STRUCTURAL CONSTRUCTION WORKS

LEVEL – II

Based on March 2022 Version - I Curriculum

Module Title: - Erect Pre-Cast Concrete Structural &

Cladding Units

Module code: EIS SCW2 M07 0322

Nominal duration: 80 Hours

Prepared by: Ministry of Labor and Skill

August, 2022

Addis Ababa, Ethiopia

Table of Content

Acknowledgment

Ministry of Labor and Skills and Regional TVT Bureau wish to extend thanks and appreciation to the many representatives of TVT instructors and respective Ministry of Labor

and Skills experts who donated their time and experience to the development of this Teaching, Training and

Acronym

TTLM Learning Materials

AIA	Annual Investment Allowances
TTLM	Teaching, Training and Learning Materials
TVT	Technical and vocational Training
PVC	Polymerizing Vinyl Chloride
ACP	Aluminum composite panels

Introduction to the Module

In structural construction work; the Erect Pre-Cast Concrete Structural & Cladding Units module helps the trainee how to Erecting temporary propping members, precast concrete structural units and pre-cast concrete cladding. And it is also designed to meet the industry requirement under the structural construction work occupational standard, the knowledge, attitudes and skills required in Erect Pre-Cast Concrete Structural & Cladding Units

This module covers the units:

- Plan and prepare
- Erect precast concrete structural units
- Erect pre-cast concrete cladding
- Clean up

Learning Objective of the Module

- Plan and prepare
- Erect precast concrete structural units
- Erect pre-cast concrete cladding
- Clean up

Module Instruction

For effective use this modules trainees 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: Plan and prepare

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

- Work safe and healthy
- Work Information.
- Materials and components
- Tools and equipment
- Preparing form

This unit will also assist you to attain the learning outcomes stated below. Upon completion of this learning guide, you will be able to:

- Apply work safe and healthy
- Interpret Work Information.
- Select materials and components
- Identify tools and equipment
- Prepare form

1.1. Work safe and Healthy

1.1.1. Occupational Safety and Health

The word safety refers to your freedom from danger, injury and damage, and to your personal security.

1.1.2. What Safety Means

- Safety means a complete understanding of your work and knowledge of every step that must be taken and the realization that mistakes could be costly to yourself and to the company.
- Safety means good judgment. Never rely on luck; always be prepared to cope with unexpected situations and being alert when following your routine.
- Safety means remembering the safety rules set up by your company and applying them every minute when you are on the job.

1.1.3. Goals

- Maintaining a safe and healthy working environment.
- Preventing fatalities and lost time injuries.
- Preventing damage to the equipment, facilities and potential effects on progress.
- Eliminating risk to the environment.
- No fires. A Safe and Productive Project, in Scheduled time.

1.1.4. Safe Work Method

A written Safe Work Method for a job is prepared by the Safety Personnel in consultation with the concerned engineers. The Work Method helps to foresee the risk involved in the job, take precautionary action for the risk involved and plan the materials required for the safety cause. The safe work method is methodically done as followed:

a. Approach Safety.

b. Work Method Safety.

c. Work area Safety.

d. Men Material and Machinery.

Factors that Contribute to the Occurrence of Accidents in the Construction

Industry:

1. Fall from heights is the predominant causes of accidents
2. Lack of supervision for workers working at heights
3. Workers lack awareness on OSH
4. Workers have limited trainings
5. Due to lack of training, workers

a. Build improper temporary structures

b. Tolerate improperly guarded floors

c. Work with unstable/unsecured/scaffolds

6. Accident reports lack relevant information
7. Proper investigations are hardly conducted

1.2. Work Information

Work Instructions are documents that clearly and precisely describe the correct way to perform certain tasks that may cause inconvenience or damage if not done in the established manner. That is, describe, dictate or stipulate the steps that must be followed to correctly perform any specific activity or work.
A document describing specific activities and tasks within the organization. It contains the greatest amount of detail.

As a component of a process, "defines how one or more activities in a procedure should be executed in detail, using technology or other resources.

Here are some examples of documented work instructions which may be found on a typical construction site:

- ✓ Working Drawings issued for construction such as Plans, elevations, sections etc.
- ✓ Specifications/Contract specifications
- ✓ Construction method statements
- ✓ Quality requirements

- ✓ Operational details
- ✓ Maintenance manuals

1.3. Materials and components

Building materials have an important role to play in this modern age of technology. Although their most important use is in construction activities, no field of engineering is conceivable without their use. Also, the building materials industry is an important contributor in our national economy as its output governs both the rate and the quality of construction work.

There are certain general factors which affect the choice of materials for a particular scheme.

Perhaps the most important of these is the climatic background. Obviously, different materials and forms of construction have developed in different parts of the world as a result of climatic differences. Another factor is the economic aspect of the choice of materials. The rapid advance of constructional methods, the increasing introduction of mechanical tools and plants, and changes in the organization of the building industry may appreciably influence the choice of materials.

Due to the great diversity in the usage of buildings and installations and the various processes of production, a great variety of requirements are placed upon building materials calling for a very wide range of their properties: strength at low and high temperatures, resistance to ordinary water and sea water, acids and alkalis etc. Also, materials for interior decoration of residential and public buildings, gardens and parks, etc. should be, by their very purpose, pleasant to the eye, durable and strong. Specific properties of building materials serve as a basis for subdividing them into separate groups. For example, mineral binding materials are subdivided into air and hydraulic-setting varieties. The principal properties of building materials predetermine their applications. Only a comprehensive knowledge of the properties of materials allows a rational choice of materials for specific service conditions.

1.3.1. Cementing Materials

In a general sense, these are materials with adhesive and cohesive properties and are capable of uniting or bonding solid particles together. This definition covers a large number of very different substances.

For engineering purposes the meaning of the term cement is restricted to one group of adhesive substances, namely, to those materials which when mixed with water form paste. The paste is temporarily plastic and may be molded or deformed. But later it sets and hardens to a rigid mass. Cements of this king are known as calcareous cements whose principal constituents are compounds of lime that might include certain allied compounds of magnesium.

Calcareous cements can be classified as Non-hydraulic and Hydraulic. Non-hydraulic cements are cements which are not able to set and harden in water (e.g. non-hydraulic lime) or which are not stable in water (e.g. gypsum plasters). Hydraulic cements are cements that are able to set and harden in water, and give a solid mass that does not disintegrate, i.e., remain stable in water (e.g. Portland cement).

Therefore, lime, gypsum and Portland cement are the cementing materials in building construction and engineering works.

i. Cement

Cement is the binder in mortar and concrete. It is usually supplied in bags of 25kg or 50kg and should be marked ISI. Do not use cement older than three months as it has lost some of its strength. Cement bags should be carefully handled and kept dry at all times. Bags should be stored dry and in a well-ventilated room, thereby avoiding moisture.

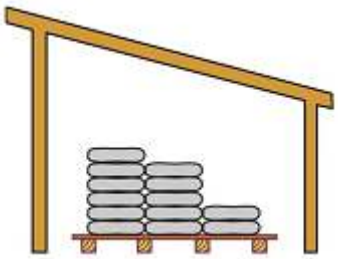

Fig.1.1. storing of cement

Cement deteriorates with time and should therefore only be purchased just before it is to be used. The oldest cement in the store should be used first.

The reduction of strength in a standard 1:2:4 mix as a result of storage is shown in the table below.

Age of Cement	Reduction in Strength
3 Months	20%
6 Months	30%
12 Months	40%
24 Months	50%

Table: 1.1. Reduction of strength of cement

ii. Lime

It is found in its natural form as a rock of varying degree of hardness. It is mainly composed of calcium oxide (CaO). However, lime deposits are generally found mixed with impurities such as CO2, Fe2O3, and MgCO3. Depending on the impurities lime deposits acquire different colors.

iii. Sand

Sand is used when mixing mortar and concrete. Mortar is a mixture of sand, cement and water while concrete consists of cement, sand, stone and water. The sand should be:

- Clean - free from dirt and organic material
- Containing a limited amount of clay (not more than 8%)
- Grains should be of a certain size, not bigger than 2.36mm and not smaller than 0.15mm. Use a sieve to separate larger particles and debris.
- Beach sand should never be used for mortar and concrete as it contains salt. Salty water reduces the strength of concrete.
- Quarry dust may be used in places where sand is not available for certain purposes, e.g. cement mortar.

Fig.1.2. sand

iv. Stone

Stone of different sizes is a key ingredient in concrete, providing its compressive strength. Stone should be clean, free from dirt, clay, organic material and dust. Two sizes of stones are commonly used:

- Fine = 12.5mm to 20mm
- Coarse = 25mm to 40mm

Fig.1.3. Agregate

v. Water

Water is a key ingredient in mortar and concrete. It is also essential for curing mortar and concrete.

- ❖ Water should be clean. It can be taken from rivers, lakes, wells and taps.
- ❖ Salt water, surface run-off water and water with other chemical or organic impurities should never be used.
- ❖ Dirty water with organic particles can be poured into a drum and used once such particles have settled at the bottom (use only the clean upper part of the water).
- ❖ Water on site is best kept in drums.

1.4. Tools and equipment

1.4.1 Tools

Common Masonry Tools used in Masonry Construction

01. Trowel

The basic masonry trowel is made up of stainless steel with a plastic/ wooden handle. The ends of trowel may be bull nosed or pointed. This is used to lift and spread mortar in joints during masonry construction. There are different kinds and sizes of trowels used in masonry work.

Fig.1.4. Trowel

02. Corner Trowel

It is one of the common modifications of the basic trowel. It is used for shaping corners of the wall. They are two types of Corner Trowel.

(A) Outside Corner Trowel

(B) Inside Corner Trowel

These are more common than the outside corner trowel, just because corner aid is used on the outside corners. They have standard features, comparable to an outside corner tool but also have adjustable models that can get wider or narrower, depending on the angle of the corner.

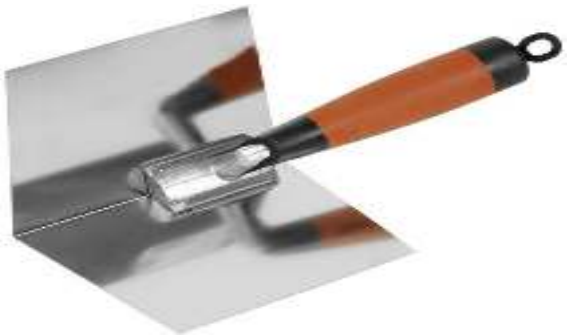

Fig.1.5. Corner Trowel

03. Setting Out Square or Mason Square

It is used to set out right angles at the corner of masonry wall. This is very important and basic tool used in masonry work. This tool has “L” shape. It is made of flat steel having each arm about 0.5 m long

Fig.1.6. Mason Square

04. Plumb Rule and Bob

This basic masonry tool is used to check the verticality of walls. It consists of a string tied to a weight at bottom called bob and straight wood board with uniform edges called plumb rule. On its center a groove is provided in which plumb bob is placed. When the rule is placed vertically with the wall, the plumb bob must be in the groove line indicating the perfect vertical wall. If the plumb bol does not fall on the groove line, the wall will not be vertical.

Fig.1.7. plumb bob

05. Spirit Level

It is used to check the horizontality and verticality of the surfaces. Spirit level is made of hard plastic or wood with bubble tube in the middle. The bubble tube is partially filled with alcohol in such a way that, an air bubble is formed in it. The spirit level is placed on surface of masonry wall and bubble is checked. The surface is called leveled when the bubble in the tube settles at middle of tube

Fig.1.8. Spirit level

06. Water Level

It is used to transfer and check level. It is a simple tool to measure the level at two different points. It is a tool that works on the principle that water always seeks its own level. It consists of flexible tube with liquid, and the liquid at both ends will be at the same level whether you're holding them together or spreading them a hundred feet apart.

Fig.1.9. Water Level

07. Tape measure

Tape measure is helps to measure distance or length. There are various type of tape measure exist. The most common length of tape measure used for setting out are5m,30m and 50m.

Fig.1.10. Tape measure

08. String/mason line/ fish line- Is rope used to transfer vertical and horizontal alignment or lines

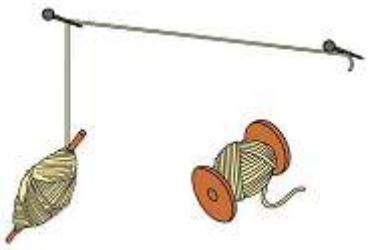

Fig.1.11. String/mason line

9. Floats: The steel plate which is sandwiched between the timbers in a flitch beam. Float A flat tool with a handle on the back; used on cement or plaster surfaces for smoothing or for producing textured surfaces. Also see angle float, bull float, carpet float, rotary float.

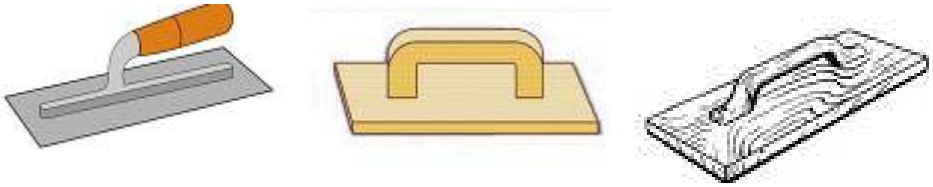

Fig.1.12. Float

10. Bucket: An attachment for a materials-handling or excavating machine that digs or carries loose materials such as earth, gravel, stone, or concrete; may be shaped like a scoop, with provision for opening and closing for convenience in unloading.

Water bucket: - Used to transport measured quantity of water to hand mixing place in the construction site and can also be used for transporting concrete mix to working area.

Fig1.13. Bucket

1.4.2. Equipment

1. Wheelbarrows

The wheelbarrow is a useful piece of transport equipment for short distances (up to 200meters).

Wheelbarrows are used for earth and concrete works, transporting construction materials such as soil, gravel, sand, aggregate, stone, concrete, etc. Wheelbarrows are made in many different types and qualities. A good wheelbarrow should be able to take a big load (struck capacity approximately 60 to 70 liters) and be easy to balance and tip. A wheelbarrow consists of a body or tray that rests on a chassis with attached handles, a wheel and legs. The chassis is normally made from tubular steel, although

It is a small cart with a single wheel at the front and two supporting legs and two handles at the rear, used typically for carrying loads in building work or gardening.

A wheelbarrow is a metal, wood or plastic transportation device that has one wheel, a bucket (barrow) and two handles. The modern user of the wheelbarrow lifts up the handles and pushes the device forward, using the wheel to lighten the load. Wheelbarrows may be used to transport garden soil.

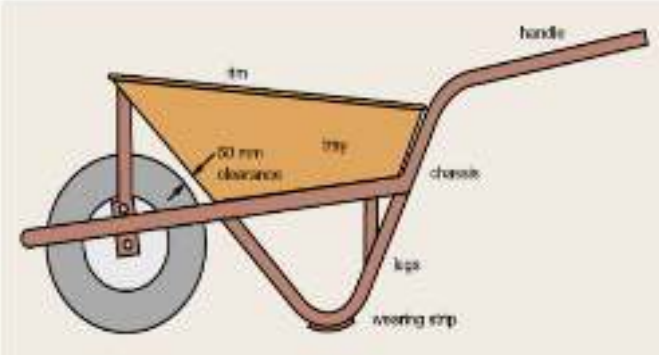

Fig.1.14. wheelbarrows

2. Concrete/ Mortar Mixer

Concrete mixers are available in from of different capacities. Small mixers can produce 250Lit. of mortar or concrete and the big ones produces more and more, up to 6000Lit.; widely used, small mixers up to a capacity of 1000Lit. Mixers are driven with diesel, benzene engine or electrical power.

They can be distinguished into

Free-fall or gravity mixer consists from a rotating drum with metal blades inside

Compulsory mixer, here is the drum fixed and the blades alone are rotating Mixer 250 lit

Fig.1.15. Mixer 250 lit

1.5. Preparing form

1.5.1. Formwork

When concrete is placed, it is in a plastic stage and requires to be supported by temporary supports and casing of the desired shape till it becomes sufficiently strong to support its own weight. This temporary casing is known as formwork or shuttering. The term mold is sometimes used to indicate formwork for relatively small units such as lintels, cornices, etc.

Formwork: - Temporary structure required to safely support concrete until it reaches adequate strength

False work

False work is any temporary structure used to support the forms for concrete. False work supports the forms until the concrete can support itself. It must be strong enough to support the weight of the forms, the fresh concrete and any construction equipment and workers. False work may be equipped with hydraulic jacks, wedges and other approved devices.

Basic objectives in form building are:

1. Quality − In terms of strength, rigidity, position, and dimensions of the forms
2. Safety − for both the workers and the concrete structure
3. Economy − the least cost consistent with quality and safety requirements

Cooperation and coordination between engineer/architect and the contractor are necessary to achieve these goals. Economy is a major concern since formwork costs constitute up to 60 percent of the total cost of concrete work in a project

1.5.2. Types of formwork

Formwork materials can be generally classified as

- ✓ Timber /eg. Solid wood, plywood
- ✓ Metals / eg. Steel, Aluminum
- ✓ Plastics

❖ **Timber Formwork**

Timber used for the formwork should satisfy the following requirements:

- ✓ It should be well seasoned.
- ✓ It should be light in weight.
- ✓ It should be easily workable with nails without splitting, and
- ✓ It should be free from knots

Timber used for shuttering exposed concrete work should have smooth and even surface on all faces, which are to come in contact with concrete. In situations where concrete surfaces are not exposed as in the case of foundations, undressed timber can be used.

Use of plywood instead of timber planks is getting popular these days. In this case resin bonded plywood sheets are attached to timber frames to make up panels of required sizes. The panels thus formed can easily be assembled by bolting in the form of shuttering. This types of shuttering ensures quality surface finish and is especially recommended in works where large exposed areas of the concrete are to be constructed such as floor slab, faces of retaining walls, etc. Generally, the number of reuses of plywood formwork is more as compared with timber shuttering.

Timber for form-work should be neither too dry nor too wet. If the timber is too dry, it will absorb water from the wet concrete and swell and may be distorted or decayed. On the other hand, if it is too wet, shrinkage may result especially moisture content of timber. The normal moisture content of timber used for form-work should be 20 percent.

Advantages of Timber Formwork

- ✓ It is relatively cheap.
- ✓ It is more economical than steel where work is non-repetitive.
- ✓ It can be found locally.

Disadvantages of Timber Formwork

- ✓ It is susceptible to insect and fungal attack.
- ✓ It warps, especially when it is not well seasoned.
- ✓ It is not good for repetitive work.

Fig.1.16. Timber formwork

- **Plywood Formwork**

The use of plywood in concrete forming for form facing has improved the quality of finished concrete.

•The relatively large sheets of plywood have reduced the cost of building and at the same time have provided smooth surfaces that reduce cost of finishing of concrete surfaces.

Plywood is a manufactured wood product consisting a number of veneer sheets, or plies. Type of plywood can be grouped as exterior and interior. For formwork the exterior plywood is used. Adhesive used to bond the piles in manufacturing of exterior plywood is watertight and gives maximum number of reuses.

Fig.1.17. Plywood formwork

- **Metal Formwork**

The initial cost of metal formwork is more than timber formwork but the lumber of reuses of metal formwork is higher than that of timber. In long run metal formwork can be economical.

İn heavy construction works metal formwork may require a lifting mechanism to handle the formwork panels or props

- **Steel Formwork**

This consists of panels fabricated out of thin steel plates stiffened along the edges by small steel angles. The panels can be fabricated in large numbers in any desired modular shape or size. Although steel shuttering costs more initially, it may work out to be economical in the long run due to its large number of re-uses of the same shuttering. Steel formworks are available in the market on rental basis.

Advantages of Steel Formwork

- It is durable and can be used as many times as necessary.
- It gives smooth finish.
- It is not liable to warp.
- It is more economical than timber where repetitive work is necessary.

Disadvantages of Steel Formwork

- ✓ The initial outlay of money is great.
- ✓ It is easily dented.
- ✓ It rusts under humid conditions.

Steel sheet formwork has the problem of rusting also. To avoid rusting, in every use the surfaces should be oiled with an appropriate releasing agent. In metal formwork usage, the metal sheets are prepared as panels of standard sizes. This brings the difficulties of erecting irregular dimensions of formwork.

Steel or aluminum or magnesium is the most widely used metals.

Fig.1.18. Metal formwork

❖ **Aluminum formwork**

- Pure aluminum chemically attacked by wet concrete
- Light weight allow larger forming units
- High reuse value

❖ **Plastics form work**

They have impervious surfaces that usually create a smooth finish to the concrete. • Plastic formwork could be reinforced or unreinforced. Plastic is reinforced by glass fibers. Reinforced plastics are specially produced for a specific formwork type. Un-reinforced plastics are produced in sheet form with smooth or textured surfaces. • Plastic formwork is lighter but less durable than metal formwork.

Fig1.19. Plastic Formwork

Among the advantages of plastic formwork are as follow:

a) Very useful for complex shape and special features
b) Easy to disassemble
c) Light (not heavy)
d) Damages on the formwork can be easily be repaired

Among the disadvantages of glass reinforced plastic formwork are as follow:

a) Expensive at first

Formwork For beam

- Grade beam
- Tie beam

A beam formwork consists of a three-sided box which is supported by cross members called head trees which are propped to the underside of the soffit board. In the case of framed buildings, the beam box is provided by the column form. The soffit board should be thicker than the beam sides since this member will carry the dead load until the beam has gained sufficient strength to be self-supporting. Soffit boards should be fixed inside the beam sides so that the latter can be removed at an early date, this will enable a flow of air to pass around the new concrete to speed up the hardening process and also releasing the form work for reuse at the earliest possible time. Generally the beam form is also used to support the slab form work and the two structural members are then cast together.

Fig1.20.Beam Formwork

Slab Formwork

Floors require a large area of formwork to be provided usually from beam to beam. Timber floor formwork consists of timber boards or plywood sheets supported on a framework and resting on a series of timber joists. Again timber and metal props can be used for vertical supports. Metal panels can be used and bolted or clipped together and held in place by a system of metal beams or a tabular scaffold system. Adjustable props need for leveling purposes

Fig.1.21. Steel Form Work for Slab

Fig.1.22.Wood formwork

Fig.1.23. Beam and Slab Formwork

Formwork For stair

In constructing formwork for stairs, the landing is first set in position. The process for constructing the formwork for the landing is the same as that of floors.

After the landing has been set, two strings are tied to the landing and grounds (or upper) floor maintaining the width and the inclination of the flight. The soffit (50 mm thick) is most often prefabricated, especially when the flight is short. The soffit boards are held underneath by timber measuring 100 mm x 75 mm placed at 300 mm centers. The prefabricated soffit is raised and its position checked with strings.

The stringers are set in position, on these boards, the positions for the tread and risers are marked off with chalk. The face boards for risers are cut to the required height. They are then nailed to the stringers and are supported by cleats.

Braces are nailed to the side boards and to the protruding part of bearer. These prevent the side boards from falling apart when concrete is poured on due to vibration.

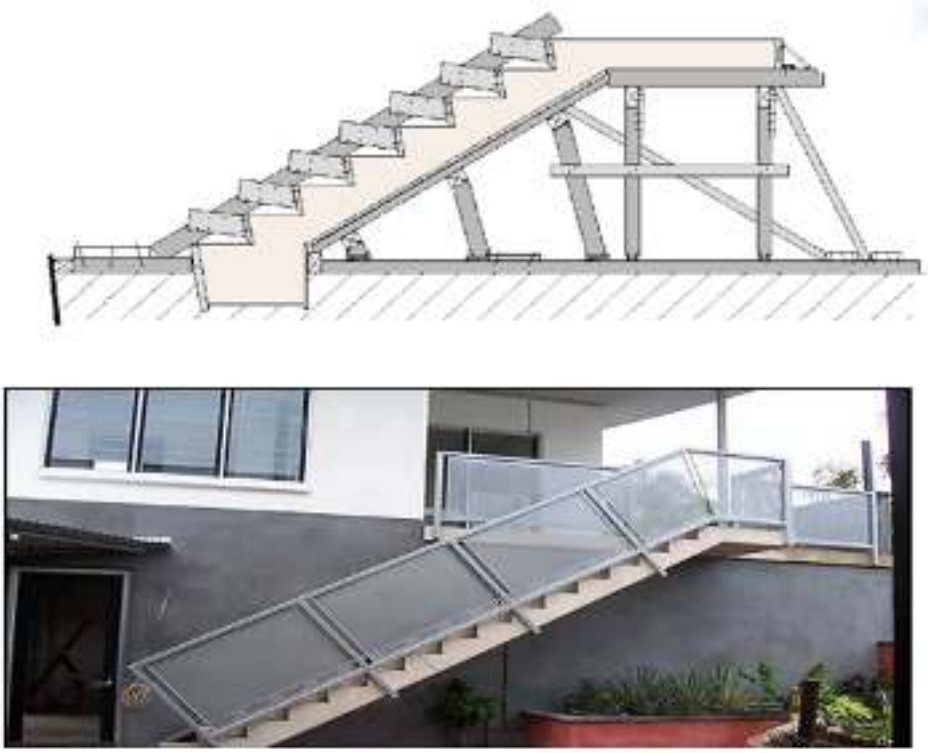

Fig.1.24. Steel stair formwork

Fig.1.25. Timber stair formwork

Column Formwork

Column is the main supporting structural member of any building. Column: Column is defined as compression member which has an effective length greater than its least lateral dimension

Column formwork is made usually with either timber or metal panels. The principle is to create an enclosed box with frames at the exact size of the column and fix it tightly on the kicker left from base or at the last stage of column concreting. The box is held in position by steel column clamps or bolted yokes and supported by timber studs or props

Form-work for column consists of vertical board called sheeting, cleats, wedge and yokes. Usually the boards are 25 mm thick. The width of the boards may vary depending on the section of the column. Boards internal dimensions are normally constructed the same size as the external dimensions of the columns. In large column, boards up to 32 mm thick are used. The cleats used at the base of the box are larger so as to withstand the pressure which is exerted by the weight of the concrete.

Fig.1.26. column formwork

Self-Check 1	**Multiple choice**

Instruction: Select the best answer and encircle the letter

1. One of the following is not the classification of Formwork materials

   A/Timber

   B/Metals

   C/Plastics

   D/ None of the above are correct

2. One of the following is not the disadvantage of Steel Formwork

   A/The initial outlay of money is great.

   B/It is easily dented.

   C/It rusts under humid conditions.

   D/ None of the above are correct

3. After six month age Reduction in Strength of Cement will be

   A/20%

   B/30%

   C/40%

   D/50%

4. Why we store our material properly?

   A/ To prevent from thief

   B/ To manage it properly

   C/ To avoid wastage of material

   D/All of the above

Note:

- **Satisfactory rating – above 3 points**
- **Unsatisfactory - below 3 points**

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. What is the purpose of Personal Safety?

2. Write down at least three disadvantages of Timber Formwork
3. What is the advantage of bucket?

Operation Sheet 1

Operation Title	Preparing Work Area

Purpose:- To apply quality work and health care

Instruction: - Using the right tools to perform your task within the given time. You have

given 10Minut for the task.

Equipment and Tools

- Shovel
- Chisel
- Brooms
- Concrete Saw
- Hammer
- Drill
- Cleaning Materials

precaution:-

- ✓ Safe working area environment
- ✓ Ensure the work area hazard free
- ✓ Avoid horse play
- ✓ Availability of proper tools and equipment

PROCEDURE,

1. Wear your PPE properly.
2. Secure workshop manuals, Specifications, tools and equipment.
3. Sort different tools and materials based on their size and kind.
4. Select appropriate way of house cleaning.
5. Identify and prepare resources and technical requirements for Carry-out Concrete Bursting
6. Observe the proper application of Occupational Health and Safety requirements.

Quality Criteria: Assured to follow the kaizen principle

LAP Test 1	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 min.

Task 1: Prepare Work Area

Unit Two: Erect precast concrete structural units

This unit to provide you the necessary information regarding the following content coverage and topics:

- Positioning structural units
- Fixing structural units
- Erecting temporary prop
- Erecting pre-cast structural units

This guide will also assist you to attain the learning outcomes stated below. Upon completion of this learning guide, you will be able to:

- Apply positioning structural units
- Fix structural units.
- Apply erect temporary prop
- Erect pre-cast structural units

2.1. Positioning structural units

2.1.1. Locating reinforcement material in formwork and placed on bar chairs/spacers

❖ **Placing of Reinforcement**

Reinforcement shall be accurately placed and adequately supported before concrete is placed, and shall be secured against displacement.

Steel shall be free from all loose rust, grease, tar, paint, oil, mud, mill scale or other coating which would tend to destroy its bond with the concrete. All reinforcing bars shall be bent as shown on the

Drawings and shall be placed accurately and be well secured by tie wiring or welding where permitted so that no displacement can occur during placing of concrete. The specified clear cover shall be maintained. Tie wire of at least 18 s.w.g. soft iron wire shall be bent inwards or cut off.

Bar chairs of 25 MPA concrete or other material approved by the Superintendent shall be used to space and support the reinforcing bars; galvanized steel chairs shall not be permitted.

Bending and splicing of reinforcing shall be carried out as required by AS 3600. Splices shall be of length sufficient to fully develop the capacity of the bars.

A. Locating and securing cast-ins

❖ **Stairs cover.**

When you pour stairs be careful to see that all reinforcing bars have adequate concrete

Stair Details A complete set of stair details includes a section or elevation together with a plan view of each stairway. Details of tread construction and handrail construction may be included.

Checklist: Stairs

1. Check building requirements
2. Check required loading, dimensions and clearances
3. Material inductions
4. Width of tread, number of risers, height of rises
5. Direction of travel (in stair plan arrows with notation" up " and "dawn" are used to show stair direction)
6. Hand rails, balustrades, railing
7. Grade elevation of landing
8. Structural coordination and feature of stair and other
9. Parts further magnified I stair details
    a) Landing to wall connection
    b) Stair to foundation and floor connection
    c) Stair to upper floor connection
    d) Foundation of two flight
    e) Handrails to balustrade connection
    f) Balustrade to stair connection.

Typical detail of two-span stairs

A. First span stair

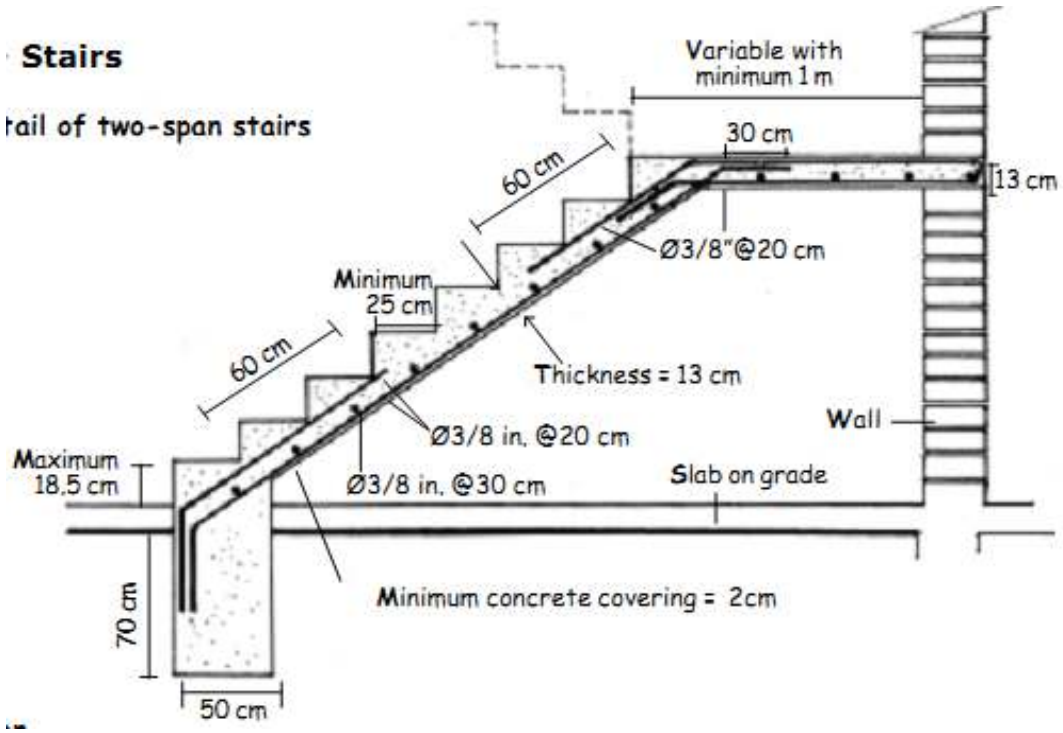

Fig.2.5.First span stair

B. Second span Stair

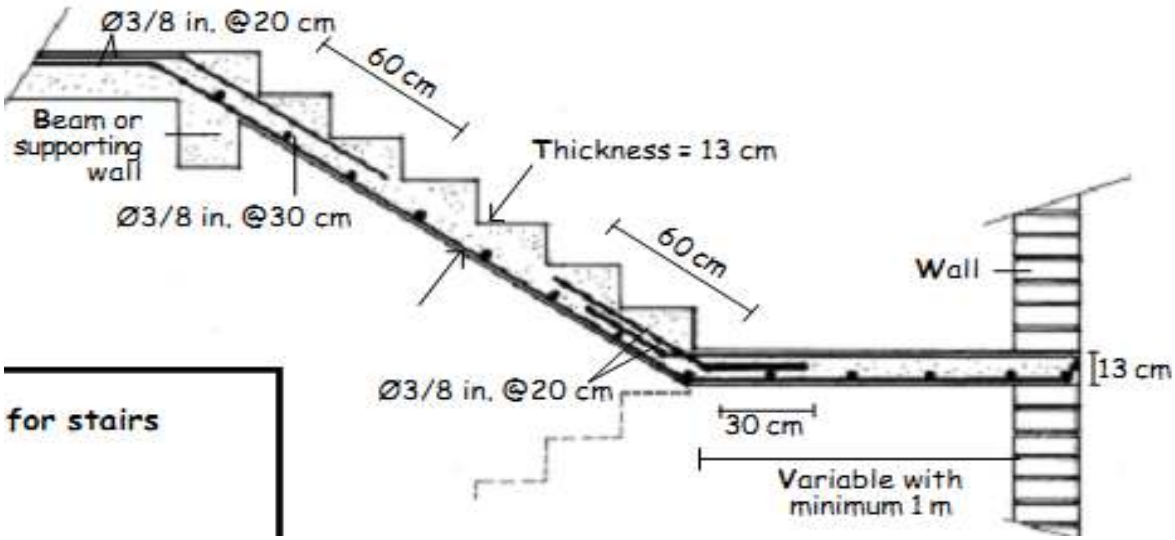

Fig.2.6a. Second span stair

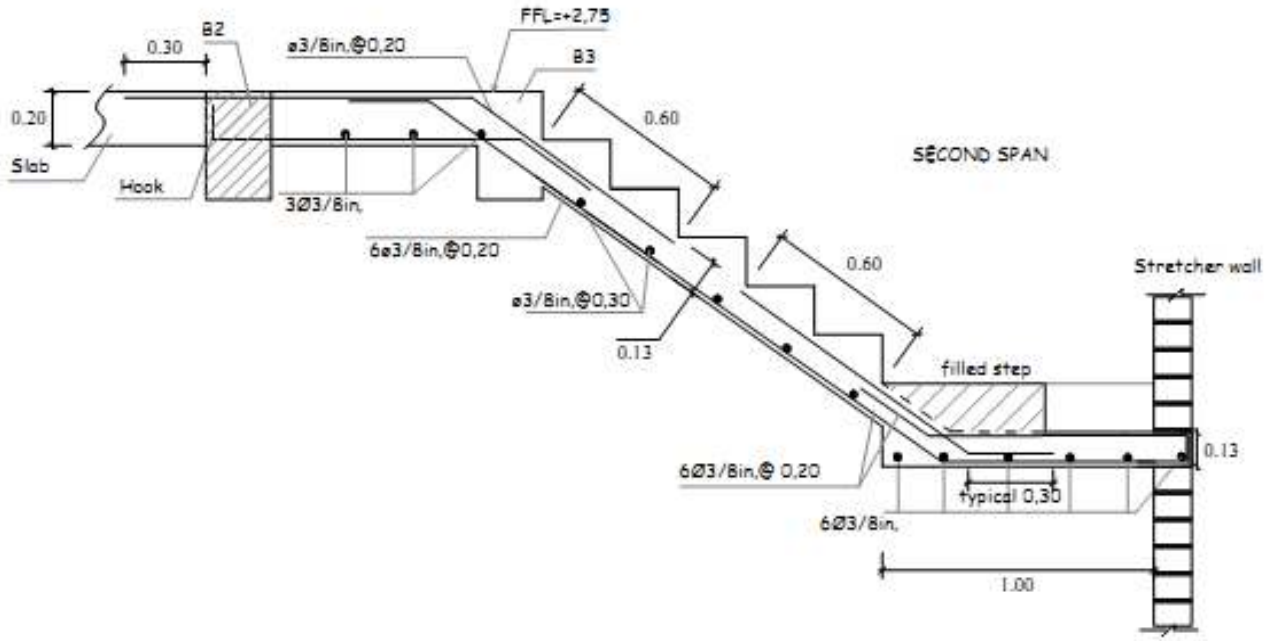

Fig.2.6b. Second span stair

Fig.2.7a. precast stair

Fig.2.7b.Installed precast stair

2.2. Fixing structural units

2.2.1. Installation, Connections, and Finishes

Concrete weighs about 150 pounds per cubic foot, so precast items are heavy. For instance, a full-sandwich panel that is 10-by-20-feet by eight inches thick (with a three inch void for insulation) weighs more than six tons. Cranes and other lifting equipment should be appropriately sized to handle the panels. Tight quality control of dimensions allows panels to be erected quickly at the site with only a minimum of field adjustments.

Sandwich panels are bolted to the footing or slab. The panel must be placed, leveled, and plumbed before the attachment is made. It must be braced during this time. Generally, the brace remains in place until the panel is connected to neighboring panels which complete the structure and provide support. Hollow core panels are attached to dowels in the footing or slab and the core is grouted to create a column that ties the wall structurally to the base.

Connections between panels are made either by grout columns (hollow core slabs) or by bolting or welding plates cast with the concrete. Bolted joints should be finished by caulking with a sealant to seal the building enclosure and protect the steel connections from rusting

Fig. 2.8 fixing precast

2.2.2. Tying /fixing fabric and bars

Fixing reinforcement in place/position

- Having stored cut and bent steel, transport and fix it in the correct designed place.
- Before fixing it needs to be clean. Slight rusting does not harm but any loose flaky rust and other surface material such as paint, mud and oil need to be removed.
- Ensure that bars placed in the correct position

I.Tying

- It is normally carried out by using 1 – 1.5 mm diameter black wire, care being taken to select the approximate sizes.

- Loose ends of the tie must be either be cut off or bent so that they can not cause any harm by rusting and showing through the concrete face.
- Possibly the mesh (cape) can be welded together according to the specification given on the contract document instead of using tying wire.

❖ **Slash**

Slash, simple or snap ties are the most commonly used infill ties. Often the wire ties are doubled for added strength

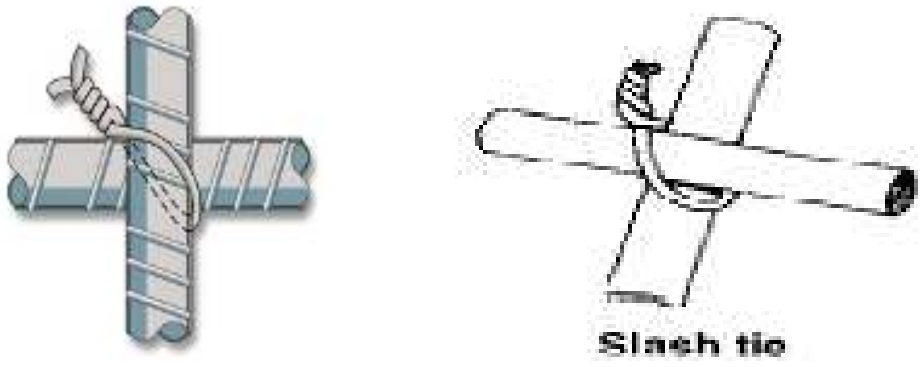

Fig.2.9. Slash

❖ Ring-slash or wall ties

Ring-slash or wall ties prevent bar displacement and are often used to tie smooth stirrups to main deformed bars

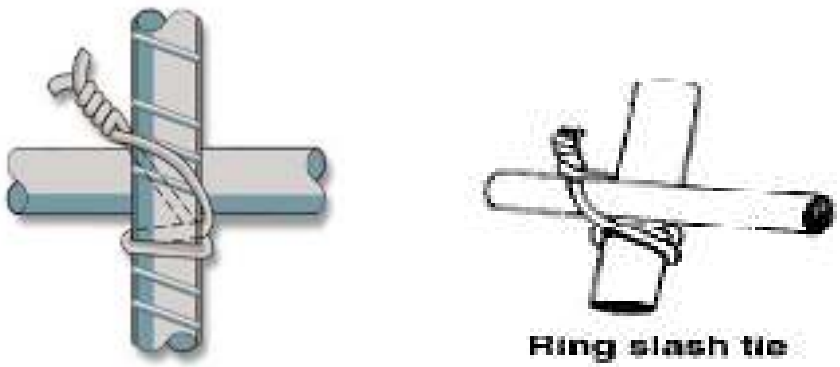

Fig.2.10. Ring-slash or wall ties

These ring ties are useful for preventing movement of vertical or horizontal bars.And it also holds a bar ancharage upright .

When making ring ties there are two golden rules

3. Always go around the far bar first
4. Start on the opposite side to the side where the ring should go ,ie,if the ring is riquired on the left of the vertical bar begin on the right of the unit

❖ Hair Pin Tie

The hair pin or saddle tie, the most secure tie used on all good work for fixing key bars and setting the work securely, before infilling.

A most secure tie used on column, beams and for tying key bars before infilling

Fig2.11. Hair Pin Tie

❖ Crown tie, cross tie or figure-eight tie

Crown tie, cross tie or figure-eight tie is a common tie used on main bars for setting up and tying springy bars.

Fig.2.12. Crown tie, cross tie or figure-eight tie

❖ **Splice Tie**

The splice tie, is used exactly as the name indicates for joining laps of splices in bars. It is in fact, exactly the same as the crown tie. And as the same useful qualities

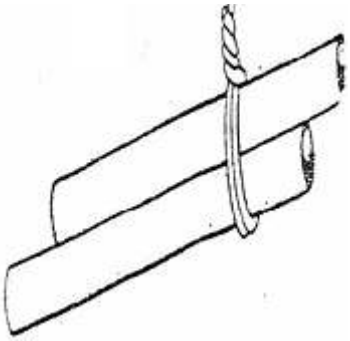

Fig.2.13. Splice Tie

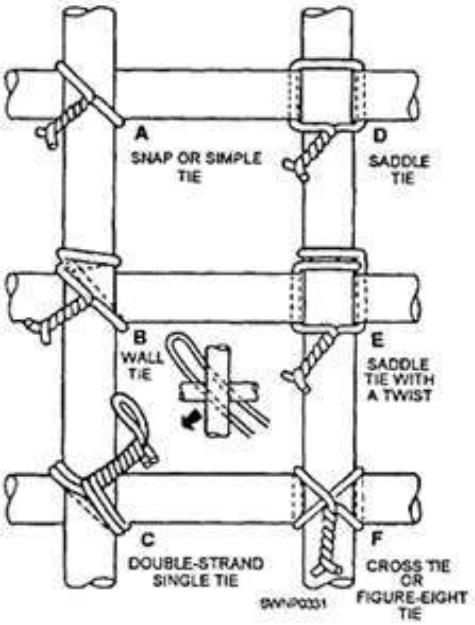

Fig.2.14. Six Types of Ties.

2.3. Erecting temporary prop

All temporary propping requirements must be shown on the erection drawings. The design of temporary propping systems should be in accordance applicable codes. Temporary propping should provide full support for all construction loads.

Where the element requires propping, that requirement should be noted on the shop drawings. Support details for precast elements include temporary shims, rubber or plastic bearing pads, leveling bolts or mortar pads.

Direct concrete to concrete, or concrete to steel bearing should be avoided unless some edge spelling and cracking is acceptable.

Precast floors exposed to the sun (for example the top levels of car parking buildings) require special consideration as the long term effects of thermally induced movements can cause severe spilling at the support.

Permanent grouting or mortar packing of precast concrete support points requires care and supervision to ensure that the requirements for strength and durability are met.

Propping and Support Details

Props are required for a variety of reasons to:-

- Reduce the self-weight deflection of precast flooring systems while the cast-in-place topping concrete is placed and cured;
- Provide temporary gravity load support during construction. For example, where seating lengths are less than the specified minimum, or where the connection requires cast-in-place concrete or welding to provide permanent support;
- Resist wind loads and accidental side loads during erection
- Prevent tensional instability or rotation of beams loaded along one edge
- Provide fine adjustment of the precast element to the correct level while freeing the crane quickly for the next lift; and
- Support temporary construction loads that exceed the design capacity of any part of the structure.

Temporary bracing

- Wherever possible bracing should be fixed to the element before lifting.
- When it is necessary to attach the braces after the element has been positioned, the element should be held safely by the crane whilst the braces are installed on the upper face by the use of a ladder or alternative access system.
- Generally, a minimum of two braces should be used for all elements.

Where elements can be effectively coupled together one central brace to resist rotation or toppling may be sufficient subject to design by a registered engineer.

- Braces shall be attached to a flat surface which is capable of withstanding the applied load.

- Bracing bolts should be checked at regular intervals and immediately after any occurrence such as an earthquake or storm.

Note: All equipment used in conjunction with the handling, transportation and erection of a precast element must be maintained to a high standard and be suitable for its intended use.

Fig.2.15.1.Erecting temporary prop

Fig.2.15. 2.Erecting temporary prop

2.4. Erecting pre-cast structural units

Erection of the structural components in prefabricated structures plays the important part in the construction of the building. ′ The erection process includes the erection of horizontal members, vertical members or complete unit. ′ To ensure effective and quality installation proper planning and preparatory works are required before the erection. It includes:-

i. Method and sequence of assembly and erection
ii. Method of providing temporary supports
iii. Erection tolerance
iv. Handling and rigging requirements

Erection plan: The erection plan, which is normally developed by a registered professional engineer, is used to establish the size and location of cranes, the location of delivery trucks, and the sequence of erection

Assembly plans: - Assembly plans are similar to erection plans, except they are more detailed and they include time components for element installation and placements of concretes or grouts. ′ It is recommended that project specifications require the submission of an assembly plan. Assembly plan includes ′ Drawings depicting the assembly procedures. The plan should be prepared by a registered Professional engineer. ′ A work area plan, depicting items such as utilities overhead and below the work area, drainage inlet structures, and protective measures. ′ Details of all equipment that will be employed for the assembly of the structure. ′ Details of all equipment to be used to lift elements, including cranes, excavators, lifting slings, sling hooks, and jacks. Include crane locations, operation radii, and lifting calculations. ′ Detailed sequence of construction and a timeline for all operations. Account for setting and cure time for grouts, mechanical connections, and concrete closure pours ′ Calculations for all aspects of the assembly plan including, erection calculations, crane capacities, rigging calculations, temporary false work and framing, and element handling stresses. The calculations should be prepared by a registered Professional engineer ′ Methods of providing temporary support of the elements. Include methods of adjusting and securing the element after placement.

Procedures for controlling tolerance limits: both horizontal and vertical. Include details of any alignment jigs, including templates for projecting anchors and dowels.

A detailed installation procedure for connecting mechanical connectors

- Including grouting procedures
- Include methods for curing grout and closure pour concrete.
- Proposed methods for installing non- shrink grout and the sequence and equipment for the grouting operation.
- Methods for placement of fill materials.
- Methods for forming and sealing closure pour.
- Methods and equipment for installation of post-tensioning systems, including stressing and grouting procedures.

Preparatory work

- ❖ Check for site accessibility
- ❖ Check for delivery checklist
- ❖ Check for adequate crane capacity and working clearance for hosting the element
- ❖ Conduct sample measurements
- ❖ Conduct visual inspection.
- ❖ Check for location and condition for lifting
- ❖ Check for accessibility for unloading point
- ❖ Check that the storage area condition.

As per IS 15916:2011 ′ In the erection of precast elements, all the following items of work shall be included:

a) Slinging of the precast element;

b) Tying up of erection ropes connecting to the erection hooks;

c) Cleaning of the elements and the site of erection;

d) Cleaning of the steel inserts before incorporation in the joints, lifting up of the elements, setting them down into the correct envisaged position

e) Adjustment to get the stipulated level, line and plumb

f) Welding of cleats

g) Changing of the erection tackles

h) Putting up and removing of the necessary scaffolding or supports

i) Welding of the inserts, laying of reinforcements in joints and grouting the joints; and

j) Finishing the joints to bring the whole work to a workmanlike finished product.

Installation of vertical precast components Installation sequence includes

- ♣ Setting out
- ♣ Lifting and installation
- ♣ Grout work
- ♣ Joist casting and sealing

Good practices for setting out

- ⌗ Check the accuracy of offset line
- ⌗ Check the shim plate level and stability
- ⌗ Check the position for the starter bars
- ⌗ Check the compressible form and backer rod are properly secured

Lifting and installation: Lifting and rigging the panels adjust the panel to the position

Good practices for lifting and hoisting

- Check the hoisting condition
- Check the alignment and verticality
- Check the stability of the erected rod before releasing the hoisting cable

Grouting work:-

- Prepare and seal non- shrink motor
- Prepare and pour non
- Shrink grout for pipe works
- Keep the installed panel undisturbed for 24hours

Good practices for grouting

- Before grouting check the joint width The grout used must be self compactable and must have a free flow
- Check whether all the horizontal joints are properly sealed
- Collect sample test cubes for the grout used for important components

Joint casting and sealing

- Install the joint rebar as required
- Set up form for casting
- Carry out concrete casting ′
- Removes form after sufficient strength is attained
- Place the connecting plates between the panels and weld

Good practices for joint casting

- Joint rebars must be accurately placed
- During casting the formwork should be correctly secured
- For better water tightness the joint gap should have proper installation of grout

Installation of horizontal precast components

Installation sequence includes

- Setting out
- Lifting and installation
- Casting of joints

Setting out Set the reference line and the offset line

Good practice

- ❖ Check the accuracy of the offset line
- ❖ Check the level and stability of shim plates
- ❖ Check the dimensions of the protruding bars

Lifting and installation

- ➢ Put up temporary props
- ➢ Lift and rig the elements in position
- ➢ Align and set the level to suit before placing the member

Good practices for lifting

- Beams should be supported minimum at two locations ′
- Balcony, slabs should be supported in more than two locations
- Levelness of the precast elements to be ensured before the joisting action

Casting of joints For cast in situ joints place and lap the rebars

- Set up form work for casting of joints
- Carry out concrete casting

Good practice for joints

- ❖ The joints rebar's should be accurately placed
- ❖ The formwork should be properly placed
- ❖ Supporting beams should be a part of formwork

General considerations

- Safety precautions in the work are of utmost importance
- Only those skilled foremen
- Trained workers and fitters who have been properly instructed about the safety precautions to be taken should be employed on the job.
- Transport of people, workers or visitors, by using cranes and hoists should be strictly prohibited
- In the case of tower cranes running on rails, the track shall not have a slope more than 0.2 percent in the longitudinal direction. In the transverse direction the rails shall lie in a horizontal plane.
- The track of the crane should be checked daily to see that all fish plates and bolts connecting them to the sleepers are in place and in good condition.

Elements in Precast Concrete Building Systems

Precast concrete members are manufactured in factory under controlled conditions to keep standard dimensions and tolerances. Structural elements used in the construction of precast concrete buildings include:

A. Precast concrete wall (Panels)

Fig2.16. Precast Concrete Panel

B. Precast Slabs

Fig.2.17. Placement of Hollow Core Precast Concrete Slab on Walls

C. Precast Beam and Girders

Beams for precast frames and precast floors in the case of large panel systems and column-slab systems are placed.

Fig.2.18.Precast Beam and Girders

D. Precast Columns

After that, the columns are placed using suitable machines and continuously checked by surveyor for alignment. In the case of Frame system and slab-column system with shear wall. Alternatively, precast panels are installed in the case of large panel system

Fig.2.19. Precast Columns

E. Precast Stairs

Fig.2.20. Precast Stairs

Self –Check 2	**Multiple Choice**

Instruction: Select the best answer and encircle the letter

1. All temporary propping requirements must be shown on the erection drawings.

   A/ True

   B/False.

   C/None of the two

   D/ All of the above are correct

2. All are Good practices for Lifting and rigging the pre-cast concrete structure unit to the position EXCEPT

   A/Check the hoisting condition

   B/Check the alignment and verticality

   C/Check the stability of the erected rod before releasing the hoisting cable

   D/ None of the above

3. What are the activities we take for Preparatory work for lifting pre-cast concrete structure unit?

   A/Check for site accessibility

   B/Check for delivery checklist

   C/Conduct sample measurements & Conduct visual inspection.

   D/Check for location and condition for lifting & Check for accessibility for unloading point

   E/ All of the above are correct

Note:

- **Satisfactory rating – above 3 points**
- **Unsatisfactory - below 3 points**

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

2. Write about three elements in Precast Concrete Building Systems

3. Write down the proper planning and preparatory works required before the erection of pre-cast concrete structure unit to ensure effective and quality installation

4. What is the advantage of pre-cast concrete structure unit?

Operation Sheet 2

Operation Title	Erecting pre-cast structural units

Purpose:- To apply quality work and health care

Instruction: - Using the right tools to perform your task within the given time. You have given 50Minut for the task.

Equipment and Tools

- Shovel
- Chisel
- Trowel
- Brooms
- Concrete Saw
- Hammer

precaution:-

- ✓ Safe working area environment
- ✓ Ensure the work area hazard free
- ✓ Avoid horse play
- ✓ Availability of proper tools and equipment

PROCEDURE,

Step 1. Wear your PPE properly

Step 2. Select required materials

Step 3. Select required tools and equipment

Step 4. Check the alignment

Step 5. Select types of connection

Step 6. Read erecting manuals, Specifications

Step 7. Erect pre-cast structural units

Quality Criteria: Assured to follow the proper application of Occupational Health and Safety requirements

LAP Test 2	**Practical Demonstration**

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 50 min.

Task 1: Erect pre-cast structural units

Unit Three: Erect pre-cast concrete cladding

This unit to provide you the necessary information regarding the following content coverage and topics:

- Erecting temporary propping concretes cladding
- Erecting pre-cast concrete cladding
- Position and fixing cladding units

This guide will also assist you to attain the learning outcomes stated below. Upon completion of this learning guide, you will be able to:

- Erect temporary propping concretes cladding
- Erect pre-cast concrete cladding
- Apply position and fixing cladding units

3.1. Erecting Temporary Propping Concretes Cladding

Temporary Propping also sometimes referred to as a temporary propping system or temporary propping solution is a common construction methodology that involves the design

and installation of a temporary structural support system to support any sort of existing structure while nearby works is undertaken.

Temporary propping involves a variety of applications and the below article will touch on just a few ways our temporary props can be used to achieve great results.

Retaining walls:

Retaining walls are a very common propping application and one that we get asked for regularly, depending on the height and type of retaining wall being propped, the type of prop and how many need to be installed will vary. At a very basic level propping a retaining wall will involve running raking props from the retaining wall down to a solid concrete footing which transfers the loads from the wall through the prop and down to the footing.

Back propping

Back propping is quite a generic term but in temporary propping applications it refers to the vertical transfer of loads, sometimes through multiple stories through to the ground slab, this is often to allow for high loads such as cranes or heavy plant to be able to track across suspended slabs without impacting the integrity of the concrete they're sitting on/moving across.

Façade retention

Façade retention is again quite a generic term which just refers to keeping elements of a structure, more specifically a building intact while works take place around what's being retained or propped, this is especially common on heritage listed buildings where no demolition can take place in certain areas. Façade retention applications are often very unique and require bespoke solutions.

Uplift reduction

A less common but still very important application where propping is required is in uplift reduction. By transferring the load from where there is potential uplift down to the ground, in for example an open-air shed or awning, you reduce the chance of uplift, protect the structure, and minimize danger for others. Enquiries around temporary propping solutions for uplift reduction often increase during storm season as extreme weather events are often when failures due to uplift can occur but uplift still remains a problem year-round so if you want to learn more about this then get in touch with us today.

Push/pull or tilt bracing for pre-cast panels

Tilt props, which are often referred to as push/pull props in the Australian market, are one of the most common temporary propping applications and relate to the erection of pre-cast concrete panels. Propping designs for pre-cast panels are necessary to account for wind loading while they set. We have a huge range of tilt props to suit this application from 1.2m up to 10.4m and much further beyond with our modular propping systems. Traditional tilt props are made from steel which can be very heavy to manhandle but after years of research and development, Shore Hire has proudly designed, manufactured and taken to market a new lightweight aluminium tilt prop which is perfect for this application.

Formwork applications

Formwork propping applications relate to the supporting of suspended slabs while the concrete is poured/set. The propping system for this application typically involves lightweight evenly spaced vertical props that are relatively fast and easy to install.

Lintel fittings and removals

The fitting and/or removal of lintels and beams can be a tricky task but with a 'strong boy' prop, which is specifically designed for this application, it is instead a very easy and efficient process.

Pole propping

Propping power poles or any type of pole for that matter can lead to big cost savings by avoiding the need for a pole grab truck. Shore Hire have designed and developed our own custom power pole clamps for this application and the system will generally involve multiple tilt bracing props at adjacent axis running to either a solid footing or temporary counterweight system to support the pole while works is taking place nearby. If shoring is also required on this application Shore Hire can provide the full solution for the entire job.

3.2. Erecting pre-cast concrete cladding

According to Steel Construction Institute, cladding is the envelope of the building which normally carries no loading beyond its own weight plus the loads imposed by snow, wind and during maintenance.

There are different materials of cladding, and they rely on the structural frame to development a envelope of building or footbridge.

Precast cladding is commonly used as a component of non-load-bearing curtain-wall assemblies.

It may also be used as a veneer over load-bearing concrete or masonry walls or as a substrate for other finish materials.

3.2.1. Cladding Building Material and Construction

I. What is Cladding?

Building cladding is the exterior skin, or envelope of a building, that includes all moisture barriers and materials used to cover the outside of the structure. • While the term cladding is widely used in Europe and Australia, these exterior finish materials are typically known as siding in North America. • Cladding can serve both a decorative and a functional purpose. It is used to complement the architectural style of the building while also offering protection from rain, wind, snow, and other outside elements. • Building cladding can also add insulation to the structure while minimizing sound transmission through the walls.

II. Types

The following are some example of the type of cladding

- Timber Cladding
- Pvc Cladding
- Stone Cladding
- Back painted Glass Cladding
- Ceramic Cladding
- Wallpaper Interior Cladding
- Terra cotta cladding
- Stone Cladding
- Metal cladding (Acp Cladding)
- Stick Frame Cladding

- ❖ Curtain wall (Glass)
- ❖ Fiber Cement cladding
- ❖ Brick Cladding
- ❖ Exterior Cladding

1.**Concrete cladding panels: -** are made from robust and durable concrete and are applied to the inside or outside of a building to either improve the aesthetic value or to improve the building's durability. Cladding itself can be made from a variety of different materials, such as brick, stone and sometimes even wood, but concrete cladding has a much wider range of benefits than any other type of cladding material. This is because

I. Cost effectiveness

One of the most important advantages of using concrete cladding panels either on the exterior or the interior of a building is that it is fairly inexpensive to install. Concrete itself is a very cost-effective material to use on any building as it offers long-lasting results but at the fraction of the cost of some other cladding materials.

Concrete cladding panels cost is one of the main reasons why this option has become so popular over time. Also, it's worth remembering that concrete cladding panels can offer potential tax advantages thanks to the Annual Investment Allowances (AIA) legislation.

II. **Durability and performance**

In addition to concrete cladding panels cost being relatively low, another reason why concrete cladding panels are so popular is because they offer unbeatable protection against weather and erosion. Concrete cladding can withstand the effects of cold and wet weather, offering all-year-round protection and peace of mind.

III. Resistance to rust, fire and termites

Not only do concrete cladding panels provide exceptional durability against adverse weather conditions, they are also resistant to rust, fire and termites which is always a key priority for any building owner.

IV. High-performance insulation

Concrete cladding panels not only weather the elements during the cold and wet seasons, they also have fantastic insulating properties which help to keep the room temperature at a reasonable level, no matter what the time of year.

V. Low-maintenance upkeep

Concrete claddings panels require very little maintenance so once they are installed you don't need to worry about regular upkeep work on the panels. The only maintenance required with concrete cladding panels is regular cleaning or repainting the panels to improve the aesthetic appeal.

In addition to the above advantages, another reason why concrete cladding panels are so popular is because they are designed to provide the ultimate flexibility for any building project. The panels are easy to install and just as easy to remove, making them the perfect choice for both permanent and temporary structures.

Fig. 3.1a.Concrete cladding panels

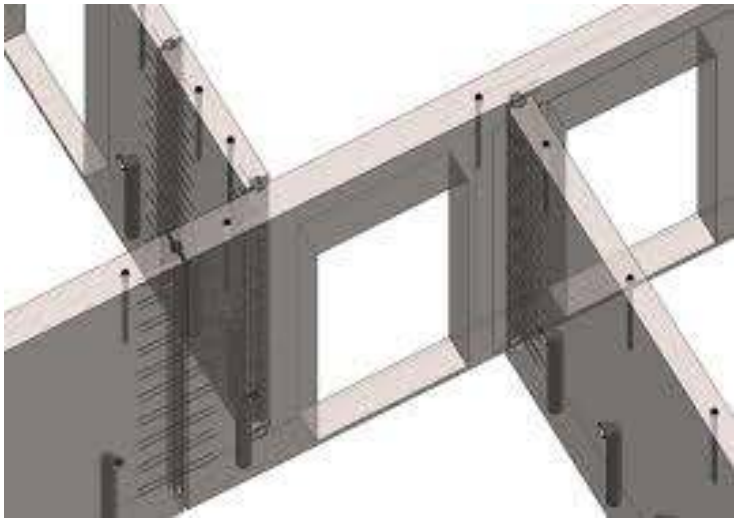

Fig. 3.1b.Concrete cladding panels

2. **Timber Cladding: -** Wood being a natural material with variety of textures and shades, elegance and warmth can be obtained and be painted in any color. Timber cladding is done in dry areas and hilly areas. Effective temperature insulator as it keeps the interior cool. It is fitted by tongue and groove joints mostly. Timber cladding requires thorough maintenance.
3. **PVC Wall Cladding:-** Long lasting, low maintenance, can also provide stone and timber look, moisture resistant and can be used in wet areas
4. **Back Painted Glass (Glass art color spray):-** Popular interior wall cladding feature in homes and commercial buildings. Provides posh, clean and sophisticated look. Colour Spray is a uniquely formulated resin based paint system which is ideal for the back painting of glass for wall claddings in any color imaginable.
5. **Ceramic Cladding**: - Ceramic cladding resists changes in temperature and atmospheric attack from pollution, acid rain and smog. • Fixed to the buildings by an adhesive. • Available in different colors and style. • Long lasting
6. **Wallpapers: -** Used for completely aesthetic purposes they are available in infinite number of patterns and designs. Due to their texture and sheen, they score over paints. They are paper, vinyl and real fabric based.
7. **Metal Cladding**:- Aluminum composite panels (ACP) & extruded aluminum are used. They are light weight, non- corrosive and recyclable in nature, have high strength-to-weight ratio and come in diverse colors and finishes. • Copper, another type of metal

cladding is used for its aesthetics alone. • Zinc is very expensive but aesthetically eye-catching and durable.

8. **Terracotta Cladding: -** Natural clay based tiles factory extruded and kiln dried to provide a durable cladding product. Color is created by adding specific dyes, custom shapes also possible.

9. **Stone Cladding**:- Brings a feel of natural style and elegance • Uses thin layers of natural or stimulated stones • Expensive and labor intensive

10. **Brick Cladding**:- For safety reasons, brick cladding is not recommended in seismically active areas, where bricks could collapse during an earthquake. • Brick cladding is designed to shed and repel water so that the water cannot reach the internal framing of the building. This reduces the risk of damage to the framing caused by mold and mildew. It also keeps the interior dry and pleasant.

11. **Mosaic Cladding** • Small tiles plastered onto the wall surface for aesthetic appeal. • Has no insulation property. • Available in variety of colors.

12. **Special Types** Plasterboard is generally used to clad internal walls. It is a pliable material that can be easily cut with a craft knife. Plasterboard should be cut a half-inch shorter than the wall and should be nailed onto the wall framework. Jointing tape should be placed over the joints of plasterboard to give a smooth finish.

❖ Procedures for erecting pre-cast concrete cladding unit

I. Erecting Precast Concrete Cladding Units in the Workplace

Interpret the given information relating to the work and resources when erecting precast concrete cladding units. Know how to comply with relevant legislation and official guidance when erecting precast concrete cladding units. Maintain safe working practices when erecting precast concrete cladding units. Select the required quantity and quality of resources for the methods of work to erect precast concrete cladding units. Minimize the risk of damage to the work and surrounding area when erecting precast concrete cladding units. Complete the work within the allocated time when erecting precast concrete cladding units. Comply with the given contract information to erect precast concrete cladding units to the required specification.

II. Slinging and Signaling the Movement of Loads in the Workplace

Interpret the given information relating to the preparation for and the slinging and signaling of loads. Organize with others the sequence and operation in which the slinging and signaling of loads is to be carried out. Know how to comply with relevant legislation and official guidance to carry out slinging and signaling of loads. Maintain safe working practices when preparing for and slinging and signaling loads. Select the required quantity and quality of resources to prepare for and when slinging and signaling loads. Minimize the risk of damage to the work and surrounding area when slinging and signaling loads. Complete the work within the allocated time when preparing to and slinging and signaling loads. Comply with the given contract information to prepare to and sling and signal loads for movement to the required specification.

III. Conforming to General Health Safety and Welfare in the Workplace.

Comply with all workplace health safety and welfare legislation requirements. Recognize hazards associated with the workplace that have not been previously controlled and report them in accordance with organizational procedures. Comply with organizational policies and procedures to contribute to health safety and welfare. Work responsibly to contribute to workplace health safety and welfare whilst carrying out work in the relevant occupational area. Comply with and support all organizational security arrangements and approved procedures.

- **Conforming to Productive Working Practices in the Workplace**

Communicate with others to establish productive work practices. Follow organizational procedures to plan the sequence of work. Maintain relevant records in accordance with the organizational procedures. Maintain good working relationships when conforming to productive working practices.

- **Moving Handling and Storing Resources in the Workplace**

Comply with given information when moving handling and/or storing resources. Know how to comply with relevant legislation and official guidance when moving handling and/or storing resources. Maintain safe working practices when moving handling and/or storing resources.

Select the required quantity and quality of resources for the methods of work to move handle and/or store occupational resources. Prevent the risk of damage to occupational resources and surrounding environment when moving handling and/or storing resources. Complete the work within the allocated time when moving handling and/or storing resources. Comply with

the given occupational resource information to move handle and/or store resources to the required guidance.

3.3. Position and fixing cladding units

3.3.1. Fixing positioning for precast cladding

Below is a layout of support and restraint fixings on a bottom supported cladding panel. Green part in the drawing represent restraint fixing and blue part as load bearing fixing.

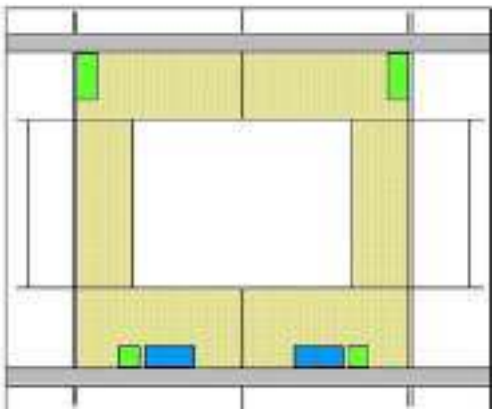

Fig. 3.2: Design for Fixing positioning for precast cladding

- Enables faster programme times - not affected by weather or labour shortages.
- Improves buildability - early enclosure of dry envelope enables follow-on trades to start sooner.
- Produces a high standard of workmanship in factory conditions - reduces potential for accidents, addresses on-site skill shortage.
- Has a high quality finish that can be left exposed - concrete's thermal properties can be exploited in low-energy buildings.

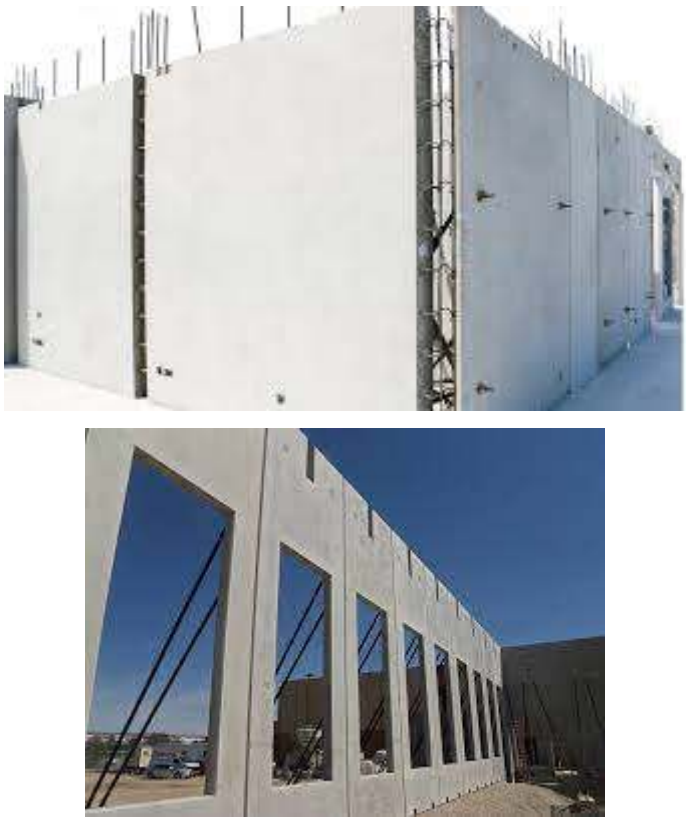

Fig. 3.3a: Fixing positioning for precast cladding

Fig. 3.3b: Fixing positioning for precast cladding

3.3.2. Types of Fixings of Precast Cladding:

- **Load bearing fixings** are designed to transfer the weight of the cladding units together with any services or secondary fixings, such as doors or windows that may be present, to the building structure and are usually designed as pin-jointed supports. These fixings generally take the form of concrete nibs or metal (usually stainless steel) angles.

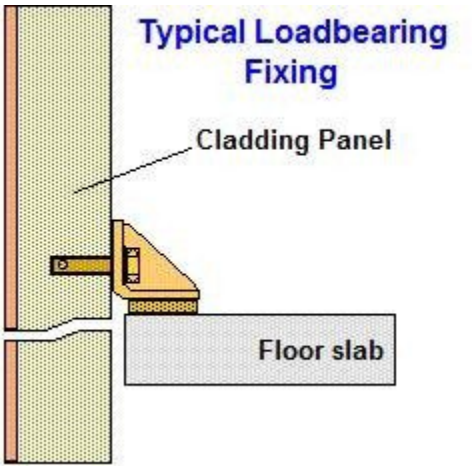

Fig. 3.4: Load bearing fixings

- **Restraint fixings** are designed to hold panels back and transfer all horizontal forces (such as wind pressure or suction) to the structure. They need to be fully adjustable to facilitate the leveling and alignment of the panel.

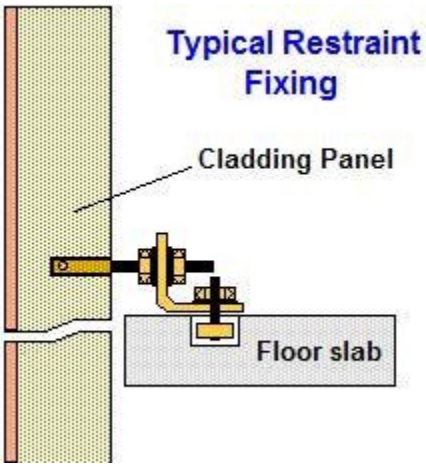

Fig. 3.5: Restraint fixings

These fixings must also be able to accommodate any differential movement between structure and cladding.

3.3.3. Design of fixings in precast cladding:

The basic requirement in any cladding design is that support and restraint to the main structure to be provided. It is important to realize that with any cladding system, once in position and the building complete, access to the fixings is not readily possible and therefore complete integrity of design and material workmanship has to be provided.

The majority of support fixings are formed from bent angel sections. Angels as single elements are basically simple to design. The outstanding leg is designed as a cantilever section.

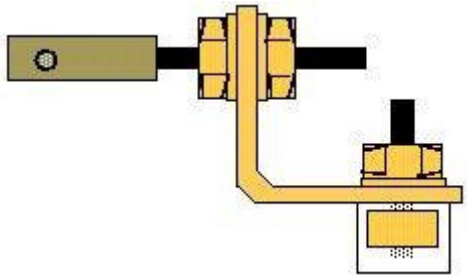

Fig. 3.6: Bent Angel Sections

The design of bolts is one of the most important aspects of fixing design. In load bearing situations a bolt has a number of forces to resist. The downward load produces a shear force, the bending moment on a bracket produces a couple which imposes a tensile pull on the bolt in some circumstances. If there is a large amount of shimming, a moment stress in the bolt can also be induced.

3.3.4. Fixing selection for precast cladding:

- The initial selection of fixings is important and several factors should be considered.
- The fixing material must be corrosion resistant.
- The metal should be non-staining when used in direct contact with the cladding material.
- The metal should have sufficient strength to resist the applied loads.
- The metal should normally be specified from standard widths and thickness. Non standard materials are difficult to purchase and also very expensive.
- The metal should have good workability but also keep its strength during fabrication.

Fig. 3.7a: Fixing for precast cladding

Fig. 3.7b: Fixing for precast cladding

Self-Check 3	Multiple choice

Instruction: Select the best answer and encircle the letter

1. One of the following is an example of the type of cladding?

   A/Timber Cladding & Pvc Cladding

   B/ Stone Cladding & Back painted Glass Cladding

   C/ Ceramic Cladding

   D/ All of the above are correct

2. …… Used for completely aesthetic purposes they are available in infinite number

   A/ Wallpapers

   B/ Ceramic Cladding

   C/ Back painted Glass Cladding

   D/ None of the above

3. Which one of the following are not the types of Fixings of Precast Cladding?

   A/Load bearing fixings

   B/Restraint fixings

   C/ A and B

   D/ None of the above

Note:

- **Satisfactory rating – above 3 points**
- **Unsatisfactory - below 3 points**

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. What is Cladding?
2. Why concrete cladding has a much wider range of benefits than any other type of cladding material?
3. What is Mosaic Cladding?

Operation sheet 3

Operation Title	Fixing of Precast Cladding

Purpose:- To apply quality work and health care

Instruction: - Using the right tools to perform your task within the given time. You have given 10Minut for the task.

Equipment and Tools

- Shovel
- Chisel
- Plum bob
- Trowel
- String
- Concrete Saw
- Hammer
- Bolt and Nut
- Tie wire
- Wrench
- Drill

precaution:-

- ✓ Safe working area environment
- ✓ Ensure the work area hazard free
- ✓ Avoid horse play
- ✓ Availability of proper tools and equipment
- ✓ The required drawing or plan

Procedure:-

Step 1. Wear your PPE properly.

Step 2. Prepare all the necessary material & equipment

Step 3. Select methods of fixing

Step 4. Check alignment

Step 5. Fix pre-cast structure unit in its position

Quality Criteria: Assured to follow the proper application of Occupational Health and Safety requirements

LAP Test 3	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 10 min.

Task 1: Fix of Precast Cladding

Unit Four: Clean up

This unit to provide you the necessary information regarding the following content coverage and topics:

- Clearing work area
- Disposing , reusing and recycling materials
- Cleaning, checking, maintaining and storing plant, tools and equipment

This guide will also assist you to attain the learning outcomes stated below. Upon completion of this learning guide, you will be able to:

- Clear work area
- Dispose, reuse and recycle materials
- Clean, check, maintain and store plant, tools and equipment

4.1. Clearing work area

A clean, well-ordered, attractive work environment sets the tone of your establishment. It encourages tidy work habits in employees. It helps reduce fatigue. It promotes good worker-management relations. It also gives a lift to morale, which is reflected in the quality of production and overall efficiency. Good housekeeping is also a good advertisement for your company. Customers and clients have more confidence in an organization when they we work being carried out efficiently in clean, pleasant, well ordered surroundings. There's an even more important reason why good housekeeping matters — it makes the undertaking a safer place to work in

4.1.1. Keep Floors Clean

Every year thousands of work injuries are caused by people falling. Floor conditions are responsible for many of these accidents. When floors are given the right treatment they are much easier to keep clean and hygienic.

Spilt oil and other liquids should be cleaned up at once. Chips, shavings, dust, and similar wastes should never be allowed to accumulate. They should be removed frequently, or better still, be suitably trapped before they reach the floor

4.2. Disposing, reusing or recycling material

Definition

Disposing Removing and destroying or storing damaged, used or other unwanted domestic, agricultural or industrial products and substances

Recycling means turning an item into raw materials which can be used again, usually for a completely new product. This is an energy consuming procedure

Reusing refers to using an object as it is without treatment. This reduces pollution and waste, thus making it a more sustainable process.

Purpose

When looking into environmental sustainability, cutting consumption or reducing rubbish during a house clearance, it's more than likely that you'll come across the following 3Rs: reduce, reuse and recycle. Learn how Disposing, reusing(R), and recycling(R) can help you, your community, and the environment by saving money, energy, and natural resources.

Recycling is the process of collecting and processing materials that would otherwise be thrown away as trash and turning them into new products. Recycling can benefit your community and the environment.

Recycling reduces waste disposal by transforming useful materials such as plastic, glass and paper into new products

The reusing process is not just about re-purposing materials, but the object as it is. This includes buying and selling used goods and repairing items rather than discarding them. Reusing is better than recycling because it saves the energy that comes with having to

dismantle and re-manufacture products. It also significantly reduces waste and pollution because it reduces the need for raw materials, saving both forests and water supplies.

Waste that cannot be reused or recycled in some form eventually finds its way to disposal. This disposal includes landfills, but an increasing number of municipalities have elected to divert waste into resource recovery. These recovery methods use the waste to generate electricity or produce raw materials for industry

4.3. Cleaning, checking, maintaining and storing plant, tools and equipment

4.3.1. Cleaning of Tools and Equipment

Tools and equipment used at the construction site undergo rigorous handling. From initial foundation development, to the final construction of the exterior trim, these tools are exposed to large amounts of dirt and abuse. Proper maintenance of construction tools and equipment is critical to preserving them for future construction jobs. Failure to maintain the tools properly results in unnecessary expense.

Clean the construction tools and equipment after each day's work. While a thorough cleaning is not required each day, a general wipe-down and removal of the heaviest construction dirt is key to extending the life of the tools.

4.3.2. Checking Hand tools

- Mechanical failure or loss of control when using a tool with defective parts.

Examples of unsafe tools are hammers with loose or damaged heads, screwdrivers with broken handles or blunt edges, chisels with mushroomed heads, and blunt saws.

4.3.3. Checking Power tools

- Malfunctioning of safety devices such as emergency button (red button), protective covers, guards, etc. In case of emergency these devices will not work properly or will provide limited protection to the worker, which in some cases can be worse than no protection at all because it gives a false sense of security.
- Risks of electrocution, shock or burns due to electrical malfunctions, torn cables and lack of proper insulation or proper earthing.
- Cracked or broken grinding wheels or cracked blades can cause injuries. E.g. cracked abrasive wheels could fly apart in operation, which could lead to serious injury or death.
- Emissions of chemical substances such as toxic fumes or dust, etc.

- Noise and vibration emitted by almost all portable tools that can lead to hearing loss and hand–arm vibration syndrome respectively. Vibration can cause “white-finger” disease, which arises from damage to the muscles and nerves that control the blood flow. Poorly maintained tools can cause a significant increase in noise and vibration emissions (e.g. a cutting tool that is not sharp emits higher levels of vibration). Also, damaged anti-vibration mountings in a tool can increase transmission of vibration to the worker.

4.3.4. Maintaining and storing of tools and equipment

Lubricate air tools and pneumatic equipment before each day's use. Condensation in the airline creates an environment for corrosion inside pneumatic tools. Coating the internal components of these tools with air-tool oil will displace the moisture and prevent tool corrosion.

Inspect and repair all construction equipment and tools at the completion of each job. Make all repairs to the equipment that are necessary for future construction work. This will prevent time being wasted repairing faulty equipment at future construction job sites.

Self-Check 4	**Multiple choice**

Instruction: Select the best answer and encircle the letter

1. What is the advantage of reusing and recycling construction products

   A/ Avoids waste
   B/Reduces waste

   C/Saves primary resources
   D/ All of the above are correct

2. -------is contribute to more sustainable development by eliminating or reducing waste

   A/ Recycling

B/ Technology

C/ Learning

D/ All of the above

3. What is the dis advantage if someone left Keeping Floors Clean?

A/ It will be attractive

B/ It will be good for working

C/ It will be caused of people falling

D/ All of the above

4. Which one is true about clear area?

A/ It will be benefit by providing safe working area

B/ Expense will be saved

C/The working area and learning classes will be a better place in which to work

D/ All of the above

5. What is the advantage of maintaining construction tools and equipment?

A/ Increase the service life of the equipment

B/ The performance of the equipment

C/Decrease the price of the equipment

D/ A & B are correct

6. Why we maintain construction tools and equipment?

.A/ Because it make tools and equipment good performance

B/ Because tools and equipment suffer a lot of wear and tear

C/ Because working with broken tools and equipment lead to injure

D/ All of the above

Note:

- **Satisfactory rating – above 3 points**
- **Unsatisfactory - below 3 points**

Test II: short Answer writing

Instruction: write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. why we dispose waste materials?
1. Mention at least two points about the advantage of cleaning of tools and equipment
2. Write the benefits of recycling of waste materials

Reference

- IS15916:2011 -Building design and erection using prefabricated concrete — code of practice ′ CONQUAS Quality Assessment Criteria

Participants of this Module (training material) preparation

No	Name	Qualification (Level)	Field of Study	Organization/ Institution	Mobile number	E-mail
1	Tesfaye Assegidew	Msc	Construction Mgt	Butajira PTC	+251913442444	tesfayeassegidew@gmail.com
2	Melsew Keba	Msc	Construction Mgt	Assosa PTC	+251913283335	melsewkeba@gmail.com
3	Dawit showafera	Msc	Construction Mgt	DDPTC	+251986314667	dawitshowafera835@gmail.com
4	Muluken Solomon	Msc	Construction Mgt	Batu PTC	+2519-12289146	mulecot99@gimal.com
5	Tiruneh Asebe	Msc	Construction Mgt	Hossana PTC	+251911422557	tirunehasebe@gimial.com


የሥራ እና ክህሎት ሚኒስቴር
MINISTRY OF LABOR
AND SKILLS