Structural Construction Works

Level – V

Based on December, 2024 Version 2 Curriculum

Module Title: Pre-Cast Concrete Structures and Components Production

Module Code: EIS SCW5 M02 1224

Nominal Duration: 120 Hours

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Acknowledgment

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Acronyms

EIS	Economic infrastructure
SCW	Structural Construction Works
LAP	Learning Activities Performance

Introduction to the Module

This module provides a comprehensive understanding of the production processes and techniques involved in creating pre-cast concrete structures and components. Participants will explore the selection and preparation of molds, the mixing and casting of concrete, curing processes, and quality control measures. The module emphasizes industry standards and best practices, equipping learners with the skills to ensure structural integrity and efficiency in production. Topics also include handling, storage, and transportation of pre-cast components to ensure safety and minimize damage. This module is ideal for professionals seeking to enhance their knowledge in modern construction methods and improve productivity in pre-cast manufacturing.

This module is designed to meet the industry requirement under the Structural Construction Work occupational standard, particularly for the unit of competency Pre-Cast Concrete Structures and Components Production.

This module covers the units.

- Basics of Precast Concrete Production
- Setting Out for Precast Concrete Work
- Constructing and Installing Reinforcement for Precast Concrete
- Erecting Formwork for Precast Concrete
- Carrying Out Precast Concrete Work
- Stripping Precast Concrete Formwork and Cleanup

Learning Objective of the Module

- Identify basics of precast concrete production
- Set out for precast concrete work
- Construct and install reinforcement for precast concrete
- Erect formwork for precast concrete
- Carry out precast concrete work
- Strip precast concrete formwork and cleanup

Module Instruction

for effectively use this modules trainee are expected to follow the following module instruction.

1. Read the information written in each unit.
2. Accomplish the Self-checks at the end of each unit.
3. Perform Operation Sheets which were provided at the end of units.
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for examples and exercise.

Unit One. Basics of Precast Concrete Production

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

- Overview of Precast Concrete Production
- Work Instructions and Safety Protocols
- Material and Equipment Preparation
- Site Preparation and Environmental Considerations

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Explain precast concrete production processes
- Apply Work Instructions and Safety Protocols
- Prepare Materials and Equipment
- Implement Site Preparation and Environmental Measures

1.1 Overview of Precast Concrete Production

- **Introduction to Precast Concrete Processes**

Precast concrete production involves casting concrete in a controlled environment using reusable molds. This method ensures consistent quality, precision, and efficiency in construction projects. Key stages include:

- Designing molds and reinforcement layouts.
- Mixing concrete to specified proportions.
- Pouring and compacting concrete into molds.
- Curing concrete to achieve desired strength and durability.
- Transporting and installing precast elements at the construction site.

Figure 1.1 Precast concrete production

- **Key Components of Precast Concrete Production**

  - ✓ **Molds**: Shapes and forms used to create precast elements.
  - ✓ **Reinforcement**: Steel bars or meshes for structural integrity.
  - ✓ **Concrete Mix**: Consists of cement, aggregates, water, and additives.
  - ✓ **Curing Methods**: Techniques like steam curing or water curing to enhance strength.
  - ✓ **Transport and Handling Equipment**: Cranes, forklifts, and trailers for safe movement.

Figure 1.2 Precast element

- **Benefits and Applications of Precast Concrete in Construction**
  - ✓ **Benefits**:
    - ➢ Faster construction timelines.
    - ➢ High-quality control standards.
    - ➢ Reduced material wastage.
    - ➢ Enhanced durability and aesthetics.
  - ✓ **Applications**:
    - ➢ Beams, columns, and slabs.
    - ➢ Bridges and culverts.
    - ➢ Facades and decorative elements.
    - ➢ Sewer and drainage systems.

1.2 Work Instructions and Safety Protocols

- **Understanding and Interpreting Work Instructions**

Work instructions provide detailed steps for completing tasks. Key points include:

- ✓ Reading and comprehending technical drawings.
- ✓ Following sequence steps for efficiency.
- ✓ Adhering to specified tolerances and measurements.

- **Workplace Health and Safety Requirements**
  - ✓ **Personal Protective Equipment (PPE)**: Hard hats, gloves, safety boots, and goggles.
  - ✓ **Safe Work Practices**:

- Handling materials safely.
- Using equipment as per guidelines.
- Avoiding hazardous areas.

✓ **Emergency Preparedness**:

- Knowing first aid procedures.
- Identifying emergency exits.

- **Identifying and Implementing Signage for Safe Operations**

✓ **Types of Signage**:

- Warning signs: "Wet Floor," "High Voltage."
- Instructional signs: "Wear PPE," "Authorized Personnel Only."

✓ **Placement**: Ensure visibility at relevant work zones.

1.3 Material and Equipment Preparation

- **Selecting Tools, Plant, and Equipment for Precast Work**

✓ **Tools**: Trowels, vibrators, mixers.

✓ **Plant and Equipment**: Concrete batching plants, curing chambers, cranes.

- **Preparing and Handling Materials Appropriately**

✓ **Storage**: Keep materials in dry and covered areas.

✓ **Handling**: Use lifting tools to prevent damage.

- **Calculating and Verifying Material Quantities for Accuracy**

✓ **Calculation Tools**: Use software or manual computation for accuracy.

✓ **Verification**: Cross-check quantities against project specifications.

1.4 Site Preparation and Environmental Considerations

- **Environmental Protection Measures and Compliance**

✓ **Waste Management**: Proper disposal of excess concrete and materials.

✓ **Dust and Noise Control**: Use barriers and water sprays.

✓ **Compliance**: Follow local environmental regulations.

- **Determining Locations for Steel Reinforcement and Formwork**
  - ✓ **Marking Layouts**: Use chalk lines and markers.
  - ✓ **Ensuring Stability**: Secure formwork and reinforcement to avoid displacement.
- **Assessing Site Conditions for Precast Concrete Placement**
  - ✓ **Inspection**: Check ground stability and load-bearing capacity.
  - ✓ **Accessibility**: Ensure clear paths for equipment movement.

Self-Check 1

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. Precast concrete is produced in a _____ environment using reusable molds.
2. _____ bars or meshes are used to reinforce precast concrete.
3. Proper disposal of excess concrete ensures compliance with _____ regulations.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

4. Which of the following is a benefit of precast concrete?
   a. Increased material wastage
   b. Enhanced durability and aesthetics
   c. Longer construction timelines
5. What is the primary purpose of curing concrete?
   a. To increase color uniformity
   b. To enhance strength and durability
   c. To reduce material costs
6. Which equipment is essential for transporting precast elements?
   a. Trowels
   b. Cranes
   c. Vibrators

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

7. Explain the key stages in precast concrete production.
8. List three types of personal protective equipment required in precast concrete operations.
9. Why is it important to verify material quantities before production?

Operation Sheet 1.1

Operation Title

- Preparing Molds for Precast Concrete

Purpose

- To ensure molds are clean, properly assembled, and ready for casting concrete.

Conditions for the Operation

- Controlled work environment.
- Access to tools and materials.

Equipment, Tools, and Materials

- Steel or wooden molds
- Cleaning brushes and agents
- Release agents
- Measuring tools

Quality Criteria

- Molds are clean and free of debris.
- All joints are sealed to prevent leakage.
- Dimensions match design specifications.

Precautions

- Use PPE to avoid injuries.
- Handle molds carefully to avoid damage.

Steps in Doing the Task

1. Inspect molds for damage or wear.
2. Clean molds using appropriate brushes and agents.
3. Apply release agents evenly to ensure easy demolding.
4. Assemble molds and check for tight joints.
5. Verify dimensions and alignment using measuring tools.

Operation Sheet 1.2

Operation Title

- Calculating Material Quantities

Purpose

- To ensure accurate measurement and availability of materials for production.

Conditions for the Operation

- Access to design specifications and calculation tools.
- Suitable storage and workspace.

Equipment, Tools, and Materials

- Calculation software or spreadsheets
- Measuring tapes and scales
- Material lists

Quality Criteria

- Quantities align with project specifications.
- Minimal material wastage.

Precautions

- Double-check calculations to avoid errors.
- Ensure scales and tools are calibrated.

Steps in Doing the Task

1. Review design specifications and material requirements.
2. Calculate volumes for each component of the mix.
3. Verify quantities using measurement tools or software.
4. Adjust calculations if site conditions differ.
5. Document and confirm material availability.

Learning Activity Performance (LAP) Test 1

Practical Demonstration

Name: _____ **Date: _____**

Time Startd: _____ **Time Finishd: _____**

Time Allotted: 4 Hours

Instruction. Perform the following tasks accordingly.

Task 1. Preparing Molds for Precast Concrete

Task 2. Calculating Material Quantities

Unit Two. Setting Out for Precast Concrete Work

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

- Setting String Lines
- Checking Grades of Concrete
- Preventing Concrete Damage

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Set string lines
- Check grades of concrete
- Prevent concrete damage

2.1 Setting String Lines

- **Techniques for Establishing Accurate String Lines**

  a. **Survey the Area:** Identify the boundaries and dimensions of the structure to set precise reference points.

  b. **Choose Suitable Anchor Points:** Secure the string line to sturdy, immovable stakes or anchors.

  c. **Use a Level:** Employ a line level, laser level, or transit to ensure the string line is perfectly horizontal or aligned as per design.

  d. **Tighten the String:** Ensure the string is taut to eliminate sagging, which could distort measurements.

  e. **Double-check Measurements:** Reconfirm distances and alignments using a measuring tape or calibrated tools.

- **Importance of Correct Alignment in Precast Concrete Work**

  ✓ Ensures structural stability and uniformity.

  ✓ Facilitates proper placement of forms and reinforcement.

  ✓ Reduces material wastage and enhances aesthetic appeal.

  ✓ Avoids costly rework by preventing misalignment issues.

2.2 Checking Grades of Concrete

- **Methods for Verifying the Grade and Strength of Concrete Mixes**

  a. **Slump Test:** Assess workability and consistency.

  b. **Compressive Strength Test:** Use cylindrical samples cured and tested under controlled conditions.

  c. **Rebound Hammer Test:** Quickly gauge surface hardness.

  d. **Chemical Analysis:** Verify the mix's cement, aggregate, and water ratios.

  e. **Visual Inspection:** Identify signs of segregation or improper mixing.

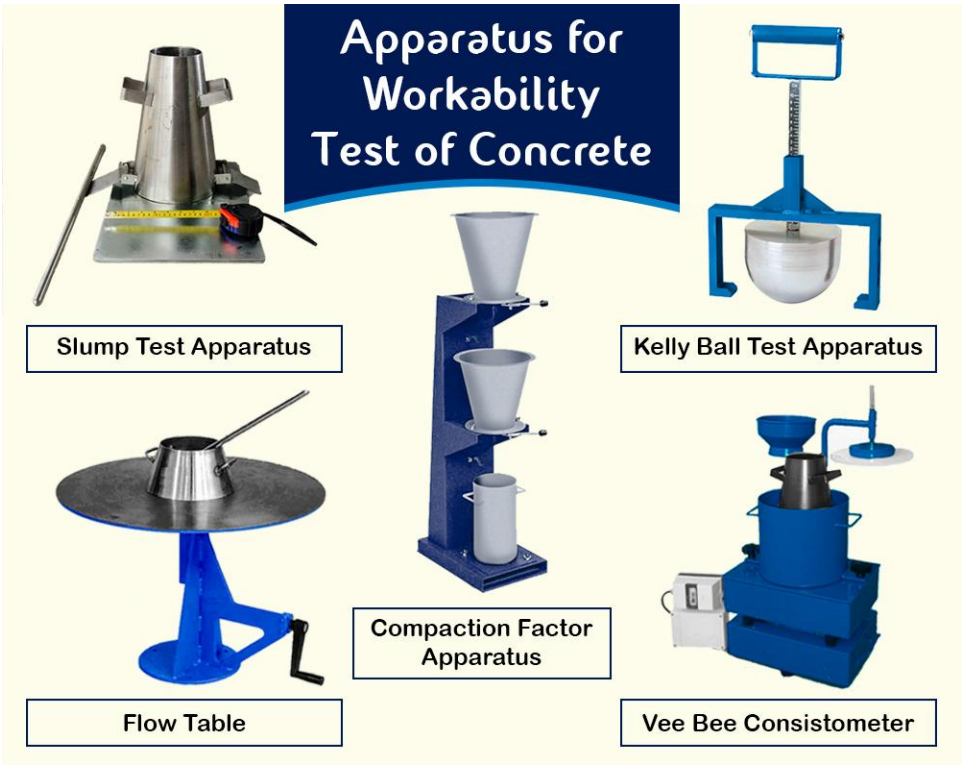

Figure 2.1 Concrete test

- **Impact of Improper Concrete Grades on Precast Structures**
  - ✓ Reduces load-bearing capacity.
  - ✓ Leads to premature cracking and structural failure.
  - ✓ Increases susceptibility to environmental degradation.
  - ✓ Compromises safety and durability.

2.3 Preventing Concrete Damage

- **Strategies for Protecting Concrete from Damage During Placement and Curing**
  a. **Use Proper Formwork:** Ensure forms are leak-proof and stable.
  b. **Control Temperature:** Employ curing blankets, heaters, or water spraying for temperature-sensitive pours.
  c. **Minimize Vibration:** Avoid excessive mechanical vibration, which can cause segregation.
  d. **Apply Surface Protection:** Use plastic sheeting or curing compounds to shield against evaporation.

e. **Monitor Placement Timing:** Place and finish concrete within its working time to maintain integrity.

- **Best Practices for Minimizing Surface Defects and Achieving Quality Finishs**
  - ✓ **Use Consistent Mixes:** Avoid over-watering or inconsistent batching.
  - ✓ **Apply Correct Finishing Techniques:** Prevent over-troweling, which could lead to weak surfaces.
  - ✓ **Protect Against Contaminants:** Ensure clean tools and environments during finishing.
  - ✓ **Allow Proper Curing:** Follow recommended curing times and methods to achieve desired strength.

Figure 2.2 Concrete Damages

Self-Check 2

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. The primary purpose of a _____ is to provide a reference for alignment and level in construction.
2. Proper curing ensures _____ and _____ of the concrete.
3. A _____ test measures the workability of a concrete mix.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

4. What is the best tool to ensure a string line is level?
   a. Measuring Tape
   b. Line Level
   c. Hammer
   d. Compass
5. Which of the following is not a method to verify concrete grade?
   a. Slump Test
   b. Soil Test
   c. Rebound Hammer Test
   d. Chemical Analysis

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

6. Explain why proper alignment of string lines is crucial in precast concrete work.
7. Describe two strategies for preventing surface defects during concrete placement.

Operation Sheet 2.1

Operation Title:

- Setting String Lines

Purpose

- To establish accurate reference points for the alignment and leveling of construction components.

Conditions for the Operation:

- Open construction site.
- Tools such as stakes, string, line level, and measuring tape available.
- Clear visibility and minimal environmental disturbances.

Equipment, Tools, and Materials:

- Sturdy stakes
- High-tensile string
- Line level or laser level
- Measuring tape
- Hammer or mallet

Quality Criteria:

- String lines are taut and aligned as per design specifications.
- No sagging or deviations in the alignment.

Precautions:

- Avoid loose anchor points.
- Protect lines from damage or displacement by ongoing site activities.

Steps in Doing the Task:

1. Identify and mark anchor points on the site.
2. Secure stakes firmly in the ground.
3. Attach the string to the stakes and pull it tight.
4. Use a level to verify horizontal or vertical alignment.
5. Recheck measurements for accuracy before proceeding.

Operation Sheet 2.2

Operation Title:

- Checking Grades of Concrete

Purpose:

- To ensure the concrete mix meets required specifications for strength and durability.

Conditions for the Operation:

- Access to fresh concrete samples.
- Laboratory or on-site testing facilities.

Equipment, Tools, and Materials:

- Slump cone and rod
- Compression testing machine
- Rebound hammer
- Sample molds

Quality Criteria:

- Results comply with project specifications.
- No signs of segregation or improper mixing.

Precautions:

- Handle fresh concrete samples carefully.
- Follow safety protocols for testing equipment.

Steps in Doing the Task:

1. Collect a representative sample of the concrete mix.
2. Perform a slump test to check workability.
3. Prepare cylindrical samples for compressive strength testing.
4. Conduct rebound hammer tests on set concrete.
5. Record and compare results to design requirements.

Operation Sheet 2.3

Operation Title

- Preventing Concrete Damage

Purpose

- To maintain the integrity and quality of concrete during placement and curing.

Conditions for the Operation:

- Placement occurs in suitable weather conditions.
- Required curing materials are available.

Equipment, Tools, and Materials:

- Curing blankets or plastic sheets
- Water sprayers or misting equipment
- Vibrators and trowels
- Thermometers for temperature monitoring

Quality Criteria:

- No visible surface defects or cracking.
- Concrete achieves design strength and finish.

Precautions:

- Avoid over-vibration.
- Protect fresh concrete from extreme weather.

Steps in Doing the Task:

1. Place concrete carefully into the formwork.
2. Use vibration sparingly to avoid segregation.
3. Apply surface protection immediately after finishing.
4. Maintain curing for the recommended duration.
5. Monitor conditions regularly and adjust as needed.

Learning Activity Performance (LAP) Test 2

Practical Demonstration

Name. _____ **Date. _____**

Time Start_____ **Time Finish_____**

Time Allotted: 1 Hours

Instruction. Perform the following tasks accordingly.

Task 1. Setting String Lines

Task 2. Checking Grades of Concrete

Task 3. Preventing Concrete Damage

Unit Three. Constructing and Installing Reinforcement for Precast Concrete

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

- Cutting and Bending Reinforcing Bars
- Tying Fabric and Bars
- Fixing Fabric and Bars
- Attaching Stiffening Rods
- Locating Reinforcement Material in Formwork
- Placing Bar Chairs/Spacers in Formwork
- Locating and Securing Cast-in Components

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Cut and bend reinforcing bars
- Tie fabric and bars
- Fix fabric and bars
- Attach stiffening rods
- Locate reinforcement material in formwork
- Place bar chairs/spacers in formwork
- Locate and secure cast-in components

3.1 Cutting and Bending Reinforcing Bars

- **Techniques for Precise Cutting and Bending of Reinforcing Bars**
  - ✓ **Use of Tools**: Ensure use of appropriate tools like bar cutters, bending machines, or manual bending rods.
  - ✓ **Measurement**: Mark the bars accurately based on the design specifications using a tape measure and marker.
  - ✓ **Cutting**: Align the bar cutter at the marked point and apply steady force to achieve a clean cut.
  - ✓ **Bending**: Use a bending machine for precise angles, ensuring the bar is securely clamped and bent to the required angle slowly to avoid cracks.
  - ✓ **Inspection**: Check for burrs or deformities after cutting and bending.
- **Importance of Correct Bar Size and Shape for Structural Integrity**
  - ✓ **Structural Strength**: Incorrect bar size or shape can compromise load-bearing capacity.
  - ✓ **Design Compliance**: Follow design drawings to ensure bars fit correctly in the formwork.
  - ✓ **Durability**: Proper bending prevents stress points, reducing the risk of failure.

3.2 Tying Fabric and Bars

- **Methods for Tying Reinforcing Fabric and Bars Together Effectively**
  - ✓ **Wire Tying**: Use binding wire for secure fastening.
  - ✓ **Tie Types**: Use saddle ties, wrap ties, or figure-eight ties based on the requirements.
  - ✓ **Spacing**: Maintain consistent spacing between ties to ensure stability.
  - ✓ **Tension**: Ensure wires are tight but not overly strained to avoid snapping.
- **Tools and Techniques for Ensuring a Secure and Stable Assembly**
  - ✓ **Tools**: Use pliers, wire reel dispensers, and tying guns for efficient tying.
  - ✓ **Techniques**: Twist the wire ends securely and trim excess to avoid injuries.
  - ✓ **Inspection**: Check that the assembly is stable and does not shift under light pressure.

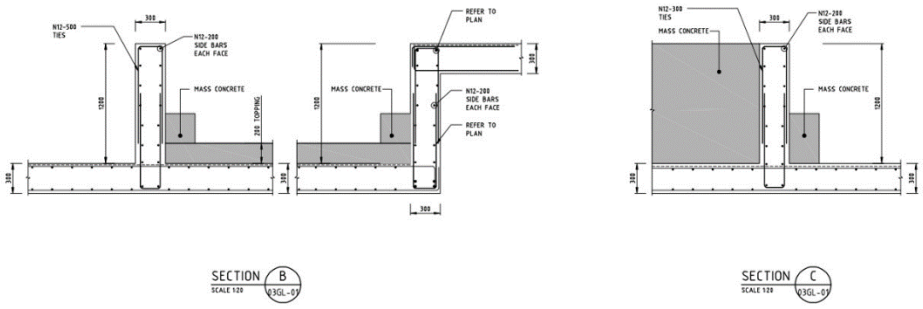

Figure 3.1 Reinforcement drawing

3.3 Fixing Fabric and Bars

- **Proper Methods for Placing and Securing Reinforcing Fabric and Bars in Formwork**
  - ✓ **Preparation**: Clean formwork and check for correct dimensions.
  - ✓ **Placement**: Lay the fabric and bars as per the structural drawing.
  - ✓ **Securing**: Tie bars to the formwork using binding wire or clamps.
- **Ensuring Correct Alignment and Spacing to Meet Structural Requirements**
  - ✓ **Alignment**: Use alignment tools like templates or laser levels.
  - ✓ **Spacing**: Maintain specified spacing to allow proper concrete flow and coverage.

3.4 Attaching Stiffening Rods

- **Installation of Stiffening Rods to Provide Additional Support and Stability**
  - ✓ **Preparation**: Identify areas needing extra support.
  - ✓ **Attachment**: Secure rods to the main reinforcement using clamps or binding wire.
  - ✓ **Inspection**: Verify all rods are firmly attached and aligned.
- **Techniques for Attaching Rods Securely to Reinforcement Cages**
  - ✓ **Use of Clamps**: Tighten clamps adequately to hold rods in place.
  - ✓ **Manual Binding**: Use wire to bind rods to the cage at intervals.

3.5 Locating Reinforcement Material in Formwork

- **Placement and Positioning of Reinforcement Materials Within Formwork**
  - ✓ **Referencing Plans**: Cross-check placement with structural blueprints.
  - ✓ **Positioning**: Ensure reinforcement is centered within the formwork.
  - ✓ **Fixing**: Use spacers or supports to hold materials in place.
- **Techniques to Maintain Correct Placement During Concrete Pouring**
  - ✓ **Bar Chairs**: Place bar chairs to keep reinforcement from moving.
  - ✓ **Stabilization**: Secure ends and intersections with additional ties.

3.6 Placing Bar Chairs/Spacers in Formwork

- **Methods for Positioning Bar Chairs or Spacers to Hold Reinforcement at the Proper Height**
  - ✓ **Placement**: Place bar chairs at regular intervals as per design.
  - ✓ **Verification**: Use leveling tools to ensure proper height.
- **Importance of Spacing to Prevent Sagging and Ensure Uniform Concrete Coverage**
  - ✓ **Uniform Support**: Prevent sagging by evenly distributing chairs.
  - ✓ **Coverage**: Ensure adequate concrete thickness over reinforcement to prevent corrosion.

3.7 Locating and Securing Cast-in Components

- **Techniques for Accurately Placing and Securing Cast-in Components**
  - ✓ **Alignment**: Align components using templates or guides.
  - ✓ **Fixing**: Secure components with bolts or clamps to prevent movement.
- **Ensuring Proper Alignment and Functionality in the Finishd Precast Unit**
  - ✓ **Pre-Pour Checks**: Double-check alignment and dimensions.
  - ✓ **Post-Pour Inspection**: Ensure components are visible and functional after curing.

Self-Check 3

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. The primary purpose of using bar chairs is to _____.
2. _____ is used to bind reinforcing bars securely.
3. Proper spacing of reinforcing bars ensures _____ of concrete flow.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

4. What tool is best suited for cutting reinforcing bars?
   a. Pliers
   b. Bar Cutter
   c. Hammer
   d. Screwdriver
5. What is the main purpose of stiffening rods?
   a. Provide alignment
   b. Increase stability and support
   c. Bind bars together
   d. Replace binding wire
6. What ensures uniform concrete coverage?
   a. Proper tying techniques
   b. Correct placement of bar chairs
   c. Use of stiffening rods
   d. Cutting bars to the correct length

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

7. Explain why proper alignment of reinforcing bars is critical during concrete pouring.
8. Describe the steps to securely attach stiffening rods to reinforcement cages.

Operation Sheet 3

Operation Title:

- Cutting and Bending Reinforcing Bars

Purpose:

- To prepare reinforcing bars of the correct size and shape to meet structural design requirements.

Conditions for the Operation:

- Flat and stable work surface.
- Availability of tools and safety gear.
- Proper lighting and ventilation.

Equipment, Tools, and Materials:

- Bar cutter, bending machine, pliers.
- Tape measure, marker.
- Safety gloves, goggles.

Quality Criteria:

- Bars are cut and bent to precise measurements.
- Edges are smooth and free of burrs.
- Bars meet design specifications.

Precautions:

- Wear safety gear.
- Ensure tools are in good condition.
- Avoid overcrowding the work area.

Steps in Doing the Task:

1. Refer to design drawings for bar specifications.
2. Measure and mark the bars accurately.
3. Use the bar cutter to cut bars at the marked points.
4. Position the bar in the bending machine and adjust to the required angle.
5. Inspect the bars for accuracy and smoothness.

Learning Activity Performance (LAP) Test 3

Practical Demonstration

Name. _____ **Date. _____**

Time Start_____ **Time Finish_____**

Time Allotted: 2 Hours

Instruction. Perform the following tasks accordingly.

Task 1. Cutting and bending reinforcing bars

Unit Four. Erecting Formwork for Precast Concrete

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

- Clearing Work Area for Safe Erection of Formwork
- Setting Out Formwork
- Assembling Formwork
- Erecting Formwork
- Removing Debris, Sawdust from Formwork
- Applying Release Agent on Formwork

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Clear work area for safe erection of formwork
- Set out formwork
- Assemble formwork
- Erect formwork
- Remove debris, sawdust from formwork
- Apply release agent on formwork

4.1 Clearing Work Area for Safe Erection of Formwork

Purpose

To ensure the work area is free of obstructions, reducing the risk of accidents and creating a safe environment for formwork erection.

Key Steps

a. Inspect the designated area for hazards such as debris, loose tools, and uneven surfaces.
b. Remove unnecessary materials and waste.
c. Ensure proper disposal of debris according to environmental regulations.
d. Verify the area is clear of unauthorized personnel.

Safety Precautions

- Wear appropriate personal protective equipment (PPE) including gloves, safety boots, and helmets.
- Use designated pathways to transport debris.
- Follow waste disposal guidelines.

4.2 Setting Out Formwork

Purpose

To ensure the formwork is accurately positioned to achieve the desired dimensions and alignment of the precast concrete element.

Key Steps

a. Review construction drawings for dimensions and layout.
b. Mark reference points using chalk, stakes, or string lines.
c. Use measuring tools such as tape measures, levels, and theodolites to ensure accuracy.
d. Double-check measurements for alignment and spacing.

Quality Criteria

- Markings must match the specifications on the construction drawings.
- Alignments should be within the permissible tolerances.

Precautions

- Avoid marking surfaces that will remain visible after construction.
- Ensure proper calibration of measurement tools.

4.3 Assembling Formwork

Purpose

To securely connect formwork components to create a stable structure for precast concrete.

Key Steps

a. Select the appropriate formwork panels and accessories.
b. Assemble components based on the manufacturer's guidelines.
c. Ensure joints are tight and properly aligned.
d. Reinforce formwork using braces or supports where necessary.

Quality Criteria

- All components should fit securely without gaps.
- Assembly should withstand loads during concrete placement.

Precautions

- Follow manufacturer's guidelines strictly.
- Inspect components for damage before use.

4.4 Erecting Formwork

Purpose

To position and stabilize the assembled formwork structure at the designated location.

Key Steps

a. Transport the assembled formwork to the site.
b. Position the formwork according to reference points.
c. Anchor the formwork securely using stakes or weights.
d. Inspect the erected structure for stability and alignment.

Quality Criteria

- Formwork should remain stable under external forces.
- Alignment should match the specified dimensions.

Precautions

- Use proper lifting techniques or equipment.
- Check weather conditions before erection.

4.5 Removing Debris, Sawdust from Formwork

Purpose

To ensure the surface of the formwork is clean for smooth concrete finishing.

Key Steps

a. Use a broom or vacuum to remove loose debris and sawdust.
b. Wipe surfaces with a damp cloth if necessary.
c. Check corners and joints for trapped debris.

Quality Criteria

- Surfaces should be clean and free from foreign materials.
- No residue should remain in corners or joints.

Precautions

- Avoid using water excessively to prevent swelling of wooden formwork.
- Ensure tools used for cleaning do not damage the formwork.

4.6 Applying Release Agent on Formwork

Purpose

To facilitate easy removal of formwork after concrete curing without damaging the surface.

Key Steps

a. Select the appropriate release agent for the formwork material.
b. Apply a thin, even layer using a brush, roller, or sprayer.
c. Ensure full coverage, including corners and edges.

Quality Criteria

- The release agent should be evenly distributed without excess.
- No areas should be missed during application.

Precautions

- Follow the manufacturer’s instructions for application.
- Avoid applying release agents on reinforcing steel.

Self-Check 4

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. Always wear appropriate _____ while clearing the work area.
2. Reference points are marked using _____ or string lines.
3. Reinforce formwork using _____ or supports.
4. Anchor the formwork securely using stakes or _____.
5. Remove debris using a _____ or vacuum.
6. Apply the release agent using a brush, roller, or _____.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

7. What should be done after clearing the area?
   a. Leave tools scattered
   b. Ensure waste disposal is properly completed
   c. Begin assembling formwork
8. What tool is used for checking alignment?
   a. Wrench
   b. Theodolite
   c. Trowel
9. What is critical during formwork assembly?
   a. Speed of assembly
   b. Secure fit and alignment
   c. Random placement of braces
10. What should be done after positioning the formwork?
    a. Begin pouring concrete
    b. Inspect for stability and alignment
    c. Remove supports
11. Why is it necessary to clean the formwork surface?
    a. To make it shiny

b. To prevent imperfections in the concrete surface

c. To reduce the workload

12. What is the primary purpose of a release agent?

a. To make the formwork waterproof

b. To ease removal after curing

c. To strengthen the formwork

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

13. Why is it important to clear the work area before erecting formwork?

14. List two tools essential for setting out formwork.

15. Why is it necessary to inspect formwork components before assembly?

16. Describe one method for anchoring formwork.

17. What tool would you use to remove sawdust from formwork?

18. Why should release agents not be applied to reinforcing steel?

Operation Sheet 4

Operation Sheet: Erecting Formwork for Precast Concrete

Operation Title: Erecting Formwork for Precast Concrete

Purpose: To ensure the safe and efficient erection of formwork that meets project specifications.

Conditions for Operation:

- Work area must be clear and prepared.
- All tools, equipment, and materials should be available and in good condition.
- Personnel should wear appropriate PPE.

Equipment, Tools, and Materials:

- Measuring tools (tape measure, level, theodolite)
- Formwork panels and accessories
- Cleaning tools (broom, vacuum, cloth)
- Release agent and applicator (brush, roller, sprayer)

Quality Criteria:

- Formwork is stable and aligned.
- Surfaces are clean and treated with release agent.
- Safety guidelines are followed throughout.

Precautions:

- Avoid overloading lifting equipment.
- Ensure clear communication among workers.
- Inspect tools and formwork components for defects.

Steps in Doing the Task:

1. Clear the work area and prepare the site.
2. Set out the formwork positions using reference points.
3. Assemble formwork components securely.
4. Transport and erect the assembled formwork at the site.
5. Remove debris and sawdust from the formwork surfaces.
6. Apply the release agent evenly on the formwork.
7. Inspect the erected formwork for stability and alignment.

Learning Activity Performance (LAP) Test

Practical Demonstration

Name. _____ **Date. _____**

Time Start_____ **Time Finish_____**

Time Allotted: 2 Hours

Instruction. Perform the following tasks accordingly.

Task 1. Erecting formwork for precast concrete

Unit Five. Carrying Out Precast Concrete Work

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

- Transporting Concrete
- Discharging Concrete
- Compacting Concrete
- Application of Concrete Finishs
- Curing of Concrete
- Positioning and Installing Control Joints
- Positioning Dowel Joints
- Covering and Protecting Concrete Surface

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Transport concrete
- Discharge concrete
- Compact concrete
- Apply concrete Finishs
- Cure concrete
- Position and install control joints
- Position dowel joints
- Cover and protecting

5.1 Transporting Concrete

Objective: To ensure concrete is delivered to the site without segregation or excessive delays that may compromise quality.

Key Concepts:

- ✓ **Methods of Transport:** Buckets, wheelbarrows, pumps, chutes, or conveyors.
- ✓ **Common Issues:** Segregation, contamination, and delays.
- ✓ **Best Practices:**
  - ➢ Use suitable transport equipment.
  - ➢ Maintain a consistent delivery schedule.
  - ➢ Protect concrete from extreme temperatures.

Steps for Transporting Concrete:

a. Select appropriate transport equipment based on site conditions.
b. Load concrete into transport equipment.
c. Transport concrete to the designated area promptly.
d. Prevent spillage or contamination during transit.

5.2 Discharging Concrete

Objective: To ensure uniform placement and minimize segregation.

Key Concepts:

- **Discharge Techniques:** Direct placement, chutes, or pumps.
- **Avoiding Segregation:** Minimize free-fall and avoid excessive handling.

Steps for Discharging Concrete:

a. Position the equipment close to the placement area.
b. Adjust discharge height to reduce free-fall distance.
c. Spread concrete evenly within the formwork.
d. Monitor the process to ensure uniform distribution.

5.3 Compacting Concrete

Objective: To remove air pockets and ensure proper bonding of materials.

Key Concepts:

- **Methods of Compaction:** Hand rodding, tamping, or mechanical vibration.
- **Indicators of Proper Compaction:** Absence of air pockets, shiny surface.

Steps for Compacting Concrete:

a. Select appropriate compaction tools.
b. Apply compaction uniformly across the surface.
c. Avoid over-vibration to prevent segregation.
d. Inspect for visible signs of voids.

5.4 Application of Concrete Finish's

Objective: To enhance appearance and durability.

Key Concepts:

- **Types of Finish's:** Troweled, brushed, or patterned.
- **Timing:** Begin finishing before the concrete sets.

Steps for Applying Finish's:

a. Determine the desired finish type.
b. Use appropriate tools (e.g., trowels, brushes).
c. Apply the finish evenly.
d. Inspect the surface for uniformity and defects.

5.5 Curing of Concrete

Objective: To maintain moisture content for optimal strength development.

Key Concepts:

- **Methods:** Water curing, covering with wet burlap, or applying curing compounds.
- **Duration:** Typically, 7–28 days, depending on conditions.

Steps for Curing Concrete:

a. Choose a curing method based on site conditions.
b. Start curing immediately after finishing.
c. Maintain consistent moisture levels.
d. Inspect the surface regularly during the curing period.

5.6 Positioning and Installing Control Joints

Objective: To control cracking caused by shrinkage.

Key Concepts:

- **Types of Joints:** Sawed, formed, or tooled.
- **Placement Guidelines:** Typically, 24-36 times the slab thickness.

Steps for Installing Control Joints:

a. Mark joint locations on the slab.
b. Use appropriate tools to create joints.
c. Ensure joints are straight and uniform.
d. Inspect for alignment and depth accuracy.

5.7 Positioning Dowel Joints

Objective: To transfer loads across slab sections and prevent differential movement.

Key Concepts:

- **Dowels:** Steel bars placed at joints.
- **Placement:** Half-embedded in each slab.

Steps for Positioning Dowels:

a. Mark dowel locations.
b. Insert dowels at the specified intervals.
c. Align dowels parallel to the slab surface.
d. Secure dowels to prevent movement during pouring.

5.8 Covering and Protecting Concrete Surface

Objective: To prevent damage during initial curing and setting.

Key Concepts:

- **Protection Materials:** Plastic sheeting, mats, or wet burlap.
- **Preventive Measures:** Avoid premature drying and mechanical damage.

Steps for Covering and Protecting Concrete:

a. Select appropriate protective material.
b. Cover the surface immediately after finishing.
c. Secure the material to prevent displacement.
d. Inspect regularly for damage or drying out.

Self-Check 5

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. The primary purpose of compacting concrete is to remove _____ and ensure proper bonding.
2. _____ joints help control cracking caused by shrinkage.
3. During curing, it is essential to maintain _____ levels in the concrete.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

4. Which method is not used for transporting concrete?
   a. Wheelbarrows
   b. Pumps
   c. Hand mixers
   d. Chutes
5. What is the recommended action if concrete begins to set during discharge?
   a. Add water
   b. Increase vibration
   c. Place it immediately
   d. Discard it
6. Which of the following is a sign of proper compaction?
   a. Surface voids
   b. Shiny surface
   c. Excessive water pooling
   d. Uneven texture

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

7. Explain the importance of curing in concrete work.
8. List three common methods of applying Finishs to concrete surfaces.

Operation Sheet 5

Operation Title

- Compacting Concrete

Purpose

- To ensure proper density and remove voids from freshly placed concrete.

Conditions:

- Ambient temperature: 15–30°C.
- Concrete slump within design specifications.

Equipment, Tools, and Materials:

- Mechanical vibrator or tamping rod
- Safety gloves and goggles

Quality Criteria:

- No visible air pockets.
- Uniformly compacted surface.
- No signs of segregation or excessive bleeding.

Precautions:

- Avoid over-vibration.
- Ensure proper grounding of electrical equipment.

Steps in Doing the Task:

1. Inspect concrete consistency before starting compaction.
2. Insert the vibrator vertically and at regular intervals.
3. Limit vibration time to 5-15 seconds per point.
4. Move systematically across the surface.
5. Inspect the surface for uniformity after compaction.

Learning Activity Performance (LAP) Test 5

Practical Demonstration

Name. _____ **Date. _____**

Time Start_____ **Time Finish_____**

Time Allotted: 3 Hours

Instruction. Perform the following tasks accordingly.

Task 1. Compacting concrete

Unit Six. Stripping Precast Concrete Formwork and Cleanup

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

- Removing Edge Boxing and Braces
- De-nailing Timber Components
- Cleaning and Storing Formwork
- Oiling of Formwork
- Discarding Damaged Formwork Components
- Cleaning Up

This unit will also assist trainees to attain the learning outcomes stated below. Specifically, upon completion of this learning guide, the trainees will be able to.

- Remove edge boxing and braces safely and efficiently.
- De-nail timber components and prepare them for reuse or disposal.
- Clean and store formwork systematically to ensure durability & readiness for future use.
- Apply oil to formwork for protection and easier reuse.
- Identify and discard damaged formwork components properly.
- Maintain a clean and safe working area during the process.

6.1 Removing Edge Boxing and Braces

- Steps in the Task:
- ✓ Inspect the formwork to identify edge boxing and braces to be removed.
- ✓ Ensure that the concrete has cured sufficiently to support its weight without the formwork.
- ✓ Use appropriate tools such as hammers, pry bars, or wrenches to carefully detach braces and boxing without causing damage.
- ✓ Place removed components in a designated area for further processing.

Precautions:

- Always wear protective gear (gloves, safety glasses, hard hats).
- Avoid excessive force to prevent damage to the formwork or injury.
- Ensure that all braces and boxing are removed without leaving debris.

Quality Criteria:

- All edge boxing and braces are removed without damage.
- Components are sorted and placed in designated areas.

6.2 De-nailing Timber Components

Steps in the Task:

a. Collect timber components with nails after formwork removal.
b. Use a claw hammer or nail puller to extract nails from the timber.
c. Inspect the timber for any leftover nails or damage.
d. Separate reusable timber from damaged pieces.

Precautions:

- Use tools properly to avoid accidents.
- Dispose of nails in a designated container to prevent hazards.

Quality Criteria:

- All nails are removed completely.
- Timber is free of damage and ready for reuse.

6.3 Cleaning and Storing Formwork

Steps in the Task:

a. Remove excess concrete and debris from formwork using scrapers or wire brushes.
b. Wash the formwork with water and cleaning agents if necessary.
c. Allow the formwork to dry completely.
d. Stack formwork neatly in a dry and secure storage area.

Precautions:

- Handle formwork carefully to avoid damage.
- Ensure storage areas are clean and organized.

Quality Criteria:

- Formwork is free of concrete residue and stored appropriately.

6.4 Oiling of Formwork

Steps in the Task:

a. Select a suitable formwork oil and apply it evenly using brushes or sprayers.
b. Cover all surfaces that will be in contact with concrete during future use.
c. Allow the oil to soak in or dry as per the manufacturer's instructions.

Precautions:

- Use oil in a well-ventilated area.
- Avoid over-application, which can cause dripping and waste.

Quality Criteria:

- Formwork is evenly coated with oil.
- Surfaces are protected from sticking during future use.

6.5 Discarding Damaged Formwork Components

Steps in the Task:

a. Inspect all formwork components for cracks, warping, or significant wear.
b. Mark damaged components for disposal.
c. Transport damaged components to a designated disposal area.
d. Follow local waste management regulations for disposal.

Precautions:

- Ensure proper lifting techniques to avoid injury.
- Use protective gear while handling damaged materials.

Quality Criteria:

- Damaged components are identified and disposed of properly.
- Disposal complies with environmental regulations.

6.6 Cleanup

Steps in the Task:

a. Collect and sort tools, materials, and debris after formwork stripping.
b. Dispose of debris in designated waste bins.
c. Clean tools and store them in their designated locations.
d. Inspect the work area to ensure it is clean and safe.

Precautions:

- Wear gloves and other protective equipment during cleanup.
- Follow site waste disposal protocols.

Quality Criteria:

- Work area is clean and free of hazards.
- Tools and materials are stored appropriately.

Self-Check 6

Part I. Fill in the Blank Space

Direction. Complete the blank space with the most appropriate word, phrase, or information.

1. The process of _____ timber components ensures they are safe for reuse.
2. _____ should be applied to formwork to protect surfaces and prevent sticking.
3. Damaged formwork components must be _____ following local regulations.

Part II. Multiple Choice

Direction. Select the most accurate answer from the options provided.

4. What tool is most commonly used for de-nailing timber?
   a. Hammer
   b. Screwdriver
   c. Chisel
   d. Wrench
5. Why is it important to clean formwork after stripping?
   a. To reduce weight
   b. To remove concrete residue for reuse
   c. To make storage easier
   d. All of the above

Part III. Short Answer

Direction. Respond to the short answer questions below in a concise and relevant manner.

6. List two precautions to take when removing edge boxing and braces.
7. Why is it necessary to oil formwork before reuse?

Operation Sheet 6

Operation Title:

- Stripping Precast Concrete Formwork and Cleanup

Purpose:

- To safely and efficiently strip, clean, and prepare formwork for reuse or disposal.

Conditions for the Operation:

- Cured concrete ready for formwork removal.
- Proper tools and safety equipment available.
- Designated areas for cleaning, storage, and disposal.

Equipment, Tools, and Materials:

- Pry bars, hammers, nail pullers, scrapers
- Cleaning agents, brushes, formwork oil
- Protective gear (gloves, helmets, goggles)

Quality Criteria:

- Formwork components are free of debris and damage.
- Work area is clean and organized.
- Reusable components are properly stored.

Precautions:

- Adhere to safety protocols during all operations.
- Handle formwork carefully to avoid injuries and damage.

Steps in Doing the Task:

1. Inspect formwork and prepare tools and materials.
2. Remove edge boxing and braces safely.
3. De-nail and clean timber components.
4. Clean and store formwork systematically.
5. Oil formwork for protection.
6. Discard damaged components responsibly.
7. Perform a thorough cleanup of the work area.

Learning Activity Performance (LAP) Test 6

Practical Demonstration

Name. _____ **Date. _____**

Time Start_____ **Time Finish_____**

Time Allote.

Instruction. Perform the following tasks accordingly.

Task 1. Stripping Precast Concrete Formwork and Cleanup

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Video URL

- How Precast Concrete Is Made: This video provides a comprehensive overview of the precast concrete manufacturing process. [Watch here] (https://www.youtube.com/watch?v=8yoHltK1Naw)
- Amazing Modern Precast Concrete Manufacturing Process With Advanced Technology and Skillful Workers Showcasing modern techniques and technologies in precast concrete production. [Watch here] (https://www.youtube.com/watch?v=J-GdvMTL_SI)

- Innovative Precast Concrete Factory

An introduction to an innovative precast concrete factory and its production technology.

[Watch here] (https://www.youtube.com/watch?v=1Dd46UeVyHo)

- Learn How to Make Precast Concrete Walls and Building Elements

A tutorial on producing strong and reliable precast components for construction projects.

[Watch here] (https://www.youtube.com/watch?v=FaAgG7AwkRU)

- Automated Precast Concrete Factory Solutions Turning Buildings Into Products

Exploring the transformative power of automation in the precast concrete industry.

[Watch here] (https://www.youtube.com/watch?v=Hgjt3cv6oeU)

- The Incredible Chinese Factory Production of Precast Reinforced Concrete

A look into the production processes of precast reinforced concrete in a Chinese factory.

[Watch here] (https://www.youtube.com/watch?v=6KeT17z9Mls)

- Moulds for Precast Concrete Plants

An insight into the moulds used in precast concrete plants.

[Watch here] (https://www.youtube.com/watch?v=JZj-U0KhVt8)

- 8. Production of Solid Precast Concrete Elements at the New Plant in Germany

A detailed look at the production of solid precast concrete elements in a German plant.

[Watch here] (https://www.cpi-worldwide.com/cpi-tv/video/71708)

- The American Innovator - Japan Precast Concrete Factory Tour

A tour of a precast concrete factory in Japan, highlighting innovative practices.

[Watch here] (https://www.youtube.com/watch?v=mXyOex11qws)

- Precast Operations Showcase Featuring the ins and outs of precast concrete demonstrations from the World of Concrete event. [Watch here] (https://www.concreteconstruction.net/videos/precast-operations-showcase)

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