



# **BAR BENDING AND CONCRETING**

**Level-II**

## **Learning Guide -39**

**Unit of Competence:- Erect Pre-cast Concrete**

**Structural & Cladding Units**

**Module Title:- Erecting Pre-cast Concrete Structural &  
Cladding Units**

**LG Code: EIS BBC2 M11 LO3-LG-39**

**TTLM Code: EIS BBC2 TTLM 1019v1**

### **LO 3: Erect pre-cast concrete cladding**

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## Instruction Sheet

## Learning Guide #39

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

- Pre-cast concrete cladding units
- Erecting temporary propping
- Erecting pre-cast concrete cladding unit
- Positioning and Fixing cladding unit

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

Specifically, upon completion of this Learning Guide, **you will be able to –**

- Erect temporary propping.
- Position and fix cladding units
- Pre-cast concrete cladding is erected in accordance to contract specification

### Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4,---” in **page 3, 9, 11 and 14** respectively.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” ,---” in **page 8, 10, 13 and 19** respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ” in **page 20** and Operation Sheet 4 in **page 21**
6. Do the “LAP test” in **page 21**



## Information Sheet-1

## Pre-cast concrete cladding units

### 1.1 Introduction

- Precast cladding is used in a variety of commercial and residential building types. It can be of custom design or one of many proprietary systems.
- Precast panels range in size from small spandrel units to entire wall units and are limited only by available transportation and erection methods.
- The cladding (none load bearing exterior enclosure) is the most visible part of building it is also the part of building most its appearance & must defined the interior space against invasion by water, wind, sun light, heat & cold the other force of nature.

### 1.2 materials of cladding units

- **Concrete**

Precast concrete is better than other materials for cladding because it's good strength-to-weight ratio, its mobility and its fire performance.

Precast concrete is better than in situ concrete because the speed of erection, freedom from shuttering support on site and better quality control.

The precast concrete is cast on the moulds, which and be standardization or special made. The standardization can reduce the producing and erection costs, shorten the erection time and reduce the time for detailing.

The size of the unit is affected by the ease of manufacture, method of transportation and weight of lifting.

The panel or components are usually joined by sealant, gasket or open-drained.

The surface casts direct from the mould, eg. Smooth centre, board- marked concrete, grooved or serrated, including reconstructed stone finishes. The finishes in the cement surface is removed to expose the aggregate in the concrete. Tiles, stone facings and bricks can be applied to the surface.

- **Steel:** used as a mould commonly at every aspect

- **Metal**

The metal cladding can be categorized in two types: form metal and sheet metal panel.

For **form metal**, the process of forming can be carried out in four different ways:

Brake pressing, rolling, stamping and deep drawing.

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. It is the term used when the steel sheet is exposed to the elements.

- ✓ **Profiled steel and aluminum sheets** are available in the sinusoidal, symmetrical trapezoidal and asymmetrical trapezoidal

Rolling is the best way to produce profiled steel and aluminum sheets

Coating, paint can be applied to the surface of metal. For aluminum, it has its own built-in protective surface coating of aluminum oxide, which form immediately on exposure to the atmosphere.

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Screw, nut and bolt are the common way to joint different parts together.

There are four types of sheet metal and composite panel system:

- ✓ Rolled flat sheet panels mounted onto a supporting framework
- ✓ Box-type panels (including proprietary panels), usually with foamed cores
- ✓ Laminated panels
- ✓ Rain screen panel

Composite construction is the bonding together of layers of materials to form a rigid structure due to their different thermal and structural performance.

Some composite panels, particularly those with a foamed insulation core, failed in the past because of delamination of the outer skin from the insulation to which they were bounded.

To prevent delaminating:

- ✓ Use light colors on the outer skin to reduce the heat gain on the skin.
- ✓ The size of the panel should be taken into consideration. Large panels will deflect more than small one.
- ✓ Fixings in the centre of panels should be avoided.
- ✓ The adhesive and type of insulation core should be selected to take account of stresses set up by thermal movement
- ✓ If the inner skin has a higher coefficient of expansion than the outer, then the effect of thermal movement will be reduced

### • Curtain Wall

Curtain wall may be defined as being non bearing wall, usually suspended in front of a structural frame, their own dead weight and wind loadings being transferred to the structural frame through anchorage points. Usually they consist of a rectangular grid of vertical or horizontal framing with in fill panels of glass or some other light weight panel.

**Four Type of Curtain Wall System:**

- ✓ Patent glazing;
- ✓ Pressed or extruded metal box framing;
- ✓ Suspended glass assemblies;
- ✓ Silicone-bonded glazing

### **Metal Box Framing**

There are two basic approaches to assembling a box framed curtain wall:

- ✓ The component parts of the system are assembled on site, with panels being offered up to a frame, also called stick system
- ✓ The panel system is bolted together, the panels themselves becoming the frame effect of thermal movement will be reduced

### **1.3 Producing prefabricate and carpentry steel**

The concept of precast (also known as “prefabricated”) construction includes those buildings where the majority of structural components are standardized and produced in plants in a location away from the building, and then transported to the site for assembly. These components are manufactured by industrial methods based on mass production in order to build a large number of buildings in a short time at low cost.

The main features of this construction process are as follows:-

1. The division and specialization of the human workforce
2. The use of tools, machinery, and other equipment, usually automated, in the production of standard, interchangeable parts and products This type of construction requires a restructuring of

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the entire conventional construction process to enable interaction between the design phase and production planning in order to improve and speed up the construction. One of the key premises for achieving that objective is to design buildings with a regular configuration in plan and elevation.

- A prefabricated building, informally a prefab, is a building that is manufactured and constructed using prefabrication. It consists of factory-made components or units that are transported and assembled on-site to form the complete building.

- **Advantages of prefabrication**

- ✓ High quality product
- ✓ Labor related savings
- ✓ Savings in time
- ✓ Overall efficiency is greatly increased
- ✓ Mass production is easier and quick
- ✓ Protected and controlled production environment
- ✓ Potential for lower production costs and other cost savings
- ✓ Independence of climatic conditions
- ✓ The disruption of traffic is avoided
- ✓ Ensures high degree of Safety

- **Prefabs and the modernist movement**

Architects are incorporating modern designs into the prefabricated houses of today. Prefab housing should no longer be compared to a mobile home in terms of appearance, but to that of a complex modernist design. There has also been an increase in the use of "green" materials in the construction of these prefab houses. Consumers can easily select between different environmentally friendly finishes and wall systems. Since these homes are built in parts, it is easy for a home owner to add additional rooms or even solar panels to the roofs. Many prefab houses can be customized to the client's specific location and climate, making prefab homes much more flexible and modern than before.







*Fig. 1.1: modern designs pre-cast*

#### 1.4 How Cladding System Be Limited under the Condition

Once planning to build a footbridge, the first problem is the loading transfer. Because of the steel column on the façade is non-bearing component, the loading cannot transfer by those column to the ground. The footbridge must connect to the mega columns through the façade so that the force can go to the ground. On the other hand, the side near Cheung Kong Centre is connecting to a concrete base and produce another direction of force transfer. However, the footbridge should be lighter so that its structure can catch the column and form a rigid structure. Therefore, the roof, the two sides of the base and the columns on the footbridge are finished by cladding. The loading of footbridge can be reduced by cladding system.

#### 1.5. Performance requirements

- **Overall design considerations:-** Cladding must perform a number of functions

- ✓ Stable
- ✓ Strong
- ✓ Resistant to elements
- ✓ Fire resistant
- ✓ Acoustic and thermal properties
- ✓ Resist erosion and corrosion
- ✓ Aesthetic
- ✓ Thermal expansion/joints
- ✓ Allow for frame tolerances/movement

- **Conditions Required in the Building**

- ✓ Daylight
- ✓ Solar radiation and glare
- ✓ View



- ✓ Rain barrier
- ✓ Ventilation and draughts
- ✓ Heat loss / cold areas
- ✓ Security
- ✓ Noise
- ✓ Fire proof

- **Natural Forces**

- ✓ **Wind:-** Location, Height, Topography
- ✓ **Rain:-** Location, intensity, time, associated with wind.
- ✓ **Frost**
- ✓ **Chemical and biological degradation**
- ✓ **Earthquakes and vibration.**

- **Performance requirements of fabric**

- ✓ Appearance:- Colour, texture, width of joints
- ✓ Geometry:- Dimensional co-ordination, joints, tolerance & fit
- ✓ Security
- ✓ Maintenance
- ✓ Construction:- Handling, storage, ease of fixing

- **Finishes**

- ✓ Load bearing units – brick, block
- ✓ Small units to frames – masonry
- ✓ Large units – metal, PCC, GRC, GRP, composites
- ✓ Curtain Walling – Any prefabricated framework with an infill of glazing and/or panels of other materials, supported by structural frame.

**Self-Check -1****Written Test**

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Which one are not materials of cladding unit?
  - A. Concrete
  - B. Metal
  - C. Glass
  - D. All
2. Which one is advantage of cladding unit?
  - A. High quality products
  - B. Savings in time
  - C. Protected and controlled production environment
  - D. ALL
3. Which one is performance requirement of fabric
  - A. Appearance
  - B. Security
  - C. Chemical and biological degradation
  - D. Maintenance
4. Which one are the design consideration for cladding
  - A. Stable
  - B. Strong
  - C. Aesthetic
  - D. All

**Note: Satisfactory rating - 3 points**

**Unsatisfactory - below 3 points**

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**

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<b>Information Sheet-2</b>	<b>Erecting temporary propping</b>
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## 2.1 introductions

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 spalling 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 spalling 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.

## 2.2 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.

## 2.3 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.

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- 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.

<b>Self-Check -2</b>	<b>Written Test</b>
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**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the purpose of temporary bracing.

**Note:** Satisfactory rating - 3 points

Unsatisfactory - below 3 points

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**



### **Information Sheet-3**

## **Erecting pre-cast concrete cladding unit**

### **3.1**

### **introduction**

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 Procedures for erecting pre-cast concrete cladding unit**

### **3.2.1 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.

### **3.2.2 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.

### **3.2.3 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.



### 3.2.4 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.

### 3.2.5 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. Site Access

- The general contractor shall be responsible for providing adequate access to the site to facilitate hauling, storage and proper handling of the precast concrete units

### 3.4. Installation

- Precast concrete cladding units shall be installed to the lines and grades shown in the contract documents or otherwise specified.
- Precast concrete cladding units shall be lifted by suitable lifting devices at points provided by the precast concrete cladding units producer.
- Precast concrete cladding units shall be installed in accordance with applicable industry standards. Upon request, the precast concrete cladding units producer shall provide installation instructions.
- Field modifications to the product shall relieve the precast producer of liability regardless if such modifications result in the failure of the precast concrete cladding units

### 3.5. Water tightness

- Where water tightness is a necessary performance characteristic of the precast concrete cladding units end use, watertight joints, pipe-entry connectors and inserts should be used to ensure the integrity of the entire system

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**Self-Check -3****Written Test**

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write the procedure of erecting pre cast cladding unit.

**Note:** Satisfactory rating - 3 points

Unsatisfactory - below 3 points

**Answer Sheet**

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Short Answer Questions**



## List of Reference Materials

1. <https://www.constructionskillspeople.co>

<b>Information Sheet-4</b>	<b>Positioning and Fixing cladding unit</b>
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### 4.1 introductions

The first part of this project will concrete on the theory of cladding system.

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.

### 4.2 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.

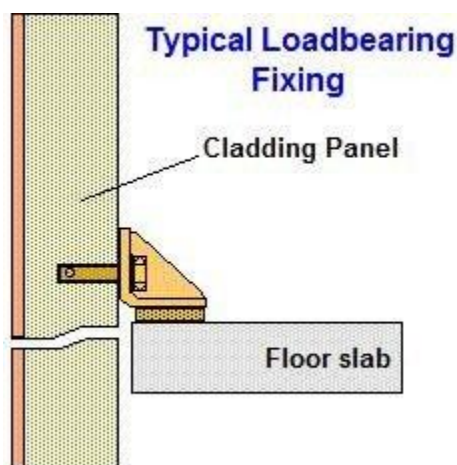
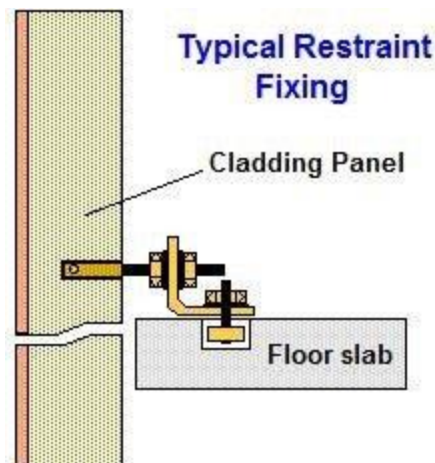


Fig. 4.1: Load bearing fixings

- **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.





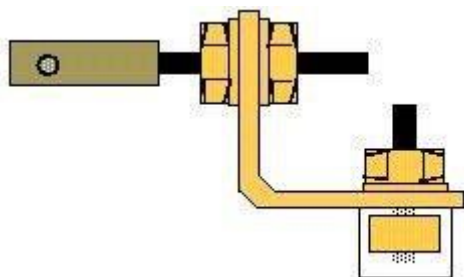
*Fig. 4.2: Restraint fixings*

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

#### 4.3 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. 4.3: 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.

#### 4.4 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.

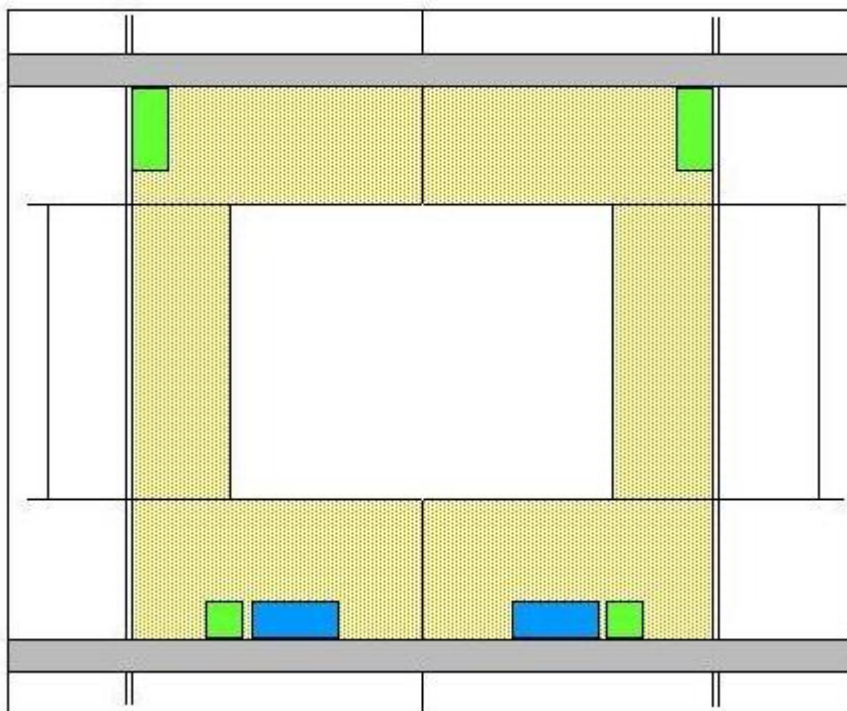


- The metal should have sufficient strength to resist the applied loads.
- The metal should normally be specified from standard widths and thickness. Non standard materials are difficult to purchase and also very expensive.
- The metal should have good workability but also keep its strength during fabrication.

#### 4.5 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. 4.4: 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. 4.5: Fixing for precast cladding*



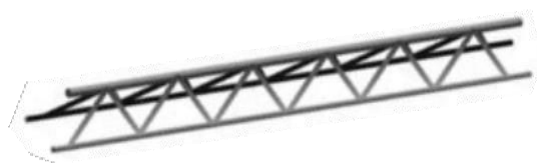
## Tran's floor

A direct equivalent of an in situ slab, Trans floor provides the facility to combine precast and in situ concrete and offers major benefits to specifiers, engineers and builders.

- Fast to erect, acts as fully participating permanent formwork, saving time and money
- Exceptional flexibility where each panel can be designed to suit a specific location and load
- Irregular shaped buildings easily accommodated
- Service holes etc formed and positioned during manufacture
- Smooth level soffit suitable for direct decoration

The use of site placed concrete effectively ties all the Trans floor panels together providing safety, rigidity and structural redundancy. The lattice girder truss ensures a practical bond between the precast and in situ concrete.

All Trans floor panels incorporate triangular lattice girder trusses. Each truss is cut to size and attached to the layer of reinforcement. Concrete is then poured to create the Trans floor panel.



The trusses cast into each panel provides the strength and stiffness for handling and transport, allows the panels to support construction loads with a minimum of temporary propping and contributes to the bottom steel.

The length, width, thickness, plan shape and reinforcement steel of a Trans floor panel can easily be varied to suit design requirements.





### Self-Check -4

### Written Test

**Directions:** Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. -----are designed to hold panels back and transfer all horizontal forces to the structure.  
A. Load bearing fixing  
B. .restraint fixing  
C. Temporary prop  
D. None

Say the answer **true** or **false**

2. The initial selection of pre-cast cladding fixing is important and several factors should be not considered.
3. The pre-cast cladding fixing material corrosion resistant.

**Note:** Satisfactory rating - 5 points

Unsatisfactory - below 5 points

### Answer Sheet

Score = \_\_\_\_\_

Rating: \_\_\_\_\_

Name: \_\_\_\_\_

Date: \_\_\_\_\_

### Short Answer Questions



### Operation Sheet 1

### Pre-cast concrete cladding units

Techniques for Pre-cast concrete cladding units

- Step 1- wear PPE.
- Step 2- select required materials
- Step 3- select required tools and equipment
- Step 4- prepare working area

### Operation Sheet 2

### Erecting temporary propping

Techniques for erecting temporary propping

- Step 1- wear PPE.
- Step 2- select required materials
- Step 3- select required tools and equipment
- Step 4- installs temporary propping

### Operation Sheet 3

### Erecting pre-cast concrete cladding unit

Techniques for Erecting pre-cast concrete cladding unit

- Step 1- wear PPE.
- Step 2- select required materials
- Step 3- select required tools and equipment
- Step 4- check alignment
- Step 5- select types of connection
- Step 6- erect pre-cast cladding unit





<b>Operation Sheet-4</b>	<b>Positioning and Fixing cladding unit</b>
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**Techniques for Positioning and Fixing cladding unit**

Step 1- wear PPE.

Step 2- select required materials

Step 3- select required tools and equipment

Step 4- check alignment

Step 5- select types of fixing materials

Step 6- erect pre-cast cladding unit

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<b>LAP Test</b>	<b>Practical Demonstration</b>
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Name: \_\_\_\_\_ Date: \_\_\_\_\_

Time started: \_\_\_\_\_ Time finished: \_\_\_\_\_

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

**Task 1.** Pre-cast concrete cladding units

**Task 2.** Erect temporary propping

**Task 3.** Erect pre-cast concrete cladding unit

**Task 4.** Position and Fixing cladding unit

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## Reference

- Different website like the contractor civil engineering .com
- Internet
- Christian Meuli Karl Wehrle Heini Müller Heini Pfiffner Volume 3

<b>Name trainers who prepared the material</b>
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N0	Name	Qualification	Region	E.mail
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5	Getachew Mohammed	MSC in CoTM	Amhara	Gerimom07@gmail.com
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