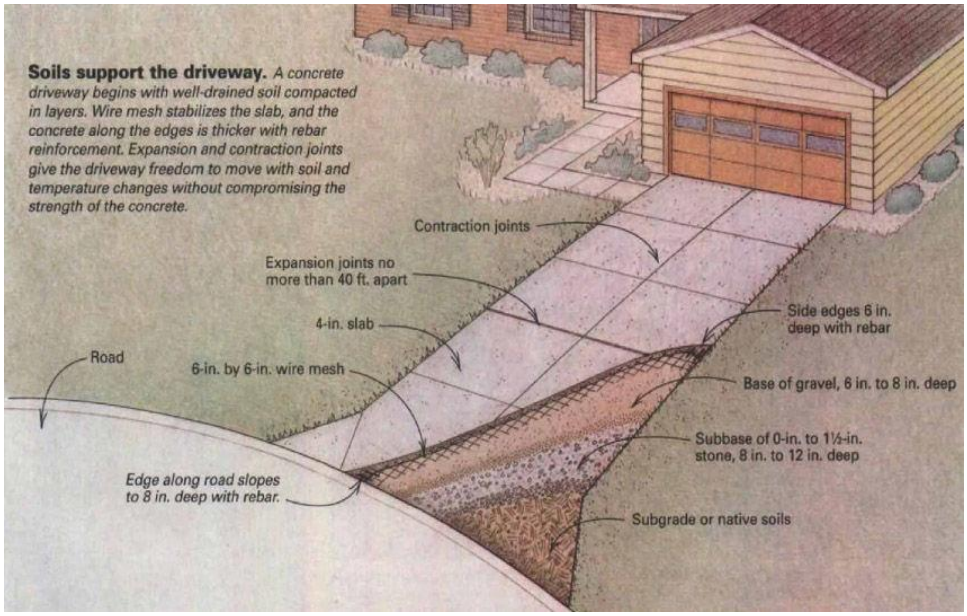

Figure 1. 6 Driveway

E. Inverts: is the lowest point upon which water can flow on the inside. If circular in shape, the invert is the lowest point on the inner circle if looking at a section of the construction.

Figure 1. 7 Inverts

1.2 Compliance Documentation

1.2.1 Code, Standard, and Responsible Bodies

Code generally refers to a set of rules or guidelines that outline expected behavior or practices in a particular context. A standard is a set of guidelines or criteria that outline minimum requirements or best practices for a particular product, process, or service. Standards are often set by industry organizations, government agencies, or consensus among experts. They provide a benchmark against which the quality, safety, or performance of something can be measured. Authority (Responsible Body) refers to the power or right to give orders, make decisions, or enforce rules. It can be vested in individuals, organizations, or institutions and is often derived from laws, policies, or recognized expertise. Authority is an important aspect of maintaining order and ensuring compliance with codes and standards. Compliance Documentation means specific documents or information including records, reports, observations and verbal responses required to verify compliance with standards by a facility or program. For design and implementation of concrete kerb, channels, and road side fixtures Ethiopian Road Authority (currently: Ethiopian Road Administration) ERA manual (Version: 2013) and Ethiopian Building Code Standard (Version: 2013), Addis Ababa City Roads Authority (AACRA) Standard Specification for AACRA Urban Infrastructure Works: Curbs, Channels & Other Structures (Version: 2003), American Association of State Highway and Transportation Officials (AASHTO), and American Standard for Testing Material (ASTM) will be referred. [Note: Regions and City Administration use their own manual, code, and standard.]

1.3 Safety Requirements

1.3.1 Occupational Safety and Health (OSH)

Occupational safety and health are concerned with preserving and protecting human and facility resources in the workplace. Safety is the state of being "safe", the condition of being protected from harm or other danger. Safety can also refer to the control of recognized hazards in order to achieve an acceptable level of risk.

1.3.2 Construction Site Safety

Construction site safety is crucial to ensure the well-being of workers and prevent accidents and injuries. Factors to consider for construction site safety:

A. Training: Workers should receive proper training on safety procedures, hazard identification, and how to use protective equipment. Regular refresher training should be provided to keep workers updated on safety protocols.

B. Personal Protective Equipment (PPE): All workers should have access to and wear appropriate PPE, such as hard hats, safety glasses, gloves, high visibility clothing, and steel-toed boots. PPE helps protect against head injuries, eye injuries, hand injuries, and falls.

C. Hazard identification: Conduct regular site inspections to identify and address potential hazards, such as uneven walkways, exposed wiring, or hazardous materials. Clear signage should be used to indicate hazardous areas.

D. Fall prevention: Implement fall protection measures, such as guardrails, safety nets, or personal fall arrest systems, for elevated work areas. Workers should also be trained on how to properly use and inspect fall protection equipment.

E. Equipment safety: Regular maintenance and inspection of tools and equipment are essential to ensure their safe operation. Operators should be trained on the safe use of machinery, including cranes, forklifts, and power tools.

F. Communication: Establish clear communication channels among workers, supervisors, and contractors to ensure everyone is aware of hazards, safety protocols, and emergency procedures.

G. Emergency response planning: Develop and practice emergency response plans, including evacuation procedures, assembly points, and first aid. Adequate first aid kits should be readily available on-site.
H. Traffic management: If the construction site is near roadways, implement proper traffic management measures, including traffic signs, barriers, and signals. Adequate separation of pedestrians and vehicles should be ensured.
I. Regular safety meetings: Conduct regular safety meetings to discuss any safety concerns, near misses, or accidents. This provides an opportunity to reinforce safety practices and address any emerging risks.

By implementing these measures and promoting a safety-focused culture, construction site accidents can be minimized, creating a safer working environment for all workers involved.

1.3.4 First Aid

First aid in concrete work involves assessing and treating injuries that occur while working with concrete. First aid measures for common injuries in concrete work:

A. Eye Injuries:
   - Flush the eye with clean water for at least 15 minutes.
   - Do not rub or touch the eye.
   - If a foreign object is lodged in the eye, do not try to remove it and seek immediate medical help.
B. Chemical (Admixtures) Burns:
   - Remove contaminated clothing or wash the affected area.
   - Flush the area with clean water for at least 15 minutes.
   - Seek immediate medical attention.
C. Inhalation of Concrete Dust:
   - Move the person to fresh air.
   - Allow them to rest and breathe slowly.
   - If breathing difficulties persist, seek medical attention.

It is important to have a fully stocked first aid kit readily available at the worksite, along with well-groomed and trained first aid personnel. Additionally, always follow safety protocols and wear personal protective equipment to minimize the risk of injury.

1.4 Signage Requirements

1.4.1 Signage Requirements on Concrete Work

Signage requirements depending on local regulations and the specific project. Common signage requirements to consider:

A. Safety signs: To promote a safe working environment, certain safety signs required on construction sites. These signs can include warnings about potential hazards, instructions for personal protective equipment (PPE), emergency contact information, and safety rules.

B. Traffic signs: If the concrete work involves road construction or affects traffic, signage required to direct drivers and pedestrians. This can include signs indicating detours, speed limits, lane closures, and temporary road markings.

Figure 1. 8 Traffic sign for concrete work

C. Construction project signs: In some areas, construction projects are required to display signs that provide information about the project, including the contractor, project name, contact information, and any necessary permits or approvals. These signs can help inform the public and address any concerns or inquiries.

D. Perimeter fencing and barricade signs: When concrete work involves construction sites that are fenced off or barricaded, signage required to indicate restricted access, potential dangers, and provide contact information for authorized personnel.

E. Warning signs: Specific warning signage necessary depending on the type of concrete work being done. For example, if there is wet concrete or freshly poured slabs, signs indicating "Wet Concrete" or "Construction Area - Keep Out" needed to prevent accidents and protect the work.
F. Accessibility signs: In accordance with accessibility regulations, signs indicating accessible routes and areas should be provided. This helps ensure that individuals with disabilities can navigate around the construction site safely.

It is crucial to consult with local authorities, construction project managers, or regulatory bodies to determine the specific signage requirements for a concrete work project. They can provide accurate information on signage dimensions, design, placement, and any additional requirements that must be met.

4.4.2 Signage Requirement Under Traffic Conditions

Traffic includes various environments and areas. examples:

A. Congested urban environments: These are busy city streets with high volumes of vehicles, including cars, buses, and motorcycles. Heavy traffic congestion during peak hours is common in such areas.
B. Low traffic rural areas: These are sparsely populated regions with less vehicle movement and low traffic density. These areas mainly consist of countryside roads and highways.
C. Off-road un-trafficked areas: These are unpaved or non-road areas where vehicles are not meant to be driven. It includes deserts, forests, and other natural terrains.
D. Buildings: Traffic within buildings, such as multi-level parking structures or underground tunnels, where vehicles navigate through ramps, narrow passages, and levels.
E. Parking sites: These areas include parking lots, garages, and open spaces dedicated to vehicles. Traffic occurs when vehicles enter, exit, or maneuver within parking areas.
F. Pedestrian areas: Places like city squares, sidewalks, and crosswalks where pedestrian movement is high. Traffic can refer to the movement of pedestrians and the interaction between pedestrians and vehicles.

Understanding traffic patterns and environments is crucial for urban planning, transportation management, and traffic control systems to ensure safe and efficient movement of vehicles and people.

1.5 Tools, Equipment, and Plant

Some common tools, equipment, and plant used in concrete work include:

Table 1. 1 Tools, equipment, and plant

Tools, Equipment, and Plant	Figure
Concrete Mixer: Used for mixing cement, sand, aggregate, and water to form concrete.	
Concrete Vibrator: Used for removing air bubbles and ensuring proper compaction of the concrete.	
Concrete Pump: Used for transferring liquid concrete to the desired location, particularly when large volumes or long distances are involved.	
Trowels: Used for spreading, leveling, and finishing the concrete surface.	

Bull Floats: Used for smoothing and finishing larger concrete areas by removing high spots and filling low spots.	
Concrete Forms or Molds: Used for shaping the concrete into the desired structure, such as walls, columns, or slabs.	
Concrete Testing Equipment: Used for testing the strength, quality, and durability of the concrete, including tools like slump cones, compression test machines, and moisture meters.	

1.6 Environmental Protection Requirements

Environmental protection requirements in concrete work typically focus on the following areas:

- Minimizing Water Usage: Concrete production requires a substantial amount of water. To reduce the environmental impact, it is essential to use water-efficient techniques like recycling process water or using low-water cement mixes.
- Use of Sustainable Materials: Incorporating sustainable materials in concrete production can help minimize environmental impact. This include using recycled aggregates, supplementary cementitious materials like fly ash or silica fume, or using recycled water in the mixing process.

- Waste Management: Concrete construction generates significant construction waste, including excess concrete and packaging materials. Proper waste management, such as recycling or reusing excess concrete and segregating waste materials for appropriate disposal, is crucial to minimize environmental impact.
- Energy Efficiency: Concrete production often requires a substantial amount of energy. Utilizing energy-efficient equipment and optimizing production processes can help reduce energy consumption and associated greenhouse gas emissions.
- Air Quality Control: Concrete work can generate dust and potentially harmful emissions. Implementing measures to control dust, such as using water sprays or dust collection systems, can help prevent air pollution and protect worker health.
- Noise Pollution Mitigation: Concrete construction can create noise pollution, especially during mixing and pouring activities. Implementing noise control measures like using quiet equipment or scheduling construction activities during less noise-sensitive hours can help mitigate noise impact on the surrounding environment.
- Prevention of Water Contamination: Concrete additives, curing compounds, and wastewater from concrete operations can contain harmful chemicals that contaminate soil and water bodies. Implementing appropriate containment measures, such as using impermeable liners or proper disposal of concrete waste, is necessary to prevent water contamination.
- Protection of Natural Habitats: Concrete work often requires excavation and land disturbance. It is crucial to minimize the impact on natural habitats by implementing erosion control measures, avoiding sensitive areas, and restoring disturbed areas after construction.
- Compliance with Environmental Regulations: Concrete work must comply with local, regional, and national environmental regulations. This includes obtaining necessary permits, adhering to emission limits, and following best practices to ensure environmental protection throughout the construction process.

Overall, it is essential to adopt sustainable construction practices, optimize resource usage, and minimize environmental impacts to promote environmental protection in concrete work.

Self-Check-1

Part I: True or False question

Instruction: Say true if the statement is correct and false if the statement is incorrect.

1. Code generally refers to a set of rules or guidelines that outline expected behavior or practices in a particular context.
2. A standard is a set of guidelines or criteria that outline minimum requirements or best practices for a particular product, process, or service. Standards are often set by industry organizations, government agencies, or consensus among experts.

Part II: Matching

Instruction: Match Terms in column A with its meanings in column B.

A	B
1. Kerb	A. preserving and protecting human and facility resources in the workplace.
2. Channel	B. a mixture of aggregate, water, and cement.
3. Road Side Fixtures	C. a linear structure made of concrete that is designed to convey and control the flow of water.
4. Concrete	D. a solid, raised edge constructed along the sides of roads, sidewalks, parking lots, and other public areas.
5. Occupational Safety and Health	E. any permanent structures or objects that are found along the side of a road or highway.

Part III: Short Answer Questions

Instructions: Answer all the following questions accordingly.

1. What are the environmental protection requirements in concrete work.
2. Review compliance document for concrete kerb, channels, and road side fixtures.
3. List and describe safety requirement for concrete kerb, channels, and road side fixtures.
4. List and describe signage requirement for concrete kerb, channels, and road side fixtures.
5. List and describe tools, equipment, and plant for concrete kerb, channels, & road side fixtures.

Unit Two: Cast In-situ Concrete Unit

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

- Existing Services
- Setting Out Kerb, Channel, and Road Side Fixtures
- Formwork and Concrete Work
- Cleaning Up Construction Work Area, Martials, and Tools

This unit 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:

- Identify and protect existing services.
- Set out kerb, channel, and road side fixtures.
- Install formwork and cast concrete work.
- Apply clean up construction work area, martials, and tools.

2.1 Existing Services

Existing services means and includes electric, water, waste-water, cable, telephone, or telecommunications services or the repair, location, relocation, improvement, or maintenance of utility poles, transmission structures, pipes, wires, fibers, cables, easements, rights of way, or associated infrastructure. In road construction existing services must be considered.

Figure 2. 1 Accidental damage to underground services

Identifying and protecting existing services on road construction sites is crucial to ensure the safety of workers and prevent damage to utilities. steps that can be taken to effectively identify and protect existing services:

- Conduct utility maps and records review: Obtain utility maps and records from utility companies to identify the location of underground services such as water pipes, sewage lines, gas lines, electric cables, and communication lines. This information will assist in planning the construction work and avoiding potential conflicts.
- Utility surveys: Conduct on-site utility surveys using ground-penetrating radar (GPR) or electromagnetic equipment to detect and map buried utilities accurately. Surveying should be done before any excavation work begins.
- Marking utilities: Mark the location of existing services using paint or flags to clearly identify their position on the ground. Use different colors or symbols for different types of utilities, making it easier for workers to identify and avoid them.
- Inform and coordinate with utility companies: Notify utility companies of the planned road construction project and seek their assistance in marking and protecting their services. They

provide additional information or guidance for the protection of their infrastructure during construction.

- Establish safe work zones: Clearly demarcate the work area and establish safe zones around existing utilities where no digging or excavation is allowed. Temporary fencing or barriers used to restrict access to these areas.
- Implement safe excavation practices: Train construction crew members on safe excavation practices, including the use of hand tools and non-destructive digging techniques, such as vacuum excavation, to minimize the risk of damaging existing services.
- Install protective measures: If necessary, install temporary protective structures, such as shoring or shielding, to prevent accidental damage to nearby utilities during excavation or construction activities.
- Regular inspections: Conduct regular inspections during the construction process to ensure that existing services remain protected and unharmed. Address any concerns or issues that arise immediately.
- Communication and coordination: Maintain open communication and coordination between contractors, utility companies, and other stakeholders throughout the project to prevent any conflicts or misunderstandings.
- Proper documentation: Keep detailed records of all utility identification, marking, and protection measures taken during the project. This documentation will be useful for future reference and can help in resolving any disputes or claims related to damage to existing services.

Overall, a proactive approach, thorough planning, and effective communication are essential to ensure the identification and protection of existing services during road construction.

2.2 Setting Out Kerb, Channel, and Road Side Fixtures

2.2.1 Setting Out Location of Kerb, Channel, and Road Side Fixtures

The exact location of kerb, channel, and road side fixtures depending on the specific requirements and regulations of your local area. However, general guidelines:

A. Kerb: The kerb is typically located at the edge of the road and serves as a barrier between the road and the footpath/sidewalk. It helps to contain and direct surface water runoff. In

urban areas, the kerb is usually placed closer to the road, while in rural areas, it set further back.

Figure 2. 2 Kerb

B. Channel: The channel, also known as the gutter, is the sloped area between the kerb and the edge of the road. Its purpose is to collect and channel rainwater towards drainage systems. The channel is usually placed slightly lower than the kerb to facilitate proper water flow.

C. Road side fixtures: Road side fixtures refer to various elements found along the road, such as road signs, traffic lights, streetlights, utility poles, fire hydrants, bus stops, etc. Their specific locations will depend on the requirements and regulations set by the local transportation or municipality department. Generally, road side fixtures are strategically placed to ensure visibility, accessibility, and safety for road users.

When determining the exact locations of these elements, it is essential to consider factors such as traffic flow, pedestrian movement, accessibility for disabled individuals, line of sight, and local regulations. It is also important to consult with local authorities or engineering professionals in your area to ensure compliance with specific guidelines and requirements.

2.2.2 Setting Out Driveways and Inverts

Setting out driveways and inverts refers to the process of determining the appropriate position and levels of driveways and drains relative to the surrounding terrain.

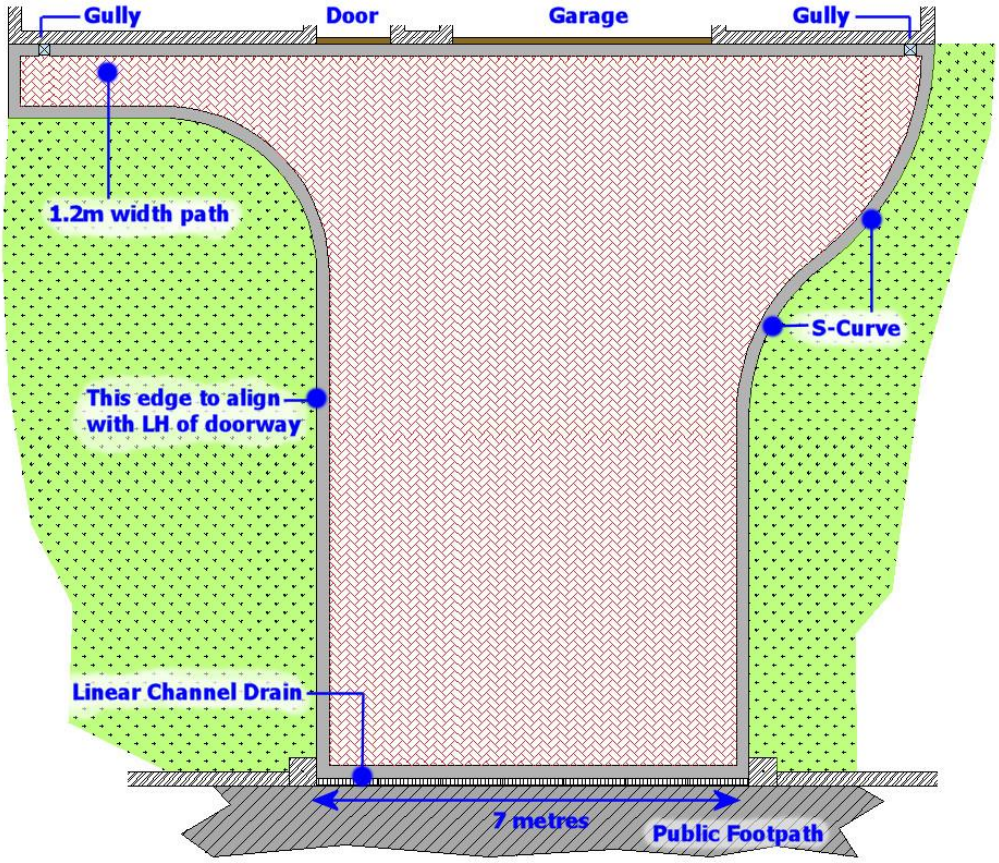

Figure 2. 3 Setting out

This is typically done during the construction or renovation of roads, sidewalks, or other paved surfaces. The general steps involved in setting out driveways and inverts:

- Analyze the site: Evaluate the existing terrain and any specific requirements for the driveway or drain installation. Consider factors such as slope, water flow patterns, underground utilities, and access points.
- Determine the desired elevation and slope: Decide on the desired height and gradient for the driveway and drains. This involve considering factors such as pedestrian accessibility, stormwater drainage requirements, and overall landscape design.
- Mark the boundaries: Use surveying equipment, such as a theodolite or total station, to accurately mark the boundaries of the driveway and inverts. This involve measuring distances and angles to ensure accuracy.

- Set out the driveway levels: Use surveying equipment to establish the desired levels for the driveway. This involve marking points at regular intervals along the proposed route of the driveway.
- Set out the drain inverts: Determine the position and level of the drain inverts. These are the lowest points of the drain where water accumulates and is then transported away. Align the inverts with the natural water flow to ensure efficient drainage.

By properly setting out driveways and inverts, it ensures that the construction of these components aligns with the overall design plans, maintains proper water flow, and provides safe and accessible access routes.

2.2.3 Checking Grades

To check surveying alignment and grades, you can follow these steps:

- Set up the surveying instrument (such as a theodolite or total station) at the desired location.
- Sight the instrument to a benchmark or known point and set up a temporary benchmark nearby if necessary.
- Level the instrument and ensure it is stable and positioned correctly.
- Take measurements of the elevation (height) and horizontal angle to various points along the alignment you want to check.
- Record these measurements in a field book or on a data collector.
- Calculate the differences in elevation and angle between each measured point and the known benchmark or starting point.
- Use the recorded measurements and calculations to determine the accuracy and alignment of the surveyed points.
- Compare the calculated grades or elevations to the desired or specified grades for the project.
- Adjust if necessary to achieve the desired alignment and grades.
- Repeat the surveying process as needed to check alignment and grades at other locations along the project area.

Remember to always follow proper surveying techniques and safety protocols while conducting surveys.

2.3 Formwork and Concrete Work

2.3.1 Constructing and Checking Formwork

A. Definition of Formwork

Formwork is a temporary structure or mold used to hold wet concrete in place until it hardens and becomes self-supporting. It is an essential part of the construction process, especially for concrete structures such as walls, columns, beams, and slabs. Formwork is typically made from wood, metal, or plastic and is designed to withstand the pressure and weight of the wet concrete. It is assembled on-site and carefully aligned and leveled to ensure accurate and precise dimensions. The formwork system consists of panels, props, and bracing to support the weight of the wet concrete and maintain the desired shape and structure. The materials used for formwork can depending on the complexity of the project and the desired finish of the concrete surface. Once the formwork is in place, the concrete is poured into the mold and allowed to set and cure. Once the concrete has hardened, the formwork is removed, leaving behind the hardened and finished concrete structure. Formwork plays a critical role in ensuring the strength, stability, and shape of the concrete structure. It must be carefully designed and executed to withstand the forces and pressures exerted by the wet concrete. Proper formwork construction is crucial for achieving a high-quality and durable concrete structure.

B. Types of Formwork

The types of formwork used in construction, including:

Table 2.1 Types of formwork

Types of Formwork	**Figure**
Timber formwork: This is the most common type of formwork and is made from timber boards and plywood sheets. It is easy to use, cost-effective, and can be customized to fit different shapes and sizes.	

Steel formwork: is made from steel sheets and provides a durable and reusable option. It is often used in large-scale construction projects and offers excellent strength and stability.	
Aluminum formwork: is lightweight, easy to handle, and has a good lifespan. It is commonly used for constructing walls, floors, and columns in residential and commercial projects.	
Plastic formwork: is made from lightweight and durable plastic materials. It is easy to clean, provides a smooth finish, and is suitable for creating different shapes and sizes.	

C. Procedure of Constructing Formwork

The procedure of constructing formwork involves several steps, as outlined below:

- Planning and design: Begin by determining the shape and size of the formwork required for the concrete structure. Consider factors such as load-bearing requirements, dimensions, and shape constraints.
- Material selection: Choose the appropriate formwork material based on the project requirements. Common materials include timber, steel, plywood, or aluminum.

- Cutting and shaping: Cut the formwork material into the desired dimensions using saws, drills, or other suitable tools. Shape the material to match the desired form and ensure a proper fit.
- Assembly of formwork panels: Assemble individual formwork panels into larger sections as per the determined design. Use appropriate connectors, such as nails, screws, or bolts, to securely join the panels together.
- Bracing and leveling: Install braces and supports to ensure the stability and proper alignment of the formwork. Use wedges, braces, or props to adjust and level the formwork as required.
- Waterproofing and release agents: Apply waterproofing membrane or release agents to the inner surface of the formwork to prevent concrete adhesion and ensure ease of removal.
- Cleaning and storage: Clean the formwork panels and remove any excess concrete residue. Store the formwork properly to ensure it remains in good condition for future use.

Note: The above steps depending on the specific project requirements, formwork material, and construction techniques used. It is essential to follow construction codes, safety guidelines, and manufacturer instructions when constructing formwork.

D. Checking Formwork

Checking formwork follow the following indicators:

- Inspect the formwork before beginning construction to ensure that it is in good condition and meets the necessary requirements for the project.
- Verify that the formwork is properly aligned and level.
- Check the formwork for any signs of damage or deterioration, such as cracks or splits. Repair or replace any damaged sections as necessary.
- Ensure that all formwork components are securely connected and in place.
- Measure and check the dimensions of the formwork to ensure that it matches the desired design and specifications.
- Verify that the formwork is adequately braced and supported, especially for vertical or elevated structures.
- Check the formwork for any gaps or spaces that could allow concrete leakage. Seal or fill any gaps with appropriate materials.

- Confirm that the formwork is clean and free from any obstructions or debris that could affect the quality of the finished concrete surface.
- Carry out a final inspection of the formwork before pouring concrete to ensure that everything is in place and ready for construction.
- Continuously monitor the formwork during and after concrete pouring to detect any potential problems, such as excessive pressure or movement.
- After concrete has cured, perform a final inspection of the formwork to ensure that it can be safely removed without damaging the concrete structure.

Note: The specific steps and procedures for checking formwork depending on the type of construction project and relevant building codes and regulations. It is important to consult and follow the specific guidelines provided by engineering or construction professionals.

2.3.2 Completing Services and Conduit Preparation

Completing services and conduit preparation involve the necessary steps to ensure that electrical, telecommunication, or other utility services are installed and ready for use. This typically includes the installation of conduits, which are pathways for electrical or communication cables.

the important steps involved in completing services and conduit preparation:

- Planning and design: Before starting any work, a detailed plan and design must be developed. This includes determining the location and layout of conduits, as well as the type and size of services needed.
- Obtaining permits: In many jurisdictions, permits are required for installing new services and conduits. These permits obtained from the local building or utilities department. It is important to ensure compliance with all applicable regulations and codes.
- Excavation: The area where the services and conduits are to be installed needs to be excavated. This involves digging trenches or holes to accommodate the conduits and services. Care must be taken to avoid damaging existing infrastructure or utilities.
- Installing conduits: Once the trench is excavated, conduits are placed in the designated locations. Conduits can be made of various materials such as PVC (polyvinyl chloride), metal, or fiberglass. They come in different sizes and shapes depending on the specific requirements. Conduits are laid out in straight lines or curves, secured in place, and properly supported to ensure durability.

- Pulling cables: After the conduits are in place, cables or wires are pulled through them. This can be done manually using specialized tools or automated machinery. Cables should be carefully handled to prevent damage or bending beyond their specified bend radius.
- Connection and termination: Once the cables are pulled through the conduits, they need to be connected to the respective services or equipment. Proper termination of cables is essential to ensure reliable and efficient operation. This involve splicing, crimping, or connecting wires to the appropriate connectors.
- Testing and inspection: After the completion of the services and conduit installation, it is important to conduct thorough testing and inspection. This ensures that all the connections are secure, the cables are properly installed, and the system is functioning as intended. Various tests performed, including continuity testing, insulation resistance tests, and signal integrity tests, depending on the type of services installed.
- Documentation: Throughout the process, it is important to maintain accurate documentation of the installation. This includes recording the location of conduits, the type and size of cables used, the specific services connected, and any test results. This documentation is valuable for future reference, maintenance, and troubleshooting.

By following these steps, completing services and conduit preparation can be done efficiently and effectively, ensuring the installation of reliable and safe utility services.

2.3.3 Maintaining Vertical and Horizontal Alignment

Maintaining vertical and horizontal setting out alignment is crucial in construction and surveying projects to ensure accuracy and precision. key steps to maintain alignment:

- Establish control points: Begin by setting up control points at precise locations using known reference points, such as benchmarks or fixed structures. These control points will serve as a basis for aligning the project.
- Use accurate instruments: Utilize high-quality surveying instruments such as total stations or digital levels to measure the vertical and horizontal alignments. Ensure that the instruments are properly calibrated before beginning any measurements.
- Check base measurements: Before proceeding with any alignment work, double-check the basic measurements and mark them on the gridded project layout or drawings. This will help identify any errors in the initial measurements and allow for corrections.

- Establish benchmarks and reference lines: Set up benchmarks and reference lines as per project specifications. These benchmarks should be stable and easily accessible during the entire project duration. Reference lines can be created using strings, lasers, or other suitable methods.
- Regularly check alignment: Throughout the project, periodically check the alignment against the established benchmarks and reference lines. Use a leveling instrument to measure vertical alignment and a theodolite or total station to measure horizontal alignment. Adjust as necessary to maintain alignment accuracy.
- Use construction stakes: Place construction stakes at appropriate intervals along the alignment to guide construction activities. Periodically check and adjust the stakes if necessary to ensure they remain in alignment with the established benchmarks and reference lines.
- Monitor during construction: During construction, continually monitor and cross-check the alignment to ensure that the work is progressing as planned. Use spot checks and measurements to identify any deviations and take corrective actions promptly.
- Regularly update the alignment records: Maintain accurate and up-to-date records of the vertical and horizontal alignment throughout the project. This will help in monitoring progress and identifying any discrepancies that arise.

By following these steps, construction and surveying professionals can ensure that the vertical and horizontal setting out alignment remains accurate and consistent throughout the project, resulting in a successful outcome.

2.3.4 Concrete Placing

Concrete placing refers to the process of depositing concrete into its intended position or location. It involves the proper placement and spreading of concrete to ensure that it is distributed evenly and accurately. This process is typically carried out by skilled workers, such as concrete finishers or concrete pump operators, who use various tools and equipment to achieve the desired results.

Figure 2. 4 Concrete placing

Concrete placing includes the following steps:

- Preparation: The area where the concrete will be placed is prepared by removing any debris, leveling the ground, and creating formwork or molds to contain the concrete.
- Concrete delivery: The concrete is usually delivered to the construction site using concrete mixers or ready-mix trucks. It is important to ensure that the concrete is of the correct consistency and quality before placing it.
- Placing: The concrete is poured and spread onto the prepared area using shovels, trowels, or mechanical methods such as concrete pumps. The workers carefully distribute the concrete to ensure it reaches all areas and has a uniform thickness.
- Consolidation: Once the concrete is placed, it is often consolidated or compacted to remove air bubbles and ensure proper bonding. This can be done using vibrating tools, such as a concrete vibrator or a screed board.
- Finishing: After consolidation, the surface of the concrete finished to achieve the desired appearance and texture. This can involve techniques like screeding, floating, or troweling the concrete.
- Curing: Once the concrete is placed and finished, it needs to be properly cured to gain strength and durability. This typically involves keeping the concrete moist and protected from extreme temperatures for a certain period of time.

Proper concrete placing is essential for the structural integrity and longevity of the finished project. It requires precision, skill, and adherence to industry standards and best practices.

2.3.5 Positioning Expansion, Construction, and Dowel Joints

Positioning expansion, construction, and dowel joints are all important techniques used in woodworking and carpentry to provide stability and strength to various structures.

- Positioning Expansion: This refers to the technique used to accurately align and position two different wooden pieces together. It involves creating slots or grooves in one piece of wood and corresponding tabs or tongues on the other piece of wood. The tongue is then inserted into the slot, creating a tight and precise joint. This technique helps in ensuring that the pieces are properly aligned and fit together snugly.

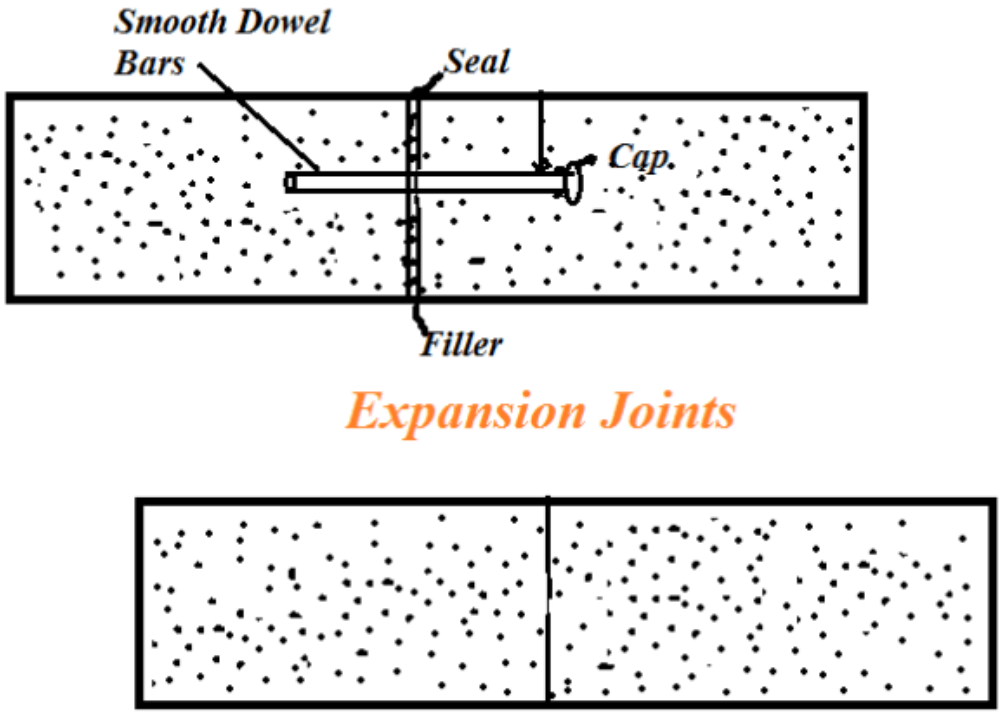

Figure 2. 5 Expansion joints

- Contraction Joints: relieve tension developed in the concrete due to contraction. They prevent the formation of irregular cracks contraction joints also relieve stresses due to warping.
- Dowel Joints: Dowel joints involve the use of small cylindrical wooden dowels to join two or more pieces of wood together. This technique is widely used for its simplicity and effectiveness. To create a dowel joint, holes are drilled into the adjoining pieces of wood,

and wooden dowels are inserted into these holes. The dowels are typically glued into place, creating a strong bond between the pieces.

Overall, positioning expansion, construction, and dowel joints are important techniques in woodworking and carpentry that contribute to the strength, stability, and longevity of structures. They provide precise alignment, secure connections, and accommodate the natural movement and expansion of materials.

2.3.6 Concrete Compaction

Concrete compaction is the process of reducing air voids and increasing the density of freshly poured concrete. It is an essential step in the construction process, as compacted concrete is stronger and more durable than non-compacted concrete.

Methods of compacting concrete, including:

- Vibrating: This is the most common method, where a vibrating poker or a vibrating plate is inserted into the concrete. The vibration helps to move the concrete particles closer together, removing air pockets.

Figure 2. 6 Vibrating concrete

- Tamping: This method involves using a hand or mechanical tamper to compact smaller areas of concrete. It is typically used for smaller projects or areas that are difficult to access with vibrating equipment.
- Rolling: For larger areas, a heavy roller can be used to compact the concrete. This method is often used for road construction or large slab projects.

The compaction process is important because it improves the strength, durability, and overall quality of the concrete. It helps to ensure that the concrete is evenly distributed and reduces the risk of cracks or voids forming. Proper compaction also helps to reduce the risk of settlement or shifting of the concrete over time. It is important to note that over compaction can also be detrimental to the concrete, as it can cause segregation or separation of the components. Therefore, it is essential to follow recommended compaction guidelines and use the appropriate method for the specific project.

2.3.7 Removing Face Formwork

The formwork is held in place until the concrete hardens and gains strength. Removing the formwork is only recommended when the concrete has its dead weight and is strengthened without the formwork or any props.

To remove face formwork, follow these steps:

- Ensure that the concrete has cured enough to support its own weight and the removal of the formwork. This typically takes around 24 to 48 hours depending on the climate and the specific concrete mix.
- Inspect the concrete surface to ensure it has hardened sufficiently. Check for any cracks or signs of weakness that indicate that it is not ready for formwork removal.
- Prepare the necessary equipment for formwork removal, such as pry bars, rubber mallets, and safety gloves.
- Start by removing any formwork support structures or bracing that were used during the pouring of the concrete. Use a pry bar or hammer to gently loosen and remove the supports.
- Once the support structures are removed, carefully tap the formwork using a rubber mallet to break the bond between the concrete and the formwork. Start at the edges and work your way towards the center.
- Gradually pry away the formwork using a pry bar. Take care not to damage the concrete surface while doing so. If the formwork is stuck, tap it gently with a rubber mallet or use a pry bar to create a small gap for easier removal.
- Continue removing the formwork section by section until all pieces have been taken out.

- Inspect the concrete surface once the formwork has been removed for any imperfections or blemishes. If necessary, touch up the surface or apply appropriate finishes to achieve the desired appearance.

Remember to always follow safety guidelines and consult with a professional if you are unsure about the formwork removal process.

2.3.8 Finishing

A. Finishing Surface to Alignment

Finishing Surface to Alignment refers to the process of refining or refining a surface to achieve proper alignment with adjacent or neighboring surfaces. This typically involves the use of tools and techniques to ensure that the surface is level, even, and aligned with other surfaces.

Some common techniques for finishing surface to alignment include:

- Planning or sanding: This involves using a plane or sandpaper to remove excess material and achieve a smooth and even surface. It helps to ensure that the surface is aligned with neighboring surfaces and tno bumps or uneven areas.
- Leveling: This involves using a leveling tool, such as a spirit level or laser level, to check if the surface is level and align it accordingly. Adjustments can then be made to correct any deviations and ensure proper alignment.
- Grinding or polishing: In cases where a high level of precision is required, grinding or polishing techniques can be employed to remove any imperfections and achieve a perfectly aligned surface. This is commonly used in industries such as manufacturing and construction.
- Using alignment aids: Various alignment aids, such as guide rails, templates, or jigs, can be used to assist in achieving the desired alignment. These aids help to ensure consistency and accuracy during the finishing process.

Overall, finishing surface to alignment is an important step in various applications, including woodworking, metalworking, construction, and manufacturing. It helps to ensure that surfaces are properly aligned, resulting in improved functionality, aesthetics, and overall quality.

B. Finishing Job to The Shape

Finishing a job to the shape typically means completing a task or project to meet specific standards, criteria, or expectations. This could involve ensuring that all elements align properly, all necessary components are in place, and the final outcome is in line with the desired shape or form.

a few steps to finishing a job to the shape:

- Review the requirements: Understand the specifications and expectations for the job. This could include design plans, customer preferences, or technical standards.
- Organize resources: Gather all necessary tools, materials, and resources needed to complete the job. Ensure everything is readily available and in good condition.
- Plan the process: Create a step-by-step plan detailing how to complete the job efficiently and effectively. Prioritize tasks, allocate resources, and schedule milestones.
- Execute the plan: Follow the plan carefully, paying attention to detail while working on each component. Be mindful of the desired shape and ensure that each step aligns with the overall goal.
- Regular checks: Throughout the process, constantly double-check the work against the desired shape. This can involve measurements, visual inspections, or other quality assurance methods.
- Final adjustments: Make necessary adjustments or corrections to bring the job closer to the desired shape. This could involve trimming, filing, sanding, or any other finishing touches.
- Quality control: Once the job is complete, conduct a thorough quality check to ensure it meets the required shape and standards. Look for any defects, imperfections, or deviations from the desired outcome.
- Final touches: If any minor adjustments are needed, make them to bring the job to its final shape. This involve adding polish, paint, or other finishing touches to enhance the appearance or functionality.
- Documentation: Keep a record of the work done, including any modifications or adjustments made. This can be useful for future reference or in case any issues arise later on.

By following these steps, you can ensure that you finish a job to the desired shape, meeting all expectations and requirements.

C. Finishing Concrete to Specifying Quality and Texture

Finishing concrete involves several steps to achieve the desired quality and texture. key factors to consider when specifying the finishing requirements:

- Quality of concrete mix: The concrete mix design should be carefully selected to meet the performance requirements. This includes choosing the correct type and proportion of cement, aggregates, and water, as well as considering the use of admixtures if needed.
- Workability: The workability of the concrete should be appropriate for the finishing process. This can be adjusted by adding water or admixtures to achieve the desired consistency and ease of placement.
- Timing: The timing of finishing operations is critical. Finishing should be done when the concrete has gained sufficient strength to support the workers and equipment, but before it becomes too hard to work with.
- Formwork and reinforcement: The formwork and reinforcement should be properly installed and secured before placing the concrete. This ensures that the concrete will be able to support the finishing operations without any deformations.
- Surface preparation: The concrete surface should be properly prepared before finishing. This involve removing any debris, cleaning the surface, and applying a suitable surface treatment if necessary.
- Finishing techniques: Tvarious techniques for achieving different textures and finishes, such as troweling, brooming, stamping, or using specialized equipment like a power float or a textured roller. The specific technique should be chosen based on the desired finish and the capabilities of the contractor.
- Curing: Curing plays a crucial role in achieving the desired quality of the finished concrete. Proper curing methods, such as water curing, curing compounds, or covering the surface with plastic sheeting, should be implemented to prevent premature drying and promote hydration.
- Control of cracks: It is important to consider crack control measures during the finishing process. This involve the use of control joints or saw cutting to create planned cracks and prevent random cracking.
- Surface protection: Once the finishing is complete, it necessary to apply a suitable sealer or protective coating to enhance the durability and aesthetic appeal of the concrete surface.

When specifying the quality and texture of finished concrete, it is important to clearly communicate the requirements to the contractor through the use of detailed specifications, drawings, and samples if possible. Additionally, regular inspections during the construction process can help ensure that the specified quality and texture are being achieved.

2.3.9 Curing and Protecting Finish Concrete Work

Curing is the process of maintaining satisfactory temperature and moisture conditions in concrete long enough for hydration to develop the desired concrete properties. To cure and protect finished concrete work, follow these steps:

- Allow proper curing time: After the concrete is poured and finished, it needs time to cure and set. Follow the recommendations provided by the concrete manufacturer or consult a professional for specific curing time. Generally, concrete should be kept moist and undisturbed for at least a week to achieve optimum strength.
- Water curing: One of the most common methods to cure concrete is by keeping it moist with water. Apply a continuous mist of water using a garden hose or a fine spray misting system. Ensure that the concrete stays wet for the specified curing period.
- Curing compounds: Curing compounds are liquid or membrane-forming coatings that help retain moisture within the concrete to promote proper curing. Apply the curing compound according to the manufacturer's instructions after the initial finishing of the concrete. The compound forms a protective barrier over the surface, preventing rapid moisture evaporation.
- Plastic sheeting: Another method to cure concrete is by covering the surface with plastic sheeting. Lay the plastic sheeting over the newly finished concrete, ensuring it is completely covered. Seal the edges of the sheeting with heavy objects or tape to create an airtight seal. This method helps retain moisture and promotes gradual curing.
- Avoid premature exposure: Avoid exposing the newly finished concrete to heavy foot traffic or other loads until it has fully cured and hardened. Prematurely subjecting the concrete to stress can result in cracking or other damage to the surface.
- Sealants: Once the curing process is complete, it is recommended to apply a sealant to protect the concrete from stains, moisture, and other damage. Choose a high-quality

concrete sealer appropriate for the desired finish (e.g., glossy or matte). Follow the manufacturer's instructions for application, and apply multiple coats if necessary.

- Regular maintenance: Protect the concrete by performing regular maintenance, such as sweeping away debris and cleaning stains promptly. Avoid using harsh chemicals or abrasive cleaners that could damage the surface. If necessary, reapply a concrete sealer periodically to maintain its protective properties.

By following these steps, you can effectively cure and protect your finished concrete work, prolonging its lifespan and maintaining its appearance.

2.3.10 Maintaining Concrete

Maintaining concrete is important to ensure its longevity, durability, and appearance. tips for maintaining concrete:

- Regularly Clean the Surface: Sweep or power wash the concrete surface regularly to remove dirt, debris, and stains. Use a mild detergent or concrete cleaner for stubborn stains.
- Protect from Heavy Objects: Avoid dropping heavy objects on the concrete surface as it can cause cracks or chips. Use padding or mats to protect the surface when moving furniture or heavy equipment.
- Seal the Concrete: Apply a concrete sealer every few years to protect the surface from water, chemicals, and stains. This also helps in preventing the formation of cracks.
- Prevent Water Damage: Avoid pooling water on the concrete surface as it can seep into the pores and cause damage. Ensure proper drainage and fix any leaks to prevent water accumulation.
- Repair Cracks and Damage: Immediately repair any cracks or chips in the concrete to prevent further damage. Use a concrete patching compound or contact a professional for larger repairs.
- Avoid Harsh Chemicals: Use appropriate cleaning products that are specifically formulated for concrete. Avoid using harsh chemicals or acids that can erode the surface.
- Avoid Deicing Chemicals: During winter, avoid using deicing chemicals like rock salt on the concrete surface as it can cause damage. Instead, use sand for traction or a concrete-safe deicer.

- Remove Oil and Grease Stains: Oil and grease stains can penetrate the concrete surface and become difficult to remove. Use a degreaser or a mixture of baking soda and water to scrub off the stains.
- Mindful Use of Snow Shovels and Garden Tools: Be careful when using snow shovels or garden tools on concrete surfaces to avoid scraping or chipping the concrete. Use plastic shovels or rubber edged tools.
- Regular Inspections: Regularly inspect the concrete for any signs of damage, cracks, or wear. Addressing issues early can prevent further damage and save on repair costs.

By following these maintenance tips, you can extend the lifespan of your concrete surfaces and keep them looking their best.

2.3.11 Mixing and Applying Mortar

Mixing and applying mortar is an essential part of many construction and masonry projects. Here is a step-by-step guide on how to mix and apply mortar:

- Gather your tools and materials: You will need a mixing container, a trowel or hoe for mixing, water, your dry mortar mix, and any additives if necessary.
- Measure and pour dry mix: Start by measuring the appropriate amount of dry mortar mix for your project into your mixing container. Consult the packaging or follow any specific instructions provided by the manufacturer.
- Add water gradually: Begin adding water to the dry mix, usually at a ratio of around 3 parts dry mix to 1-part water. Start by adding a small amount of water initially and gradually increase while mixing until you reach the desired consistency. It should be thick but still workable.
- Mix thoroughly: Use a trowel or hoe to mix the water and dry mix together. Make sure all the dry mix is fully incorporated into the water. Continue mixing until you have a consistent, lump-free mortar.
- Allow mixture to "slake": This step is optional but can improve the strength of the mortar. Let the mixed mortar sit for about 10 minutes before using it. This allows the ingredients to bond and hydrate together more effectively.

- Check consistency: Test the consistency of your mortar by lifting it with a trowel. It should stick firmly to the trowel without being too runny or too dry. Adjust the water or dry mix accordingly to achieve the desired consistency.
- Apply mortar: Once your mortar is mixed and the consistency is correct, it's time to apply it. Use a trowel to scoop up mortar and apply it to the desired surface or between bricks or stones. Depending on your project, you need to apply mortar to the surface you are working on or between the joints of your materials.
- Work in small sections: Apply mortar in small sections at a time to prevent it from drying out before you can work with it. Keep the edges of each section clean and smooth for a professional finish.
- Tool the mortar: After applying the mortar, use a pointing trowel or jointing tool to shape and finish the mortar joint. This can help improve the aesthetics and strength of your work.
- Clean up: Wipe away any excess mortar from the surface and tools before it dries. This will make the cleanup process easier and prevent unwanted mortar stains.

Remember to follow any safety precautions outlined by the manufacturer and wear appropriate protective gear, such as gloves and goggles, when mixing and applying mortar. Additionally, always refer to specific instructions provided by the manufacturer of the mortar mix you are using for optimal mixing ratios and application guidelines.

2.4 Cleaning Up Construction Work Area, Martials, and Tools

To clean up a construction work area, materials, and tools, follow these steps:

- Organize and remove debris: Start by removing any loose debris such as nails, screws, wood scraps, or other small materials. Use a broom, dustpan, or vacuum cleaner to effectively clean the area.
- Dispose of waste: Separate waste materials such as plastic, cardboard, or any other recyclable materials. Place them in designated recycling bins or arrange for appropriate disposal.
- Store materials properly: construction materials such as bricks, lumber, or metal rods, organize and stack them neatly against walls or in designated storage areas. Ensure that they are secured to prevent any accidents

- Clean tools: Wipe down or wash construction tools using appropriate cleaning agents and water. Remove any dirt, dust, or residues from each tool, ensuring they are in proper working condition for future use.
- Organize and store tools: Arrange tools in a toolbox or on a pegboard, ensuring each tool has its designated place. This makes it easier to locate tools when needed and minimizes the chances of misplacing or losing them.
- Sweep and mop the area: After all the debris and tools have been removed, sweep the entire construction work area to gather any remaining dirt or dust. Use a mop or floor cleaner to eliminate any persistent stains or spills.
- Inspect safety precautions: Before finishing the cleanup, check that safety precautions such as signage, barriers, or caution tapes are in place to prevent accidents or unauthorized access to the area.
- Perform a final walkthrough: Assess the area to ensure it is clean, organized, and free from hazards. Remove any remaining debris or objects that have been missed during the initial cleanup.

By following these steps, you will create a safer and more organized construction work area, allowing for efficient and productive work in the future.

Self-Check-2

Part I: True or False question

Instruction: Say true if the statement is correct and false if the statement is incorrect.

1. Concrete placing refers to the process of depositing concrete into its intended position or location.
2. Construction Joints are used to join different parts of a structure together, such as walls, floors, or roofs.
3. Dowel joints involve the use of small cylindrical wooden dowels to join two or more pieces of wood together.
4. Positioning Expansion refers to the technique used to accurately align and position two different wooden pieces together.
5. The kerb is typically located at the edge of the road and serves as a barrier between the road and the footpath/sidewalk.

Part II: Matching

Instruction: Match Terms in column A with its meanings in column B.

A	B
1. Channel	A. Lightweight
2. Timber formwork	B. Made from steel sheets
3. Steel formwork	C. Gutter
4. Aluminum formwork	D. Temporary structure
5. Formwork	E. Made from wooden boards and plywood sheets

Part III: Short Answer Questions

Instructions: Answer all the following questions accordingly.

1. List steps for identifying and protecting existing services.
2. List types of formwork.
3. List steps for checking grades.
4. List and describe procedure of constructing formwork.
5. List methods of compacting concrete.

Operation Sheet 1

Operation title:

- Setting out and Cast for concrete work

Purpose:

- To practice and demonstrate the knowledge and skill required to Setting out and Cast for concrete work.

Instruction:

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

Precautions:

- Follow OSH safe work practice standards.

Tools and requirement:

- Measuring tape
- Earth nail
- Leveling equipment
- Tri square
- Claw hammer
- Bow saw
- Spirit level

Procedures:

Setting out and Cast for concrete kerb work involves the following steps:

1. Determine the required dimensions and specifications for the kerb. This include the kerb height, width, depth, and any special features or finishes required.
2. Mark the kerb line using string lines and stakes. Use a measuring tape and determine the position and height of the kerb based on the site plans or drawings. Ensure the string lines are level to ensure accurate and straight kerb placement.
3. Set out the position of any kerb joints or corners. Use a measuring tape and mark the positions for joints or corners on the string lines. This will ensure the proper placement and alignment during construction.

4. Excavate the area where the kerb will be laid. Remove any existing materials or debris from the site to create a clean and even surface for the kerb installation. Use a shovel or an excavator to remove the soil or other materials.
5. Install edge restraint if necessary. Edge restraints are used to provide support and stability to the kerb. They can be made of concrete, steel, or other materials. Place the edge restraints along the marked string lines and secure them in place using stakes or other methods.
6. Mix and pour concrete. Prepare the concrete mixture according to the manufacturer's instructions. Pour the concrete into the excavated area and use a trowel to spread it evenly along the marked string lines. Ensure the concrete is at the required height and slope as per the plans.
7. Shape and finish the kerb. Use a trowel or edging tool to shape the concrete into the desired kerb profile. Smooth and finish the surface using a float or trowel. Create any necessary grooves or textures as per the specifications.
8. Allow the concrete to cure and harden. Follow the curing time recommended by the concrete manufacturer. This will ensure the kerb achieves its maximum strength and durability.
9. Clean up the site. Remove any excess concrete or debris from the area and clean off any tools or equipment used during the construction process.
10. Inspect the finished kerb. Check for any defects or imperfections and make any necessary repairs or adjustments. Ensure the kerb meets the required specifications and standards.

Quality Criteria:

- The levelling error must be $e \leq \pm 24 \frac{mm}{km} \sqrt{d}$ for normal leveling.
- Check the setting out according to drawing and specification.

LAP Test 1

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Allotted Time: 6 Hours

Instruction I: Setting Out Concrete Kerb Work

Task 1. Prepare tools and equipment for setting out concrete kerb work

Unit Three: Pre-Cast Concrete Units

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

- Base Section for Pre-Cast Unit Installation
- Installing and Joining Pre-Cast Concrete Units

This unit 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 and finish base section for pre-cast unit installation.
- Install and join pre-cast concrete units.

3.1 Base Section for Pre-Cast Unit Installation

Pre-cast refers to the process of creating and casting elements of a building or structure off-site, typically in a factory or workshop, before transporting and assembling them on-site. This method is often used in construction projects to increase efficiency, reduce costs, and improve the quality of the finished product.

Figure 3. 1 Precast curbstone

In pre-casting, various building components such as walls, beams, columns, and slabs are manufactured in controlled environments using molds and then cured before being transported to the construction site. This approach allows for greater precision, as the casting process can be closely monitored and controlled. Pre-cast elements offer several advantages over traditional on-site construction methods. They can be produced in large quantities, reducing the construction time required for a project. The controlled environment of the factory ensures consistent quality and less wastage of materials. Additionally, pre-cast components can be designed to meet specific project requirements, including customization and incorporating various architectural finishes. Some common examples of pre-cast elements include pre-cast concrete panels for exterior walls, pre-cast stairs, pre-cast slabs for floors, and pre-cast beams and columns. These components are usually transported to the construction site using specialized vehicles and then assembled using cranes or other lifting equipment. Overall, pre-casting is a modern construction technique that streamlines the construction process and offers various benefits in terms of time, cost, and quality.

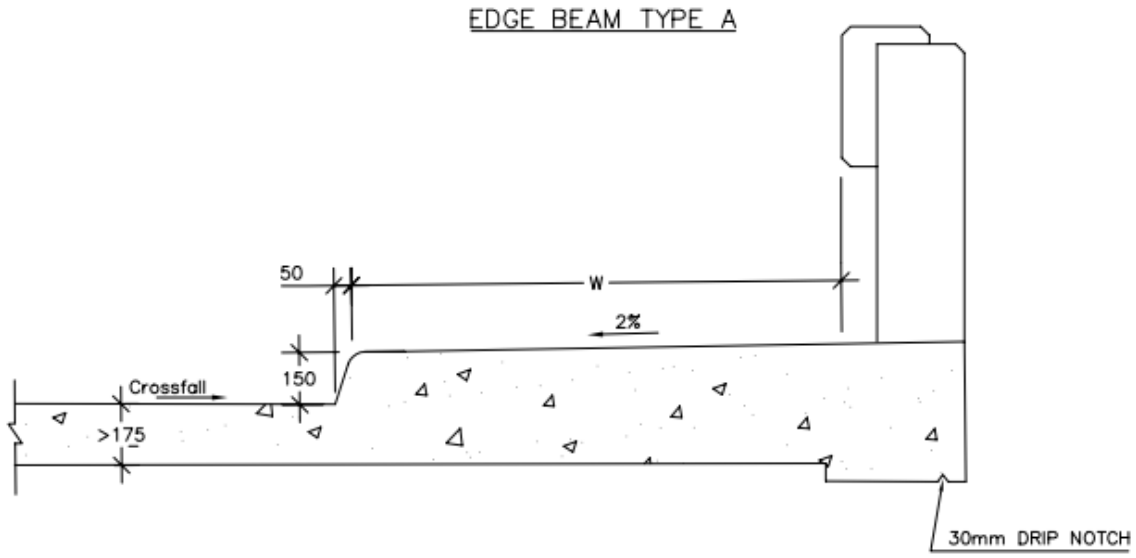

Figure 3. 2 Section view

Preparing the base section for pre-cast unit installation involves the following steps:

1. Site inspection and assessment: Assess the site conditions to determine the suitability of the ground for the pre-cast unit installation. Ensure that the ground is stable, level, and free from any obstructions.
2. Excavation: Excavate the area to the required depth and dimensions, based on the specifications provided by the pre-cast unit manufacturer. Remove any soil, rocks, or debris from the excavation area.
3. Compaction: Compact the base using a compactor or roller to ensure a stable and solid foundation for the pre-cast unit. This helps minimize settlement and movement of the unit in the future.
4. Leveling and grading: Use a level and grade the base to the correct level and slope as specified in the design. This is important for proper drainage and alignment of the pre-cast unit.
5. Base reinforcement: If required, install any reinforcement materials such as geotextiles or steel bars as specified by the manufacturer. These materials help improve the stability and load-bearing capacity of the base.
6. Base surface preparation: Clean the base surface thoroughly and remove any debris or loose particles. This ensures proper adhesion between the base and the pre-cast unit.

7. Base protection: Apply a layer of bedding material, such as sand or gravel, to protect the base and provide a smooth and even surface for the pre-cast unit to rest on. The thickness of the bedding material should be as recommended by the manufacturer.
8. Anchor installation: If the pre-cast unit requires anchoring, install the anchors in the base during the preparation stage. Follow the manufacturer's instructions and specifications for anchor placement and installation.
9. Final inspection: Conduct a final inspection of the base section to ensure that it meets all the requirements and specifications for the pre-cast unit installation. Make any necessary adjustments or repairs before proceeding with the actual unit installation.

By following these steps, the base section will be properly prepared for the installation of pre-cast units, ensuring a solid and durable foundation for the structure.

3.2 Installing and Joining Pre-Cast Concrete Units

Installing precast concrete units involves several steps and the use of appropriate equipment. Here is a general guide for installing precast concrete units:

1. Site Preparation: Prepare the ground where the precast units will be placed. Ensure the surface is level, compacted, and free from any debris or obstructions.
2. Layout: Determine the layout and position of the precast units according to the design plan. Mark the locations with stakes or paint lines.
3. Lifting Equipment: Arrange for suitable lifting equipment, such as a crane or forklift, that has the capacity to handle the weight of the precast units.
4. Safety Measures: Ensure all necessary safety measures are in place, including personal protective equipment (PPE) for workers, warning signs, and barricades if required.
5. Grout Preparation: Prepare grout or mortar mix according to manufacturer instructions. This will be used to secure the precast units in place.
6. Lifting and Placing: Using the lifting equipment, carefully lift each precast unit and position it in its designated location. Ensure the units are aligned correctly and have the appropriate spacing as specified in the design.
7. Leveling: Use shims or adjustment devices to level the precast units if necessary. Ensure they are on a stable and level surface.

8. Connection: Connect the precast units to each other using suitable connection methods, such as bolts, dowels, or adhesive. Follow the manufacturer's instructions for proper installation.
9. Grouting: Fill the gaps between the precast units with grout or mortar mix. This will enhance the structural stability and integrity of the installation. Ensure the grout is properly compacted and fills all voids.
10. Finishing: Clean any excess grout or mortar from the surface of the precast units. Ensure a smooth and uniform finish.
11. Curing: Allow the grout or mortar to cure according to the manufacturer's instructions. This typically involves keeping the area moist and protected from extreme temperatures for a specific period.
12. Inspection: Perform a thorough inspection of the installation to ensure it meets the required standards and specifications.

It is important to note that the specific installation process depending on the type and purpose of the precast units, as well as local building codes and regulations.

Self-Check-3

Part I: Blank Space

Instruction: Fill the black space with correct answer.

1. _____ refers to the process of creating and casting elements of a building or structure off-site, typically in a factory or workshop, before transporting and assembling them on-site.

Part II: Multiple Choice

1. What is the purpose of compacting the base in pre-cast unit installation?
   a. To remove any soil or debris from the excavation area
   b. To improve the stability and load-bearing capacity of the base
   c. To minimize settlement and movement of the unit in the future
   d. To ensure proper adhesion between the base and the pre-cast unit
2. Why is pre-casting often used in construction projects?
   a. To increase material wastage
   b. To decrease costs
   c. To reduce efficiency
   d. To lower quality control
3. What is the advantage of pre-cast construction?
   a. Higher material wastage
   b. Increased on-site labor
   c. Lower quality control
   d. Reduced construction time

Part II: Short Answer Questions

Instructions: Answer all the following questions accordingly.

1. List method for joining pre-cast concrete units.
2. List general guide for installing pre-cast concrete units.
3. List steps for preparing the base section for pre-cast unit installation.
4. List steps for finishing base section for pre-cast unit installation.

Operation Sheet 1

Operation title:

- Installing and joining Pre-Cast Unit Installation

Purpose:

- To practice and demonstrate the knowledge and skill required to installing and joining pre-cast unit installation.

Instruction:

- Use given tools and equipment to installing and joining pre-cast unit installation. For this operation you have given 4 Hour and you are expected to provide the answer on the given table.

Precautions:

- Follow OSH safe work practice standards.

Tools and requirement:

- Measuring tape
- Earth nail
- Leveling equipment
- Tri square
- Claw hammer
- Bow saw
- Spirit level

Procedures:

1. Prepare the Site: Clear the area where the pre-cast units will be installed and ensure it is properly graded and compacted. Remove any debris or obstructions that could hinder the installation.
2. Layout Design: Plan and layout the location and arrangement of the pre-cast units according to the project specifications. Mark the positions where each unit will be installed.
3. Foundation Preparation: Excavate and prepare the foundation for the pre-cast units. This involve pouring a concrete footing or preparing a compacted base for the units to sit on.
4. Positioning the Units: Using heavy equipment such as cranes or forklifts, carefully position the pre-cast units onto the prepared foundation. Ensure that they are aligned and leveled according to the design layout.

5. Joint Preparation: Apply joint sealants or gaskets to the pre-cast unit joints to create a watertight and secure connection between units. These joints are critical for the structural integrity and performance of the installed units.
6. Joining the Units: Carefully align and connect the pre-cast units together, ensuring that the joints are properly sealed and secured. This involve using anchor bolts, dowels, or other specialized connectors depending on the design requirements.
7. Finishing and Grouting: Once the pre-cast units are joined and in their final positions, any necessary finishing touches can be applied. This include grouting the joints, applying surface treatments, or any other required finishing work.
8. Quality Control and Inspection: Perform a thorough inspection of the installed pre-cast units to ensure they meet the specified standards and requirements. This involve checking the alignment, stability, and functionality of the installed units.
9. Backfilling and Compaction: If necessary, backfill the surrounding area around the installed pre-cast units. Compact the soil or other materials to provide adequate support and stability to the units.

Quality Criteria:

- Curbing shall be laid with joints as close as possible for stone curb.
- Expansion and weakened joints shall be constructed at the same locations as required when form construction is being used.
- The constructed joints shall meet the approval of the Engineer and shall, after edging, present an acceptable finish.
- These joints shall be filled with mortar consisting of one-part Portland cement and two parts approved sand with water as necessary to obtain the required consistency. Mortar shall be used within 30 minutes after preparation.
- Weakened joints, spaced at 3.0 meters intervals, shall be made by cutting the concrete with a trowel or by other acceptable method by the Engineer.

LAP Test 1

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Allotted Time: 4 Hours

Instruction I: Installing and Joining Pre-Cast Unit

Task 1. Prepare tools and equipment for installing and joining pre-cast unit

Task 2. Install and join pre-cast unit

Unit Four: Repairing Concrete Units

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

- Damaged Areas
- Setting Up Formwork for Repairing Concrete Units
- Placing Concrete for Repairing Concrete Units
- Finishing Concrete for Repairing Concrete Units
- Clearing, Backfilling and Finishing Area

This unit 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:

- Identify and repair damaged areas
- Set up formwork for repairing concrete units
- Placing concrete for repairing concrete units
- Finish concrete for repairing concrete units
- Clean, backfill, and finish area

4.1. Damaged Areas

Concrete, a mixture of Portland cement, water, sand and aggregate, hydrated to form cementitious material with micro-crack, void and inhomogeneous, exhibits nonlinearity and randomness of mechanical properties. Under loading and different circumstance, concrete and its properties suffer from deterioration, which could be regarded as damage.

Figure 4. 1 Concrete damage area

The type of damage on concrete is often a clue as to how it occurred in the first place. Proper diagnosing of the problem can help you determine how best to fix it, and how to address it.

- Cracks: are inevitable, and they can start appearing within two weeks of the pad being poured if not enough control joints were factored in. Hairline cracks are ok. They a bit unsightly, but they're typically not going to lead to any bigger problems. When should you be concerned about a crack? Generally speaking, you might want to intervene by repairing, resurfacing or replacing if:
- Spalling (pitting): is the chipping or flaking that occurs on the concrete's surface when it's exposed to freeze-thaw cycles or it's the victim of improper mixing. Freeze-thaw occurs when water gets into the pores, and then freezes and expands. Moisture can expand up to 9 percent of its previous volume when frozen, so when it thaws, moisture under the top layer of rigid concrete it can create pressure that leads to spalling. The proper mix at the time of pouring, including an appropriate amount of air entrapment to allow for water expansion, can help minimize incidences of spalling. While it's unsightly, spalling in and

of itself is not indicative of a larger problem, such as a failing sub-base. It can typically be resurfaced and sealed to address the issue. Concrete damage

Figure 4. 2 Spalling

- Settlement: When voids form under a concrete pad, the concrete tends to crack, break, and settle into the void. The result is an uneven and unstable surface that likely requires quick action before even larger damage can occur. Voids typically form through some type of issue with the soil, such as it being loosely compacted at the time of pouring, there being a severe drying and shrinking of the soil, or the occurrence of an underground water leak that causes a washout of a portion of the soil.

Figure 4. 3 Settlement

- Lifting: is also a possible consequence of freeze-thaw cycles. You see it commonly on sidewalks when nearby tree roots grow over time and cause a pad to lift. Frozen moisture under the surface can also cause larger sections of a concrete slab to lift at the joints, allowing for even more water and debris to enter underneath and cause greater damage. Severely lifted pads deserve immediate attention as they can be considered a safety hazard for pedestrians and individuals in wheelchairs, and can sometimes even cause damage to vehicles driving over it.

Figure 4. 4 Lifting

Identifying and repairing damaged concrete areas can be done by following these steps:

A. Inspection: Begin by inspecting the concrete surface for any visible signs of damage such as cracks, chips, spalling (flaking or breaking off of small pieces), or uneven surfaces.
B. Cleaning: Thoroughly clean the damaged area using a wire brush, broom, or pressure washer to remove any loose debris, dirt, and grease. This will ensure proper adhesion of the repair material.
C. Repairing cracks: For small cracks, use a concrete crack filler or epoxy resin to fill the crack. Make sure to follow the manufacturer's instructions for application. For larger cracks, use a concrete patching compound or hydraulic cement to fill and seal the crack.
D. Patching chipped areas: Gently chip away any loose concrete around the chipped area. Apply a concrete bonding agent to the prepared surface, then use a pre-mixed concrete patching material to fill and smooth the chipped area. Use a trowel to ensure an even and level finish.
E. Resurfacing uneven areas: If you have areas that are uneven or have spalling, consider resurfacing the entire surface. This can be done using a concrete resurface or a thin layer of mortar. Follow the manufacturer's instructions to apply the resurfacing material evenly and smoothly.
F. Drying and curing: Allow the repair material to dry and cure according to the manufacturer's instructions. Protect the repaired areas from foot traffic or heavy loads during this time.

Remember, the severity of the damage and the size of the repair will determine the best approach for repairing the concrete. It is always recommended to consult with a professional if you are unsure about the extent of the damage or the best method of repair.

4.2. Setting Up Formwork Use to Replace Removing Section

Formwork is molds into which concrete or similar materials are either precast or cast-in-place. In the context of concrete construction, the falsework supports the shuttering molds. The purpose of formwork is to safely support the reinforced concrete until it has reached adequate strength. Formwork can be a temporary structure or a permanent mold.

Figure 4. 5 Setting up formwork use to replace removing section

To set up formwork for replacing a section, follow these steps:

A. Measure and mark the area where the section needs to be replaced. Ensure that the measurements are accurate to avoid any errors during the replacement process.
B. Determine the required depth and thickness of the new section. This will depend on the specific requirements of the project and the condition of the existing section.
C. Gather the necessary materials for the formwork, including plywood or steel panels, wooden or metal stakes, and formwork ties.

D. Install the formwork by placing the panels against the existing section. Make sure they are securely held in place by driving the stakes into the ground and fastening them to the panels.
E. Use string lines or laser levels to ensure that the formwork is aligned properly and follows the desired contours of the section to be replaced.
F. Install formwork ties to strengthen and reinforce the formwork structure. These ties should be evenly spaced and securely fastened to prevent any movement during the concrete pouring process.
G. Inspect the formwork for any gaps or weak points. Fill any gaps or reinforce weak areas using additional wooden supports or wedges.
H. Once the formwork is securely in place, prepare the area for concrete pouring. This involve adding a layer of compacted gravel or leveling the ground to ensure a flat surface for the new section.
I. Pour the concrete into the formwork, ensuring that it is evenly distributed and fills all the required areas. Use a concrete vibrator to remove any air bubbles and ensure proper compaction.
J. Allow the concrete to cure according to the manufacturer's instructions. This typically involves covering the area with plastic sheeting or damp burlap and regularly moistening it to prevent premature drying.
K. After the concrete has cured, carefully remove the formwork. Start by removing the stakes and then gently pry off the formwork panels, taking care not to damage the newly poured section.
L. Inspect the replacement section for any imperfections or unevenness. If necessary, make any required repairs or adjustments to achieve the desired finish.

By following these steps, you can effectively set up formwork to replace a section and ensure a smooth and accurate replacement process.

4.3. Placing Concrete to Correct Alignment

To place concrete to correct alignment, follow these steps:

A. Prepare the site: Clear the area of any debris, rocks, or loose soil. Grade the site to ensure that it is level and smooth.

B. Build the formwork: Construct a formwork using wood, metal, or plastic. The formwork should be built to the correct dimensions and shape of the concrete structure you are placing. Use stakes and nails to secure the formwork in place.
C. Set up rebar and reinforcement: If needed, install reinforcement such as rebar or mesh to add strength to the concrete. Make sure the reinforcement is placed at the correct depth and properly secured within the formwork.
D. Pour concrete: Mix the concrete according to the instructions on the bag or based on the specifications of your project. Use a wheelbarrow or concrete mixer to transport the concrete to the pour site. Start pouring the concrete at one end of the formwork and work your way to the other end, filling it evenly.
E. Level the concrete: Use a screed board or a straight piece of lumber to level the surface of the concrete. Move the screed board back and forth in a sawing motion while resting it on the formwork. This will remove excess concrete and fill in any low spots.
F. Finish the surface: To achieve a smooth surface, use a float or trowel to level and smoothen the concrete. Gradually work your way across the entire surface, applying even pressure. Use a bull float for larger areas to help smooth and level the concrete.
G. Cure the concrete: Cover the placed concrete with a curing compound, plastic sheeting, or wet burlap to prevent moisture loss and promote proper curing. This will ensure a strong and durable finished product.
H. Maintain alignment during curing: Use string lines or level bars to check and adjust the alignment of the concrete during the curing process. This will help prevent any sagging or misalignment as the concrete sets.

Remember to always follow local building codes and guidelines when placing concrete, and seek professional advice if needed.

4.4. Finishing Concrete

Concrete finishing is a process that strives to create a smooth, durable surface. When finishing concrete, timing is crucial and you must pay close attention to the condition of the concrete. Improper finishing techniques can lead to a weak, damaged or unattractive slab. The primary purpose for finishing concrete pavements is to remove any small surface imperfections and seal the surface of the slab.

Figure 4. 6 Finishing Concrete

the steps to finish concrete to the shape of a curb or gutter:

A. Layout and excavation: Determine the desired shape and size of the curb or gutter and mark it on the ground. Excavate the area and create a solid, level base for the concrete.
B. Reinforcement (if needed): If the curb or gutter will be subjected to heavy traffic or loads, you need to add rebar or metal mesh for added strength and durability. Place the reinforcement in the excavated area.
C. Mixing concrete: Follow the instructions on the concrete mix bag to prepare the right amount of concrete. Use a concrete mixer or mix by hand in a wheelbarrow or bucket.
D. Pouring concrete: Pour the concrete into the prepared form for the curb or gutter. Fill it to the top, slightly overfilling to compensate for settling.
E. Screeding: Use a screed board or straightedge to level the concrete. Place the screed board at one end of the curb or gutter form and pull it along the top, using a sawing motion to remove excess concrete and create a smooth, level surface.
F. Finishing the edges: After screeding, use a hand float or trowel to smooth and level the surface of the concrete. Pay special attention to the edges, making sure they are defined and uniform.

G. Edging: Use an edging tool to shape the concrete to the desired curb or gutter profile. Run the tool along the edge of the concrete, applying pressure to create the shape. You can find various edging tools specifically designed for curbs and gutters at most construction supply stores.
H. Broom finish: To create a non-slip surface, lightly drag a broom over the surface of the curb or gutter. This will create texture and improve traction.
I. Curing: Cover the finished concrete with plastic or damp burlap to retain moisture and allow it to cure properly. Follow the curing time specified by the concrete mix manufacturer.
J. Maintenance: Regularly inspect and maintain the curb or gutter to ensure it remains in good condition. Repair any cracks or damage promptly to prevent further issues.

Remember to wear protective gear such as gloves, safety glasses, and a dust mask while working with concrete.

4.5. Clearing, Backfilling and Finishing Area

Clearing, backfilling, and finishing an area typically refers to the process of preparing a site for construction or landscaping. Here is a breakdown of each step:

A. Clearing: This involves removing any existing vegetation, trees, debris, or structures from the area to create a clean canvas. Clearing also include grading the land to ensure a level surface.
B. Backfilling: Once the area is cleared, backfilling is performed to fill any excavations or holes created during the clearing process. This involve adding soil or other materials to restore the site to its original level or desired grade.
C. Finishing: The finishing step involves adding the final touches to the area to make it ready for its intended purpose. This can include activities such as leveling the ground, compacting the soil, seeding or laying sod for grass, installing irrigation systems, and planting trees or shrubs. Additionally, any necessary landscaping or hardscaping elements, such as pathways, retaining walls, fences, or decorative features, also be included in the finishing process.

Overall, clearing, backfilling, and finishing an area prepares it for construction or landscaping, ensuring a clean, level, and functional space.

Self-Check-4

Part I: Short Answer Questions

Instructions: Answer all the following questions accordingly.

1. List and describe procedure for identify and repair damaged concrete areas.

2. List and describe procedure for set up formwork for replacing a section.

3. List and describe procedure for place concrete to correct alignment.

4. List and describe procedure for finish concrete to the shape of a curb or gutter.

5. List and describe procedure for clearing, backfilling, and finishing an area.

Operation Sheet 1

Operation title:

- Repairing Kerbs, Gutters, Medians, and Barrier Strips

Purpose:

- To practice and demonstrate the knowledge and skill required to repair kerbs, gutters, medians, and barrier strips.

Instruction:

- Use given tools and equipment to repair kerbs, gutters, medians, and barrier strips. For this operation you have given 8 Hour and you are expected to provide the answer on the given table.

Precautions:

- Follow OSH safe work practice standards.

Tools and requirement:

- Bow saw
- Broom
- Claw hammer
- Concrete mix
- Concrete mixer
- Earth nail
- Edging tool
- Hand float or trowel
- Leveling equipment
- Measuring tape
- Rebar or metal mesh
- Screed board or straightedge
- Shovel or trowel
- Spirit level
- Tri square
- Wheelbarrow or bucket

Procedures:

1. Assess the damage: Begin by inspecting the kerbs, gutters, medians, and barrier strips to determine the extent of the damage. Look for cracks, potholes, or any other issues that need repair.
2. Plan the repairs: Based on the assessment, determine the scope of the repairs needed. This involve patching cracks or potholes, replacing damaged sections, or resurfacing the entire area.
3. Gather materials and tools: Once the repair plan is established, gather the necessary materials and tools. This include concrete mix, asphalt, gravel, shovels, wheelbarrows, and safety equipment (e.g., gloves, goggles, and cones).

4. Prepare the area: Before starting the repairs, clean the damaged area by removing any debris or loose materials. This will ensure better adhesion of the repair materials.
5. Patch or replace damaged sections: If tcracks or potholes, prepare the surfaces by chiseling or widening the cracks and removing loose material. Then, apply a suitable concrete mix or asphalt material to fill the gaps. Allow the material to cure according to the manufacturer's instructions.
6. Resurface the area (if necessary): In cases where the entire kerb, gutter, median, or barrier strip needs repair, resurfacing required. This involves removing the old surface to create a smooth base, applying a bonding agent, and then pouring new concrete or asphalt to create a new surface.
7. Curing and finishing: Once the repairs are complete, allow the concrete or asphalt materials to cure properly. This typically involves keeping the repaired area moist and protected from heavy use until the materials have fully hardened. Apply any required finishing touches, such as painting or marking the repaired area.
8. Maintenance: Regular maintenance is crucial to extend the lifespan of the repaired kerbs, gutters, medians, and barrier strips. This include keeping them clean, removing debris and weeds, and performing periodic inspections for any signs of wear or damage that need prompt repair.

Quality Criteria:

- Curbing shall be laid with joints as close as possible for stone curb.
- Expansion and weakened joints shall be constructed at the same locations as required when form construction is being used.
- The constructed joints shall meet the approval of the Engineer and shall, after edging, present an acceptable finish.
- These joints shall be filled with mortar consisting of one-part Portland cement and two parts approved sand with water as necessary to obtain the required consistency. Mortar shall be used within 30 minutes after preparation.
- Weakened joints, spaced at 3.0 meters intervals, shall be made by cutting the concrete with a trowel or by other acceptable method by the Engineer.
- Check the repair work according to drawing and specification.

LAP Test 1

Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Allotted Time: 8 Hours

Instruction I: Repair kerbs, gutters, medians, and barrier strips

Task 1. Prepare tools and equipment for repairing kerbs, gutters, medians, and barrier strips

Task 2. Repair kerbs, gutters, medians, and barrier strips

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