



Bar bending & concreting Level II

Learning Guide #28

Unit of Competence: Erecting and dismantling
Formwork for
Footings, slabs Beam,
Stairs & column

Module Title: Erecting and dismantling
Formwork for Footings, slabs
Beam, Stairs & column

LG Code: EIS BBC2 MO6 LO3-LG-28
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LO 3: Strip formwork



Instruction Sheet

Learning Guide #28

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

- Removing edge boxing and bracing/strutting support.
- De-nailing, cleaning and storing or stacking safely Timber components
- Cleaning, oiling and storing or stacking Steel components
- Stripping formwork

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 –

- Remove edge boxing and bracing/strutting support sequentially and safely.
- Clean and store or stack timber components
- clean, oil and store steel components to manufacturer's maintenance recommendations.
- discard damage formwork components safely after stripping.

1. Learning Instructions:

2. Read the specific objectives of this Learning Guide.

3. Follow the instructions described in number 3 to 7.

4. Read the information written for each “Information Sheets given below

5. Accomplish the “Self-check after reading & understanding of each information sheet

6. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet

7. Lastly do the “LAP test

8. If you have any question ask your teacher

9.



3.1. Removing edge boxing and bracing/strutting support

Removal of formwork is also important as erecting it before formwork can be removed the concrete must have sufficient Strength to support itself Surface hardness to resist, ama.ge Curing.

3.2. Method of Removing Formwork

Formwork should be planned and constructed in such a manner that it is possible to remove the different components in the following order of sequence:

- Shuttering forming vertical faces of walls, of beams and columns sides, which bear no load but are used only to retain the concrete, should be removed first.
- Shuttering forming soffit of slabs should be removed next, and
- . Shuttering forming soffit of beams, girders or other heavily loaded shuttering should be removed in the end.

- **Factors Affecting Formwork Striking**

- ✓ Ambient Temperature
- ✓ Layout of concrete viz. horizontal, vertical or inclined
- ✓ Type of cement used. Grade of concrete, Use of retarders, plasticizers, etc.
- ✓ Feasibility of removal with props left under
- ✓ Feasibility with re-propping , Standards of finish required Structural configuration e.g. simply supported or cantilever Curing procedures adopted
- ✓



Self-Check 1	Multiple Choice item
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Directions: Select the correct answer and encircle the letter of your choice

1. Which one of the following factors affect formwork striking?
 - A. Ambient Temperature
 - B. Layout of concrete viz. horizontal, vertical or inclined
 - C. Type of cement used. Grade of concrete, Use of retarders
 - D. All of the above

2. To remove the different components of formwork which order of sequence is correct?
 - A Shuttering forming vertical faces of walls which bear no load but are used only to retain the concrete, should be removed first.
 - B Shuttering forming soffit of slabs should be removed next,
 - C .Heavily loaded shuttering should be removed in the end
 - D. All are correct

3. Formwork Shuttering is simple and no required attention
 - A. True
 - B. False



Operation Sheet-1. Remove edge boxing and bracing/strutting support

Procedure to remove edge boxing and bracing/strutting support

Step 1. Wear appropriate PPE.

Step 2. Remove first Shuttering forming vertical faces of walls.

Step 3 .Remove Shuttering forming soffit of slabs

Step 4. Remove heavily loaded shuttering at the end

Step 5. Clean the form

Step 6. Store the panels on even ground to avoid deflection.

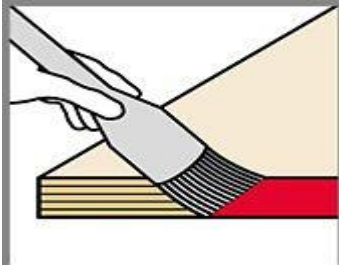
Step 7. Store the form properly

Step 8 .Protect the form from exposure to the sun and rain.



Information Sheet 2

De-nailing, cleaning and storing or stacking safely
Timber components

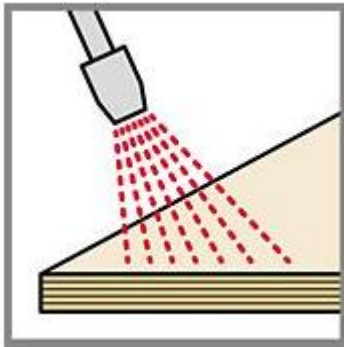


Before using the formwork

Sealing of edges and holes

At the production plant, coated plywood is protected with a coat of varnish along all four edges to protect it against moisture. You should restore this protection again after sawing or drilling.

Use sharp, suitable tools when working on the formwork panels.
Seal unprotected edges and drill holes at least once with edge protect



Lubricate before use

Treat the formwork panels regularly with a suitable release agent. Apply a thin and even film of release agent and smoothen it. Excess amount has to be removed with a cloth or a wiping mop. You can achieve the best results with high-quality concrete release agents such as PERI Clean, PERI Plasto Clean or PERI Bio Clean



After using the formwork

Clean after usage

Clean the formwork panels directly after striking.
Use only suitable cleaning tools to avoid damage (no high-pressure water cleaning).

Repair scratches or holes with PERI repair discs.
Filling is not recommended as the spackle will not permanently remain in the formwork panel.



After using the formwork, proper storing until the next use has to be:



Storage and transportation

- Protect against weather influence
- Protect the formwork panels against contact with water and direct exposure to sunlight.
- Ensure good ventilation and cleanliness of the formwork panels.
- Store the panels on even ground to avoid deflection.
- Storing of other building materials, such as e.g. concrete steel, on the formwork panels is to be avoided.
- Stacks of panels must only be transported while secured with strapping band



Fig.1 Timber formwork storage



Fig 2 De-nailed formwork

**Self-Check 2****Multiple Choice item**

Directions: Select the correct answer and encircle the letter of your choice

2. Which one of the following activities preserve the formwork?
 - A. Sealing of edges and holes
 - B Lubricate before use
 - C. Clean after usage
 - D. All of the above

2. Which one is not safe storage of materials?
 - A. Protect against weather influence
 - B. Protect the formwork panels against contact with water and direct exposure to sunlight.
 - C. Ensure good ventilation and cleanliness
 - D. None of the above

3. One is advantages or function of sealing.
 - A. Protect the form against moisture
 - B. Seal unprotected edges and drill holes at least once with edge protect
 - C. All are correct



Information Sheet 3	Cleaning, oiling and storing or stacking Steel components
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- **Oiling the surface**

Generally, a form-release coating (form oil) is applied when construction of the form is complete, and before placing reinforcing steel. Applying form oil immediately after stripping increases the likelihood of contaminating the workers handling and re-locating the form, and also makes the pieces more difficult to handle. Applying form oil after the bar is placed can lead to contamination of the bar. This does not pose an immediate hazard to the worker, but it can lead to the failure of the structure due to an insufficient bond between the bar and the concrete encasing it. In general terms, the more porous a surface is, the less slippery it will be. This is because the surface will absorb the form oil instead of the oil staying on the surface. So, if form oil is applied at the same rate to both plywood and metal formwork, the plywood may be less slippery because some of the oil will soak in, while with metal, the oil will lie on the surface.

Some form oils are flammable. Refer to the product label and the material safety data sheet (MSDS) to determine the flammability of the product you are using. If it's flammable, then you must comply with the Construction Regulation's requirement that at least one fire extinguisher be provided where flammable liquids or combustible materials are stored, handled, or used. Every worker who may have to use the fire extinguisher is required to be trained. All the time, review and understand the material safety data sheet (MSDS) for any hazardous product used, and follow all instructions including those regarding health hazards and required protection, as well as environmental issues.



✓ Oil for Steel Forms

Oil the wall and steel column forms before erecting them. You can oil all other steel forms when convenient, but they should be oiled before the reinforcing steel is placed. Use specially compounded petroleum oils, not oils intended for wood forms. Synthetic castor oil and some marine engine oils are examples of compound oils that give good results on steel forms.

- **Applying Oil:** - The successful use of form oil depends on how you apply it and the condition of the forms. They should be clean and have smooth surfaces. Because of this, you should not clean forms with wire brushes, which can mar their surfaces and cause concrete to stick. Apply the oil or coating with a brush, spray, or swab. Cover the form surfaces evenly, but do not allow the oil or coating to contact construction joint surfaces or any reinforcing steel in the formwork. Remove all excess oil.



Formwork Oil

Fig 3 Oiling formwork



Fig 4. Cleaning and Storage



- **Choosing a safe storage system**

Choose the storage system (or combination of storage systems) which best fits business needs and offers an appropriate level of safety. Consider the following:

- the physical characteristics of the stock (and any ancillary items) to be stored or handled, for example size, mass, shape, surface finish, center of gravity, or stability; the associated lifting and handling system(s) to be used which are appropriate for the particular stock range and storage system;
- maximum tonnages and volumes to be stored and their accessibility, with consideration for any foreseeable changes in the future;
- product turnover rate;
- location and space available;
- extent of banding (bundling) of supplied material and typical delivery quantities;
- stacking pattern, any likely stack failure modes, and foreseeable effects of banding failure on stack stability;
- use of battens, and the effect of batten failure on stack stability;
- environmental conditions (for example flooring; drainage; whether the storage system is in or out of doors; wind loading; and the likely weather conditions);
- impact loadings which the system needs to be able to withstand (for example from contact with vehicles, suspended loads and subsequent material collapses)



Fig 5. Steel formwork storage



Self-Check 3	Multiple Choice item
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Directions: Select the correct answer and encircle the letter of your choice

3. Which one of the following activities preserve the formwork?
- A. Sealing of edges and holes
 - B. Lubricate before use
 - C. Clean after usage
 - D. All of the above
2. Which one is not safe storage of materials?
- A. Protect against weather influence
 - B. Protect the formwork panels against contact with water and direct exposure to sunlight.
 - C. Ensure good ventilation and cleanliness
 - D. None of the above
3. One is advantages or function of sealing.
- A. Protect the form against moisture
 - B. Seal unprotected edges and drill holes at least once with edge protect
 - C. All are correct

Information Sheet 4	Stripping formwork		
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As with formwork erection, the stripping operation should be carried out in an orderly, systematic and progressive manner, considering the risks of falls, falling objects and manual task hazards in the now enclosed space.

Concrete becomes increasingly harder as time passes and it continues to cure. According to the Construction Regulation, formwork and falsework shall not be removed unless:-

- The concrete is strong enough to support its self-weight and any loads that may be applied to the structure, or
- The concrete and the structure are adequately re-shored.

The strength of the concrete is the most critical factor relating to the stripping and removal of formwork and subsequent re-shoring. It must be cured sufficiently to maintain its shape once the formwork is removed. The type and placement of re-shoring is determined by the concrete strength at time of stripping. Commonly, sample cylinders of concrete are cast at various stages of each pour to be used for testing. The concrete mix is designed to reach certain strength after a specific time. Compression tests are performed on the cylinders to verify that this strength has been reached. Once this has been confirmed through testing, the stripping process can begin.

Stripping forms before verifying cylinder strength is a dangerous & extremely risky practice so that don't do it. Under cured, "green" concrete has unpredictable characteristics, and cannot be trusted to stand unsupported. The strength of the concrete affects not only stripping and re-shoring, but it also affects the placement of guardrails. You must take great care to ensure that the concrete is cured enough to support the attachment of guardrail posts especially any posts that must be fastened into the concrete.

While formwork is being removed, workers must check the structure for loose concrete. Any rubble, debris, spalling, or over-pour must not be left on columns, walls, or other structures since it may fall unexpectedly and injure workers below. Remove such material when the forms are being stripped.



You need personal protective equipment during the stripping stage, especially gloves and eye protection. Concrete can chip easily, and there are countless places where pinches, cuts, scrapes, abrasions, and other injuries can occur. Wear eye protection, gloves, and long sleeves at all times when stripping formwork.

Formworks whether knock-down forms, fly forms or gang forms must be braced sufficiently to prevent it from falling, while allowing it to be broken free of the concrete. Falling formwork can hit workers and damage equipment.

Housekeeping is important at all stages of construction. It becomes critical when stripping forms because of the fast rate at which material and debris can accumulate in the work area. During stripping, the construction site becomes a demolition project, with material being dismantled and removed rather than installed. Depending on the nature of the formwork, much of the material can have sharp, broken, or uneven edges, and have nails protruding. The material is often taken from the forms and put on the ground. It is then cleaned from the ground after the forms are dismantled.

Therefore, workers must not be allowed to throw material to the ground from a work platform. Stripped material must be placed securely on the platform and then lowered by a controlled means to the ground.

- When assessing the risks from stripping formwork consider:
 - ✓ the number of people in the stripping crew
 - ✓ the sequence of stripping activities – this should detail how the frames and other supports should be removed i.e. how far U-heads are to be lowered
 - ✓ whether the support system will be completely removed in a zone before removing the formwork deck or whether the supports will be lowered slightly but remain under the formply while it is being removed
 - ✓ removing nails and sharp fixings before stacking the components
 - ✓ minimizing damage to the components
 - ✓ stacking the formwork components do not obstruct access ways or work areas
 - ✓ formwork components are not dropped or thrown from a building or structure
 - ✓ flatheads are not supporting the ends of bearers



- ✓ when back-propping is required or only part of the support system is to be removed, how the structural members will remain in place and the type and layout of members that will replace the formwork system
- ✓ other special requirements involved in the stripping and or building process e.g. checking of back-propping after post-tensioning
- ✓ providing lighting for the work area and surroundings, and
- ✓ Maintaining housekeeping, removing nails and rejected materials, stacking stripped formwork and removing tripping hazards e.g. concrete nails and brace anchor inserts from the floor.



Fig 4 Stripped formwork components



- **Bond reduction**

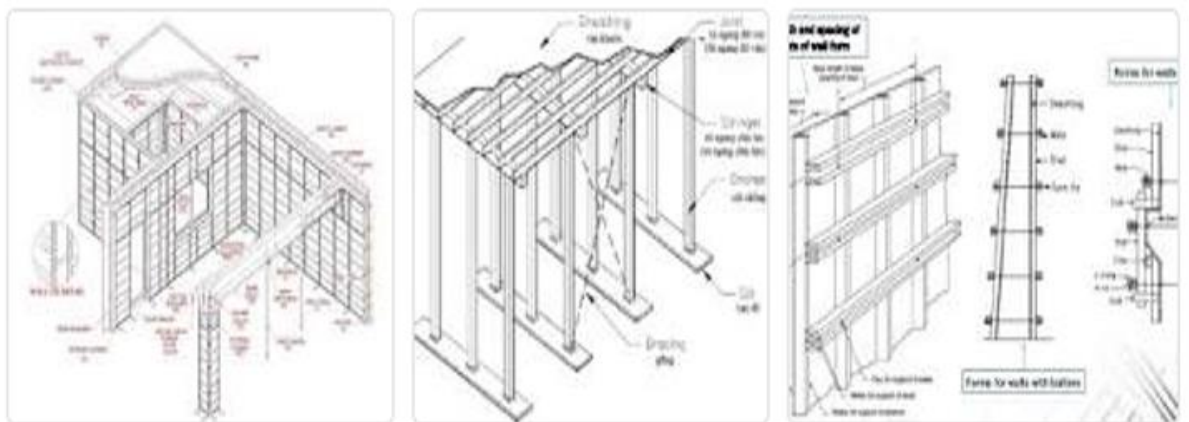
Stripping formwork is easier when the strength of the bond between the form material and the concrete is reduced. The bond will be dependent on the material characteristics and the smoothness of the form material. A liquid bond breaker can be used on wall and column forms to reduce the strength of the bond but use on floor forms is not encouraged because it can cause a slip hazard.

- **Drop stripping**

'Drop stripping' describes the method used when all of the formwork support system is removed and the formwork is then allowed to drop to the level below either by its own weight or by people levering it off.

Drop stripping should not be used. It can be very hazardous because the formwork is likely to fall uncontrolled and can hit people in the vicinity of the work.

Formwork frames should be erected progressively to ensure the installers' safety and the stability of the overall structure





- **Methods of removing/stripping Formwork**

Formwork should be planned and constructed in such a manner that it is possible to remove the different components in the following order of sequence:

- i. Shuttering forming vertical faces of walls, beams and columns sides, which bear no load but are used only to retain the concrete, should be removed first.
- ii. Shuttering forming soffit of slabs should be removed next, and c) shuttering forming soffit of beams, girders or other heavily loaded shuttering should be removed in the end.

Duration of time up to which the formwork should be kept in place depends upon many factors such as types of cement used, shape and position of the member, loads to be carried by the members and the temperature of the air. According to EBCS-2, the minimum formwork stripping periods for different elements of buildings are summarized as follows:

N.B.	Activity	Minimum duration
1	for non-load bearing parts of formwork (e.g. vertical formwork of beams; formwork for columns and walls)	18 hours
2	for soffit formwork to slabs	7 days
3	for props to slabs	14 days
4	for soffit formwork to beams	14 days
5	for props to beams	21 days

**Self-Check 4****Multiple Choice item**

Directions: Select the correct answer and encircle the letter of your choice

1. Removing/stripping formwork for soffit formwork to beams is
 - A. 21 days
 - B. 15 days days
 - C. 7 days
 - D. 14 days

2. Formwork and falsework shall not be removed unless
 - A. The concrete is strong enough to support its self-weight
 - B. The concrete and the structure are adequately re-shored
 - C. None of the above
 - D. All of the above

3. When assessing the risks from stripping formwork consider one of the following.
 - A. the number of people in the stripping crew

 - B. removing nails and sharp fixings before stacking the components

 - C. minimizing damage to the components

 - D. All are correct.



LAP Test	Practical Demonstration
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<p>Name: _____</p> <p>Date: _____</p> <p>Time started: _____</p> <p>Time finished: _____</p> <p>Instruction I: Given necessary templates, tools and materials you are required to perform the following task within 8 hours.</p> <p>Task 1. Remove edge boxing and bracing/strutting support</p>



Reference.

- Different Websites
- Internet
- Formwork Code of Practice
- formwork-cop-2016
- CIVL 392 - Chapter 6 – Formwork
- LCC_DOCS-11314877-v1-HS-PRO-028_Barricading_and_Safety_Signage_Procedure
- Construction sequence of a typical floor



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