



Skills for Employment Investment Program (SEIP)

COMPETENCY-BASED LEARNING MATERIAL (STUDENT GUIDE)

FOR

MASONRY

(CONSTRUCTION SECTOR)

**Finance Division, Ministry of Finance
Government of the People's Republic of Bangladesh**

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How to Use this Competency-based Learning Material

Welcome to the competency-based learning material for Masonry for use in construction works. These modules contain training materials and learning activities for you to complete in order to become competent and qualified as a skilled worker.

There are eight (8) modules that make up this course which comprises the skills, knowledge and attitudes required to become a skilled worker including:

1. Prepare masonry mortar/stucco
2. Carry out pavement laying work
3. Establish building lines, locate and build footer
4. Carry out brick/block work
5. Accomplish masonry surface plastering
6. Perform pattern stone finishing work
7. Perform wall panelling using bricks/stones
8. Apply waterproofing activities in construction

As a learner, you will be required to complete a series of activities in order to achieve each learning outcome of the module. These activities may be completed as part of structured classroom activities or simulated workplace demonstrations.

These activities will also require you to complete associated learning and practice activities in order to gain the skills and knowledge needed to achieve the learning outcomes. You should refer to **Learning Activity** pages of each module to know the sequence of learning tasks and the appropriate resources to use for each task.















This page will serve as the road map towards the achievement of competence. If you read the **Information Sheets**, these will give you an understanding of the work, and why things are done the way they are. Once you have finished reading the Information Sheets, you will then be required to complete the **Self-Check Quizzes**.

The self-check quizzes follow the Information Sheets in this learning guide. Completing the self-check quizzes will help you know how you are progressing. To check your knowledge after completion of the Self-Check Quizzes, you can review the **Answer Key** at the end of each module.

You are required to complete all activities as directed in the **Learning Activity and Information Sheet**. This is where you will apply your newly acquired knowledge while developing new skills. When working, high emphasis should be laid on safety requirements. You will be encouraged to raise relevant queries or ask the facilitator for assistance as required.

When you have completed all the tasks required in this learning guide, formal assessment will be scheduled to officially evaluate if you have achieved competency of the specified learning outcomes and are ready for the next task.

List of Icons

Icon Name	Icon
Module content	
Learning outcomes	
Performance criteria	
Contents	
Assessment criteria	
Resources required	
Information sheet	
Self-check Quiz	
Answer key	
Activity	
Video reference	
Learner job sheet	
Assessment plan	
Review of competency	

Module 1: Prepare masonry mortar/stucco



MODULE CONTENT

Module Descriptor: This module covers the skills, knowledge and attitudes to prepare masonry mortar/stucco which includes gathering mortar making tools, equipment and materials, preparing mortar mixing box/containment, making mortar/stucco, and cleaning and maintaining workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 22 hours



Learning outcomes:

Upon completion of the module, the student/trainee will be able to:

- 1.1 Gather mortar making tools, equipment and materials
- 1.2 Prepare mortar mixing box/containment
- 1.3 Make mortar/stucco
- 1.4 Clean and maintain workplace



Performance criteria:

1. Personal protective equipment (PPE) worn as required for the work performed
2. Tools, equipment and materials are gathered as per job requirement and check for usability
3. Mortar mixing box/containment cleaned before and after use
4. Sand and cement ratio are maintained and measured
5. Sand, cement and water are mixed in accordance with job specification
6. Appropriate transport used to carry materials at the workplace
7. Tools and equipment used are cleaned and stored as per standard practice



Learning Outcome 1.1 – Gather Mortar Making Tools, Equipment and Materials



Contents:

- Names and uses of personal protective equipment (PPE)
- List of main tools and equipment required to prepare mortar/stucco
- Collection, checking and selection for usability of the necessary tools and equipment
- Name of different types of cement and their uses
- Procedures of storage of cement
- Quality of water necessary in construction works
- Classification of sand and their uses



Assessment criteria:

1. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements.
2. Quantity and quality of tools and equipment identified and gathered according to job requirements.
3. Quantity and quality of different types of materials to be used are placed in designated area.
4. Necessary tools and equipment are checked for their usability.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth/apron, hand gloves, dust mask, safety glasses, ear plugs/ear muffs
- **Tools and equipment:** wheel barrow, sieve, measuring box, mortar mixing box/containment, bucket, mug, steel pan, shovel/spade, trowel and mortar mixer
- **Materials:** cement, sand and water



Learning Activity 1.1.1










Learning Activity	Resources/Special Instructions/References
Gather mortar making tools, equipment and materials	<ul style="list-style-type: none">▪ Information Sheets: 1.1.1, 1.1.2, 1.1.3▪ Self-Check Quizzes: 1.1.1, 1.1.2, 1.1.3▪ Answer Key: 1.1.1, 1.1.2, 1.1.3▪ https://www.sikana.tv/en/diy/masonry/safety-on-a-construction-sites




Information Sheet 1.1.1

Learning objective: to identify the personal protective equipment (PPE) used in a workplace.

Personal Protective Equipment (PPE):

<p><u>Safety Helmets:</u></p> <p>A hard hat is a type of helmet used in construction sites to protect the head from injury due to falling objects.</p>	
	<p><u>Eye Protector/Goggles/Safety Glasses:</u></p> <p>Goggles are forms of protective eyewear that usually enclose or protect the eye area.</p>
<p><u>Ear plugs/ear muffs:</u></p> <p>An earplug is a device that protects the user's ears from loud noises or the intrusion of water, foreign bodies, dust or excessive wind.</p>	
	<p><u>Dust Mask:</u></p> <p>Dust mask is necessary for dust protection in workplace.</p>
<p><u>Safety cloth (overalls)/apron:</u></p> <p>Apron has been designed to protect the body from injury in the workplace.</p>	
	<p><u>Safety vest:</u></p> <p>This is reflective safety equipment used to increase visibility of a worker.</p>
<p><u>Safety belt:</u></p> <p>This is used for fall protection of construction worker and also used for additional tools holding effective for high-rise building.</p>	
	<p><u>Safety harness:</u></p> <p>A belt/body harness is designed to catch and secure a person in case of falling while working at height level.</p>
<p><u>Hand gloves:</u></p> <p>These are designed to protect the hands while working and safeguarding of hands.</p>	

	<p>Safety shoes/Footwear/Boots:</p> <p>Safety shoes are used to protect the legs/feet from any harms or injuries.</p>
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Self-Check Quiz 1.1.1

Check your understanding by answering the following questions:

Fill in the blanks with the correct answer.

1. _____ is used to protect eyes from flying particles which may cause injury to the worker.
2. _____ is used to protect oneself from inhalation of harmful particulates.
3. _____ is used to protect the hands when working.
4. _____ used to protect one's feet from sharp object to fall.
5. _____ protects workers' ears while working from unwanted sounds that are created in the workplace.

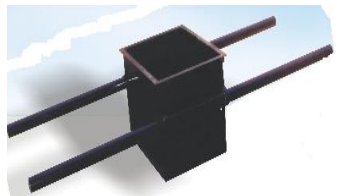




Information Sheet 1.1.2

Learning objective: to identify and gather appropriate tools and equipment for making mortar in a workplace

Tools and equipment:


To perform common construction works, requirements include the following tools and equipment.




<p>Measuring Box:</p> <p>It is made of metal sheet or timber and used to measure proportioning masonry materials like cement, sand and brick chips or stone chips.</p>	
 <p>Sieves for aggregate test/classification</p>	 <p>Sieves for removing foreign materials from aggregate</p>
<p>Sieve:</p> <p>A sieve is a device for separating wanted elements from unwanted material. It is necessary to separate the foreign materials from the fine and/or coarse aggregates.</p>	

	<p><u>Shovel:</u> A shovel is a <u>tool</u> for digging, lifting, and moving bulk materials, such as <u>soil</u>, <u>coal</u>, <u>gravel</u>, <u>snow</u>, <u>sand</u> etc.</p>	
	<p><u>Spade with handle:</u> A spade is a tool primarily used for digging of soil.</p>	
<p><u>Steel korai:</u> It is a metallic bowl with two handles, mainly used to carry and hold mixed mortar while working.</p>		
	<p><u>Bucket:</u> This is made of plastic or metallic, available on size or capacity and used to bring and measure water for the mix.</p>	
<p><u>Mug:</u> It is also made of plastic or metallic, used to measure and add water for the mix.</p>		
		<p><u>Mixer Machine:</u> This is a power-driven equipment used for mixing the mortar and/or concrete. For large scale, rapid and homogeneous mixing this is very useful equipment.</p>
<p><u>Mixing box/tray/tub/board:</u> These are made of plastic and/or asbestos/fiber to mix quickly and used for small scale & hand mixing purpose only.</p>		

Transport:

The following equipment is used to carry construction materials in workplaces.

<p><u>Wheel Barrow:</u> A wheel barrow is a small hand-propelled vehicle, usually with just one <u>wheel</u>.</p> 	<p><u>Trolley:</u> This is goods vehicle usually with four wheels of equal size mounted underneath it, to move construction materials.</p>
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<p><u>Rickshaw van</u>: It is a good vehicle usually with three wheels of equal size.</p> 	<p><u>Low bed truck/pick-up</u>: This is a power-driven vehicle and also known as delivery van.</p> 



Self-Check Quiz 1.1.2

Check your understanding by answering the following questions:

Fill in the blanks with the correct answer.

1. Proportioning of masonry materials like cement, sand and brick or stone chips _____ is required.
2. _____ is necessary to separate the foreign materials from the fine and/or coarse aggregates.
3. _____ is a helping tool made of steel with wooden handle generally used for mixing the ingredients of mortar and transfer mixed mortar.
4. For large scale, rapid and homogeneous mixing _____ is very useful power-driven equipment for mixing the mortar and/or concrete.
5. To move or shift construction materials or items in the worksite, having one wheel and used by a single person is known as _____.



Information Sheet 1.1.3

Learning objective: to identify and gather appropriate masonry materials for making mortar in the workplace.

Masonry materials:

The following materials are used in workplace for preparation of mortar/concrete.

- **Cement:**

Cement is a binder substance used in construction which sets, hardens and adheres to other materials and binding them together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete.

Tests for cement at construction site:

Colour Test: The colour of the cement should be uniform.

Presence of Lumps: The cement should be free from any hard lumps.

Cement Adulteration Test: The cement should feel smooth when touched or rubbed in between fingers.

Temperature Test: If hand is inserted in a bag of cement or heap of cement, it should feel cool and not warm.

Float Test: If a small quantity of cement is thrown in a bucket of water, the particles should float for some time before it sinks.



▪ **Aggregates:**

Fine aggregate (sand):

Sand is an extremely needful material for the construction and must be clean, free from waste stones and other harmful impurities. So, it is better to sieve and wash before use the same. Sand is mainly classified as follows:

According to grain size, sand is classified into three different forms:

Fine sand (suitable for plastering) - FM: 1.5

Medium sand (suitable for brick work) - FM: 2.0

Coarse sand (suitable for concrete casting) - FM: 2.5

Tests for sand at construction site:

1. Organic impurities test
2. Silt content test
3. Particle size distribution
4. Bulking of sand



Fine sand



Medium sand



Coarse sand

Coarse aggregate (chips):

The coarse aggregates are important materials for producing concrete. Various sizes of coarse aggregates are useful for building different components of structure.



Gravel stone chips



Broken stone chips



Broken brick chips (khoa)

▪ **Water:**

Water is one of the most important elements in construction, required for preparation of mortar, mixing of cement concrete and for curing work etc. during construction work. The quality and quantity of water has much effect on the strength of mortar and cement concrete in construction work.

Quality of Water: The water used for mixing and curing should be clean and free from harmful impurities.

Quantity of Water: The required quantity of water is used to prepare mortar or concrete, but in practice it is seen that more water is mixed to make the mix workable. This is a bad practice and additional water weakens the strength of cement paste.

Just checking:

1. *What are the uses of cement?*
2. *State the uses of aggregate.*
3. *What kind of water is considered for masonry works?*



Self-Check Quiz 1.1.3

Check your understanding by answering the following questions:

Write the correct answer for the following

1. What is cement?
2. Classify fine aggregates as per grain sizes and mention their suitability of uses.
3. What are the general coarse aggregates used for making concrete?
4. State the quality of water that suitable for mixing masonry materials and curing purposes.
5. Mention the main disadvantages of mixing too much water in mortar and concrete.



Learning Outcome 1.2 - Prepare Surface Prepare Mortar Mixing Box/Containment



Contents:

- Importance and necessity of cleaning mortar mixing box/containment:
 - Methods of cleaning: dusting, shaking and beating, sweeping, mopping and washing
 - Tools and equipment required for cleaning: dusters, polishing clothes, brooms, brushes, buckets and cotton rags
 - Cleaning materials: water, detergents and abrasives
 - Schedule of cleaning: weekly/monthly, spring/yearly and any time before and after use
- Advantages of proper placement of mortar mixing box/containment



Assessment criteria:

1. Mortar mixing box/containment is cleaned and prepared as per job requirement.
2. Mortar mixing box/containment is placed properly.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** Safety shoes, safety cloth/apron, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, mug and mortar mixing box/containment, cleaning tools and materials
- **Materials:** water



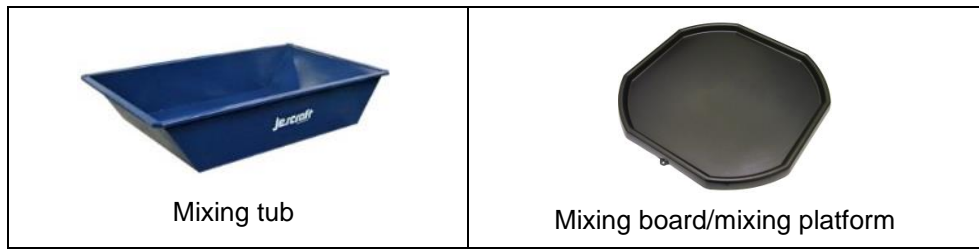
Learning Activity 1.2.1

Learning Activity	Resources/Special Instructions/References
Prepare mortar mixing box/containment	<ul style="list-style-type: none">▪ Information Sheet: 1.2.1▪ Self-Check Quiz: 1.2.1▪ Answer Key: 1.2.1



Information Sheet 1.2.1

Learning objective: to identify, clean and prepare the mortar mixing box/containment used in the workplace. Mortar mixing box/containment also named as mixing tub or board or tray. These are made of thick plastic and/or asbestos/fibre to mix quickly and used for small scale and hand mixing only.



Cotton rags: These are old cloth and used for cleaning the tools, equipment and other items.



Cotton rags



Self-Check Quiz 1.2.1

Check your understanding by answering the following questions:

Fill in the blanks with the correct answer:

1. _____ is used to mix the mortar for small scale and hand mixing.
2. Mixing board or mixing tray is used to mix the mortar for _____ purposes.
3. Mixing board or mixing tray is made of _____.



Learning Outcome 1.3 – Make Mortar/Stucco



Contents:

- Types of mortar
- Mortar mixing ratio
- How to mix mortar
- Methods of mixing mortar
- Water ratio
- Transport and handling of mortar



Assessment criteria:

1. Mixing tools and equipment to be used are checked according to job requirements.
2. Materials are laid on mortar mixing box as per instruction.
3. Cement, sand and water are mixed according to specified proportion and consistency/workability.
4. Proper handling and use of mixing tools and equipment are observed.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth/apron, hand gloves, dust mask, safety glasses, ear plugs/ear muffs
- **Tools and equipment:** measuring box, mixing box/containment, shovel/spade, pails (bucket, mug), water storage drum, one bagger concrete mixer
- **Materials:** cement, fine aggregates, coarse aggregates, potable water



Learning Activity 1.3.1

Learning Activity	Resources/Special Instructions/References
Make mortar/stucco	<ul style="list-style-type: none"> ▪ Information Sheet: 1.3.1 ▪ Self-Check Quiz: 1.3.1 ▪ Answer Key: 1.3.1 • How to Mix Cement Mortar by hand: https://www.youtube.com/watch?v=X0q_2VuFUOI • Bucket Mortar Mixer: https://www.youtube.com/watch?v=IORIZ1shRIM&t=8s



Information Sheet 1.3.1

Learning Objective: to maintain proportion of materials, water-cement ratio for making masonry mortar/stucco.

□ **General information:**

- Mortars are typically made from a mixture of sand, a binder, and water. The most common binder since the early 20th century is Portland cement, but the ancient binder lime mortar is still used in some new construction.
- The basic mix ratio for concrete is one-part water, two parts cement and three parts sand. An alternative ratio is one-part cement, two parts sand and three parts gravel with enough water added until the mixture reaches the consistency of thick mud.
- Portland and masonry cement are measured by the bag. A 94-pound bag is standard. Lime comes in 50-pound bags. Masonry sand is usually sold loose and delivered by a truck and is measured by a measurement box.
- The cement or mortar is mixed by first adding a portion of the water. The sand and cement are then poured into the water, and the mixture is stirred for several minutes. More water, cement or sand can be added if the mixture is too wet or dry.
- A basic concrete ratio is one-part cement, two parts sand, and three parts gravel, slowly mixing in water until workable. The mixture should not be too stiff or too sloppy. Too much water results in weak concrete. Too little water results in a concrete that is unworkable.

□ **Mortar Mixing Ratio:**

1. For cement mortar to lay bricks in foundations the ratio is used: Cement: Sand (1:4)
2. For cement mortar to plaster brick walls the ratio is used: Cement: Sand (1:6)
3. For cement mortar to plaster RCC surfaces the ratio is used: Cement: Sand (1:4)
4. For cement mortar to water proofing works the ratio is used: Cement: Sand (1:2)
5. For Lime concrete works on roof the ratio of the ingredients is used: Lime: Surki: Khoa (2:2:7)
6. For Mass cement concrete works the ratio of the ingredients are used: Cement: Sand: Chips (1:3:6)
7. RCC works for a simple building the ratio of the ingredients is used: Cement: Sand: Chips (1:2:4)
8. RCC works for a high rise building the ratio of the ingredients is used: Cement: Sand: Chips (1:1.5:3)
9. RCC works with very thin members the ratio of the ingredients is used: Cement: Sand: Chips (1:1.25:2.5)
10. Amount (percent) of water by weight of cement is sufficient to give it necessary consistency for 1:4 mortars: 75%.

□ **How to mix cement:**

Preparing the Dry Mix:





- Prepare a leakproof level platform.
- Collect required amount of cement, sand and gravel.
- Sieve the sand to remove the foreign materials
- Open the cement, gravel, and sandbags. For mixing concrete: use small spade to shovel a ratio of 1 part cement, 2 parts sand, and 3 parts gravel. For mixing mortar: use small spade to shovel a ratio of 1 part cement and 2 parts sand into the wheelbarrow.
- Mix the ingredients thoroughly with your spade to ensure they are well combined unique colour.

Incorporating Water into the Dry Mix:

- Pour a small amount of water into the wheelbarrow. Be sure to measure out a known amount, so that you can replicate the same consistency with successive batches of concrete. If pouring your water into a bucket before incorporating into the dry mix, mark the water level on your bucket with a marker. This way, you can quickly fill the bucket without measuring out the water each time you mix a new batch.

- Start with 3/4 of the dry mix. In a wheelbarrow or other mixing container, agitate about 3/4 of the dry mix with all of the water. This first mix will appear a bit soupy because of the excess water, but it should be easy to mix.
- Add the remaining 1/4 of dry mix to the soupy cement mix. Mixing will become a little more difficult at this point. Mix until the finished cement is thick and wet.
- Pour the mixed mortar immediately into the assigned place. This step needs to be completed as soon as possible after mixing.
- Clean up the tools and equipment as soon as possible.

□ **How to Mix Mortar (pictorial representation):**

Task Number	Description of Task	Picture
1	Prepare platform, sieve sand, pouring mortar mix into equally laid sand on a level leak proof platform for mixing	
2	Mixing mortar and sand together	
3	Add water to the sand and mortar mix and continue to mix	
4	Turn the sand and mortar mix over on itself to mix thoroughly	
5	Add small amounts of water using a watering can to the mix to ensure the right consistency	

□ **Tips on Mixing Mortar:**

- If the mortar does begin to dry while applying, add more water.
- Try to use the same materials and use the exact amount of material batch after batch.
- You can use a pail bucket to make sure you are using the same amount of material for subsequent batches.
- Mix mortar for not less than three minutes and not more than five minutes after the last materials have been introduced into the mixer.
- Mortar is good for one and a half hour. Once that time has passed, discard mortar because it starts to lose some of its characteristics.

□ **Did you know?**

1. *The fresh mix cement mortar must be used within 45 minutes.*
2. *Cement water kills grass.*



JOB SHEET 1

Qualification:	Masonry		
Learning unit:	Prepare cement mortar/stucco		
Learner name:			
Personal protective equipment (PPE):	Hand gloves, visibility vest, safety goggles, safety boots, hard hat and dust mask		
Materials:	Cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water		
Tools and equipment:	One bagger concrete mixer, mixing box/containment, shovel/spade, pails (bucket, mug), measuring box, wheel barrow		
Performance criteria:	<ol style="list-style-type: none"> 1. Distemper materials are mixed with water as requirement. 2. Horizontal or vertical coating is thoroughly applied on the working surface from top to the bottom carefully or vice-versa. 3. Vertical or horizontal coating is then applied after the previous coating or surface is dried off properly or vice versa. 4. Another coating should be applied up to get well finishing. 5. Quality of distemper is checked and rectified as required. 		
Measurement:	<ul style="list-style-type: none"> ▪ Carefully take the measurement and calculate the quantity of mortar ▪ Quantity of materials to be taken batch wise as per requirement 		
Notes:	<ul style="list-style-type: none"> ▪ Cement mortar is prepared by mixing cement and sand in dry state and then adding required amount of water in it and mixing them thoroughly. 		
Procedure:	<ol style="list-style-type: none"> 1. Take one bag of cement, which has a volume of nearly 0.035m^3. 2. Then measure required quantity of dry sand using a box measure. A box has a volume of 0.035m^3. For example, if you are preparing a cement mortar of the ratio 1:4 (i.e. 1 part cement and 4 parts of sand), then for one bag of cement take 4 boxes of sand. 3. First spread the measured amount of sand on a water tight platform or on a steel trough in equal thickness. 4. Spread the cement over the sand in equal thickness. 5. Then mix them dry by turning over & over, backward & forward several times by a shovel/spade/mixer, till the mixture looks uniform in colour. 6. Out of this dry cement & sand mix, take out only that amount of mix which can be used within 30 minutes, and form it into a heap. 7. Make a small depression on top of the heap. 8. Add required amount of water so as to give it required consistency, to the centre of the heap. 9. Mix the whole mass thoroughly for 5 to 10 minutes by means of a shovel/spade/mixer (mix minimum 3 times). 10. Water of amount 75% of weight of cement is just sufficient to give it necessary consistency for 1:4 mortars. 		
Learner signature:		Date:	
Assessor signature:		Date:	
Quality Assurer signature:		Date:	
Assessor remarks:			

Individual/Group Activity:

- Watch the video on 'How to mix cement mortar by hand' and summarise key points (if facilities available)
- Mix the mortar following the Job Sheet 1 (see above)

Field Visit:

- Visit a construction site where painting works going on in the neighbourhood.
- Observe some activities there like:
 - What tasks are being performed?
 - Which tools are being used and for what purpose?
 - Are the workers wearing adequate PPE? List the names.
 - Anything more observed you may mention.
- Fill-up the 'Field Visit Format' given and submit to your trainer.
- Present the experience group wise as per instruction of your trainer.



Self-Check Quiz 1.3.1

Check your understanding by answering the following questions:

Read and analyse the following statements carefully. Choose the best answer and write the letter only in your answer sheet.

1. For cement mortar to lay bricks in foundations the ratio is used
 - a. Cement: Sand (1:2)
 - b. Cement: Sand (1:3)
 - c. Cement: Sand (1:4)
 - d. Cement: Sand (1:8)
2. For cement mortar to plaster brick walls the ratio is used
 - a. Cement: Sand (1:2)
 - b. Cement: Sand (1:3)
 - c. Cement: Sand (1:4)
 - d. Cement: Sand (1:6)
3. For cement mortar to plaster RCC surfaces the ratio is used
 - a. Cement: Sand (1:2)
 - b. Cement: Sand (1:4)
 - c. Cement: Sand (1:6)
 - d. Cement: Sand (1:8)
4. RCC works for a simple building the ratio of the ingredients is used
 - a. Cement: Sand: Chips (1:3:6)
 - b. Cement: Sand: Chips (1:4:8)
 - c. Cement: Sand: Chips (1:2:4)
 - d. Cement: Sand: Chips (1:1.5:3)
5. Amount (percent) of water by weight of cement is just sufficient to give it necessary consistency for 1:4 mortars?
 - a. 40%
 - b. 50%
 - c. 60%
 - d. 75%



Learning Outcome 1.4 - Clean and Maintain Workplace



Contents:

- Importance and necessity of cleaning tools & equipment and work place
- Methods of cleaning, tools and equipment required for cleaning
- Lubricants
- Advantages of proper storing of tools and equipment; types of storage



Assessment criteria:

1. Tools and equipment are properly cleaned after use.
2. Appropriate tools and equipment are lubricated according to standard procedures.
3. All tools and equipment are stored following the standard procedures.
4. Waste materials are disposed as per instruction in proper place.
5. Workplace is cleaned and kept in safe state in line with OHS regulations.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth/apron, hand gloves, dust mask, safety goggles
- **Cleaning tools and equipment:** brooms, dusters, dust pans, cleaning brushes, mops, waste containers and cotton rags
- **Materials:** water, detergents, abrasives, bleaches, lubricants



Learning Activity 1.4.1

Learning Activity	Resources/Special Instructions/References
Clean and maintain the work area	<ul style="list-style-type: none"> ▪ Information Sheet: 1.4.1 ▪ Self-Check: 1.4.1 ▪ Answer Key: 1.4.1 ▪ https://en.wikipedia.org/wiki/Cleaning_agent



Information Sheet 1.4.1

Learning Objective: to clean, dry, lubricant and store tools and equipment as per standard procedures and clean the work area.

General information:

After masonry works cleaning is very important and essential for both tools and equipment used for and the workplace. To keep the tools and equipment clean, extra attention and experience required considering how to remove dirt, including dust, stains, bad smells and clutter on surfaces. For this, we can use some cleaning agents as follows:

- Water (the best cleaning agent)
- Soap or detergent
- Calcium hypochlorite (powdered bleach)
- Sodium hypochlorite (liquid bleach)
- Acetic acid (vinegar)

Methods of cleaning:

- Dusting
- Shaking and beating
- Sweeping
- Mopping
- Washing
- Polishing





Rough Cleaning:



- First remove all debris either by hand or use of brushes, brooms, scrapers, squeegees etc.
- Collect and dispose of all debris appropriately
- A warm rinse is recommended to complete the rough cleaning

Removal of Excess Water:

- Any areas where water has extensively pooled may serve as a medium for bacteria growth and should be dried
- Equipment that has the potential to rust should also be dried

Tools and equipment for cleaning:

<u>Broom:</u> A broom is a cleaning tool consisting of usually stiff fibres, also known as coconut broom.	
<u>Dusters/Dust protector:</u> A duster/dust protector is a light, loose-fitting long coat.	
<u>Dust pan:</u> A dustpan is used in combination with a broom. It is used to collect dust/waste/small debris.	
<u>Cleaning brushes:</u> Cleaning brushes are tool with bristles, wire or other filaments, used for cleaning, painting, and surface finishing, and for many other purposes.	

<p>Mop:</p> <p>A mop is a bundle of coarse strings or a piece of cloth, sponge, or other absorbent material, attached to a stick. It is used to soak up liquid, for cleaning floors and other surfaces, to mop up dust, or for other cleaning purposes.</p>	
<p>Waste container:</p> <p>A waste container is a container for temporarily storing waste and is usually made out of metal or plastic. Some common terms are dustbin, garbage can, trash can and dumpster.</p>	










Lubricant:

- A lubricant is used to reduce friction between surfaces
- Adequate lubrication allows smooth operation of equipment, reduces the rate of wear and prevents excessive stresses

Advantages of proper storage of tools and equipment:

- Ensures that tools and equipment remain in good condition and last for a long time.
- Easy to find when needed and are less likely to be lost
- Productivity is increased because time is not lost looking for tools and equipment






Common types of storage:

 <p>Cabinets</p>	 <p>Bin</p>	 <p>Tool box</p>
 <p>Bucket bag</p>	 <p>Tote bag</p>	 <p>Storage bag</p>
 <p>Tool racks</p>	 <p>Work bench</p>	 <p>Shelving</p>



Self-Check Quiz 1.4.1

Check your understanding by putting the correct answer and use as follows:

No.	Figure	Write the Name
1		
2		
3		
4		
5		



ANSWER KEY

ANSWER KEY 1.1.1

1. Eye Protector/Goggles/Safety Glasses
2. Dust Mask
3. Hand gloves
4. Safety shoes/Footwear/Boots
5. Ear protector/Ear plugs/ear muffs

ANSWER KEY 1.1.2

1. Measuring box
2. Sieve
3. Shovel
4. Mixer machine
5. Wheelbarrow

ANSWER KEY 1.1.3

1. Cement is a binder substance used in construction which sets, hardens and adheres to other materials and binding them together.
2. As per grain size fine aggregates (sand) are three types:
 - Fine sand (suitable for plastering)-FM: 1.5
 - Medium sand (suitable for brick work) -FM: 2.0
 - Coarse sand (suitable for concrete casting)-FM: 2.5
3. The following coarse aggregates are generally using for making concrete: gravel stone chips, broken stone chips and broken brick chips (khoa) with $\frac{3}{4}$ " downgraded sizes.
4. Potable water is suitable for mixing masonry materials and curing purposes.
5. Too much water in mortar and concrete are the causes of weakens the strength.

ANSWER KEY 1.2.1

1. Mixing board or mixing tray.
2. Masonry.
3. Thick plastic and asbestos/fibre.

ANSWER KEY 1.3.1

1. C
2. D
3. B
4. C
5. D

ANSWER KEY 1.4.1

1. Broom
2. Mop

3. Bin
4. Tool box
5. Dust pan with brush

Module 2: Carry out pavement laying work



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes to carry out pavement laying work which includes gathering pavement laying tools, equipment and materials, setting base for paving work and preparing raw materials, performing the laying of paving bricks/blocks, and cleaning and maintaining the workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 40 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 2.1 Gather pavement laying tools, equipment and material
- 2.2 Set-up base for paving work and prepare raw materials
- 2.3 Perform laying of brick/block
- 2.4 Complete laying of brick/block
- 2.5 Clean and maintain workplace



Performance Criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Bricks, paving tiles/blocks are selected, collected and gathered at worksite.
3. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements.
4. Reference building lines are correctly identified and located as per job requirements.
5. Forms for pavement making are built as per job requirements.
6. Base is levelled and tempered in accordance with job requirements.
7. Mortar/grouting materials prepared and used as per specification and standard procedures.
8. Proper alignment and level are maintained in accordance with the job requirements.
9. Gaps between bricks/blocks are filled up with appropriate fillers.
10. Curing is done before use of the newly built pavement.
11. Tools and equipment are properly cleaned after use.
12. All tools and equipment are stored following the standard procedures.



Learning Outcome 2.1 - Gather Pavement Laying Tools, Equipment and Material



Contents:

- List of main tools and equipment required pavement laying works
- Different types of bricks, paving tiles/blocks
- Names and uses of personal protective equipment (PPE)
- Name of different types of cement and their specific uses
- Quality of water necessary in construction works
- Classification of sand and their use



Assessment criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Bricks, paving tiles/blocks are selected, collected and gathered at work site.
3. Quality mortar/grouting materials are selected, collected and placed in designated area.
4. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, steel pan, mug, measuring box, shovel/spade, sieve, mortar mixer and mortar mixing box/containment, measuring tools, plumb bob, spirit level, nylon string, nail, mason's hammer, pointed trowel
- **Materials:** bricks/blocks, paving tiles, cement, sand and water



Learning Activity 2.1.1

Learning Activity	Resources/Special Instructions/References
Gather pavement laying tools, equipment and materials in line with the work task	<ul style="list-style-type: none"> ▪ Information Sheets: 2.1.1, 2.1.2, 2.1.3 ▪ Self-Check Quizzes: 2.1.1, 2.1.2, 2.1.3 ▪ Answer Key: 2.1.1, 2.1.2



Information Sheet 2.1.1

Learning Objective: to identify the personal protective equipment used in the workplace.

Personal Protective Equipment:

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Information Sheet 2.1.2

Learning Objective: to identify and gather appropriate tools and equipment used in the workplace.

Tools and equipment:

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 - 11)

Soil compacting machines: There are different types of rollers and other soil compaction equipment available. Use of *soil compacting machines* depends on soil types and soil moisture.



Information Sheet 2.1.3

Learning Objective: to identify and gather appropriate materials used in pavement laying works.

□ **Masonry materials:**




Brick: is building material used to make walls, pavements and other elements in masonry construction. A brick can be composed of clay-bearing soil, sand, and lime, or concrete materials. Bricks are produced in numerous classes, types, materials, and sizes.


Tests of bricks:

- Absorption test: For a good quality brick the amount of water absorption should not exceed 20% of weight of dry brick.
- Crushing strength test: Minimum crushing strength of brick is 3.50N/mm². If it is less than 3.50 N/mm², then it is not useful for construction purpose.
- Hardness test: For this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.
- Shape and size: All bricks used for construction should be of same size. The shape of bricks should be purely rectangular with sharp edges.
- Colour test: A good brick should possess bright and uniform colour throughout its body.
- Soundness test: In this test, 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break.
- Structure of brick: To know the structure of brick, pick one brick randomly from the group and break it. Observe the inner portion of brick clearly. It should be free from lumps and homogeneous.
- Efflorescence Test: To know the presence of soluble salts in a brick, placed it in a water bath for 24 hours and dry it in shade. After drying, observe the brick surface thoroughly. If there is any white or grey colour deposits, then it contains soluble salts and not useful for construction.

			
Solid Brick	Hollow Brick	Special Bricks	Part of a Brick wall

Block: is a similar term referring to a rectangular building unit composed of similar materials but is usually larger than a brick.

		
Concrete block	Paving blocks	Hollow block

<p>Paving tiles:</p> <p>Mainly used on concrete slab for walkway, parking area, foot path, roof top etc.</p>	 <p>Different types of paving tiles</p>
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- **Cement:**
Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 12 – 14)
- **Aggregates:**
Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 12 – 14)
- **Water:**
Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 12 – 14)



Learning Outcome 2.2 – Set-up Base for Paving Work and Prepare Raw Materials



Contents:

- Detail building plan/work drawing marked for brick/block laying
- Shape of the paving area
- Levelling and tempering of base
- Mortar/concrete
- Concreting raw materials:
 - Wood
 - Metal
 - Plastic



Assessment criteria:

1. Reference building lines are correctly identified and located as per job requirements.
2. Forms for pavement making are built as per job requirements.
3. Base is levelled and tempered in accordance with workplace requirement.
4. Mortar/grouting materials prepared and used as per specification and standard procedures.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, pointed trowel, form work, batter board, guide post
- **Materials:** bricks/blocks, cement, sand, gravel, water, forms (wood, metal & plastic)



Learning Activity 2.2.1

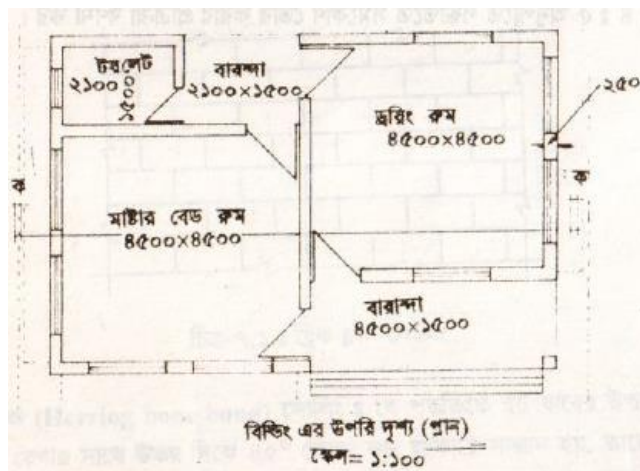
Learning Activity	Resources/Special Instructions/References
Set up base for paving work and prepare raw materials	<ul style="list-style-type: none"> ▪ Information Sheets: 2.2.1, 2.2.2 ▪ Self-Check Quizzes: 2.2.1, 2.2.2 ▪ Answer Key: 2.2.1, 2.2.2



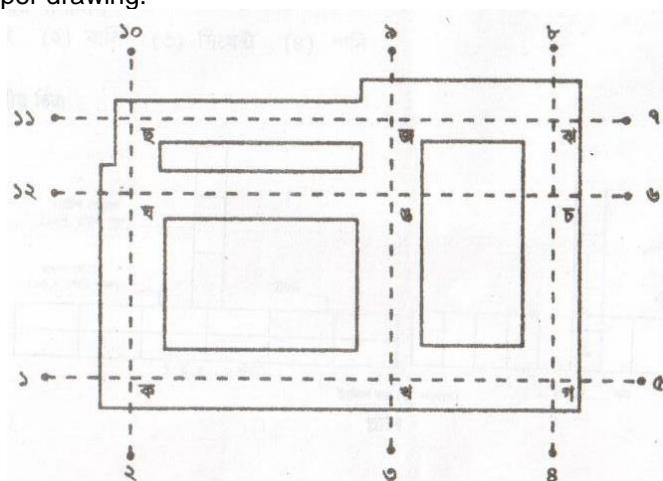
Information Sheet 2.2.1

Learning Objective: to set-up base for paving work and preparation of raw materials uses.

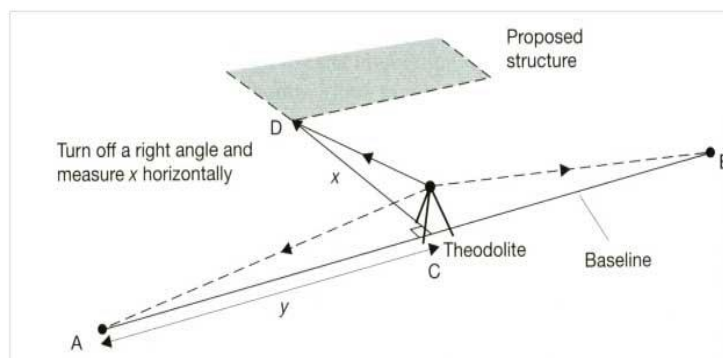
- **Floor plan:** is a drawing to scale, showing a view from above, of the relationships between rooms, spaces and other physical features. Floor plans may include notes for construction to specify finishes, construction methods, or symbols for electrical items.



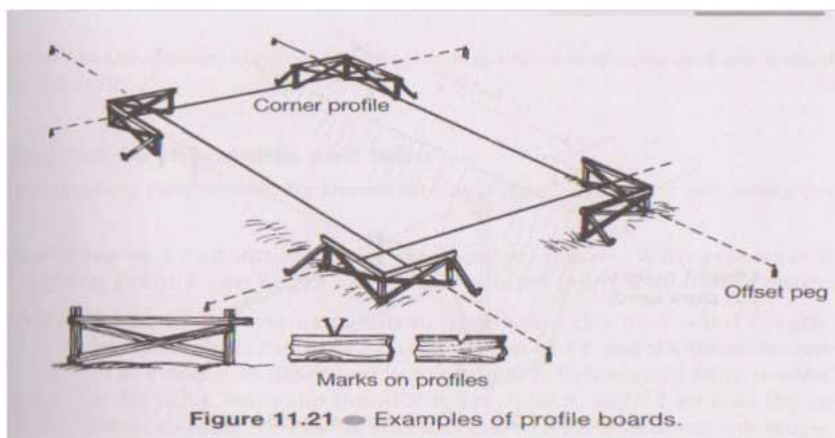
- **Layout of building:** The real meaning and purpose of setting out (layout) is to transfer the plan, length and width of its foundation on the ground so that the foundation can be excavated for construction of purposed building as per drawing.



- **Base line:** is a straight reference line with respect to which corners of the building are located on the ground. It may be outer boundary of a road or curb or boundary of the area or simply a line joining any two points.



- **Batter boards and offset pegs:** Once points specifying the layout are located on ground pegs are driven in the ground at that spot. Once excavations for foundations begin, the corner pegs will be lost. To avoid these extra pegs called offset pegs are used. Batter boards are normally erected near each offset peg and are used to relocate the points after the excavation has been done.



- **Extending lines:** Since the corner pegs of the building are to be removed during excavation these points are transferred outside that periphery by extending lines and driving pegs in the ground.
- **Centre line:** Centre line divides the plan into two equal parts. This can be marked in the field with the help of baseline. This line is very necessary and useful for layout.
- **Orientation of building:** Good orientation of building saves energy and provides comfortable living as well. To get maximum ventilation and natural light in your house, make sure the building is properly oriented. Orientation of building saves energy and provides comfortable living as well.



Self-Check Quiz 2.2.1

Check your understanding by answering the following questions:

Put the correct word(s) on the blank space.

1. To transfer the plan, length and width of its foundation on the ground so that the foundation can be excavated for construction of purposed building as per drawing is known as _____.
2. _____ is a straight reference line simply joining two points with respect to which corners of the building are located on the ground.
3. _____ line is very necessary and useful for layout.
4. To relocate the points after the excavation has been done _____ are normally erected near each offset peg.



Information Sheet 2.2.2

Learning Objective: to identify and quality of formwork and removal of formwork used in the workplace.

- **Formwork:** This is the term given to either temporary or permanent moulds into which concrete or similar materials are poured.
- **Types of Formwork:**

Traditional timber formwork:

The formwork is built on site out of timber and plywood

Engineered Formwork System:

This formwork is built out of prefabricated modules with a metal frame (usually steel or aluminium).



Steel frame formwork system



Aluminium formwork system



Timber formwork system

- **Coffor:** is a structural stay-in-place formwork system to build constructions in concrete. That is, coffor remains in the construction after concrete is poured and acts as reinforcement. Coffor is delivered completely assembled from the factory. No assembly is necessary on the construction site.
- **Good formwork:**
 - a. It should be strong enough to withstand loads.
 - b. It should be rigidly constructed so as to retain its shape.
 - c. The joints in the formwork should be tight against leakage of cement grout.
 - d. Construction of formwork should permit removal of various parts in desired sequences without damage to the concrete.
 - e. The formwork should be set accurately to the desired line and levels should have plane surface.
- **Removal of formwork:**
 - a. Shuttering forming the vertical faces of walls, beams and column sides should be removed first as they bear no load but only retain the concrete.
 - b. Shuttering forming soffit of slabs should be removed next.
 - c. Shuttering forming soffit of beams, girders or other heavily loaded shuttering should be removed in the end.

Table 1

No.	Description of structural member	Period of time
1	Walls, columns and vertical sides of beams	Minimum 3 days
2	Slabs and beam soffits (props left under)	Minimum 28 days
3	Removal of props to slabs, beams and arches	Minimum 28 days

- Formworks are measured in terms of area. So, any unit such as square meter, square foot, square centimetre can be adopted. But generally, square meter and square foot of the contact area with concrete is taken as the unit of measurement.



Self-Check Quiz 2.2.2

Check your understanding by answering the following questions:

Write the correct answer for the following questions:

1. What are the major materials used in formworks?
2. Which type of formwork remains in the construction after concrete is poured and acts as reinforcement?
3. Write the period of removal of formwork for walls, columns and vertical sides of beams.
4. Write the period of removal of formwork for slabs.



Learning Outcome 2.3 - Perform Laying of Bricks/Blocks



Contents:

- Procedures in installing horizontal/vertical guide for brick/block
- Important steps for brick/block laying
- Mortar/concrete:
 - Lime mortar
 - Lime cement mortar
 - Cement sand mortar
 - Cement concrete
- Setting and alignment of lines:
 - Base line
 - Reference line
 - Paving line
- Setting out construction lines, perpendiculars and arcs:
 - Fastening string lines
 - Establishing straight lines
 - Setting out a perpendicular
 - Setting out arcs and curves
- Methods of bedding:
 - Individual
 - Screeding
 - Spot
- Pattern and layouts:
 - Single size pattern
 - Multi-size pattern
 - Random



Assessment criteria:

1. Paving line and perpendicular line are set-up at two ends of the line as per plan
2. Mortar is spread on the base/edge of brick/block according to job specifications.
3. Batter board at ± 3 mm tolerance for proper alignment is used as required.
4. Bricks or blocks are positioned/laid according to pattern design/specifications/locations.
5. Proper level is maintained in accordance with the job requirements.
6. Constant checking of plumpness is done during brick/block laying.



Resources required:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, wooden float, pointed trowel, form work, batter board, guide post
- **Materials:** bricks/blocks, cement, sand and water



Learning Activity 2.3.1




Learning Activity	Resources/Special Instructions/References
Perform laying of brick/block	<ul style="list-style-type: none"> ▪ Information Sheet: 2.3.1 ▪ Self-Check Quiz: 2.3.1 ▪ Answer Key: 2.3.1 ▪ www.pavingexpert.com/bpvseq01.htm










Information Sheet 2.3.1

Learning Objective: to perform laying of brick/block in a workplace.

- ☐ **Pavement:** is any surfaced construction used to carry foot or vehicular traffic. It includes footpaths, patios, hard standings, roads, driveways, motorways, and even airport runways.
- ☐ **How to lay paving bricks/blocks (pictorial representation):**

<p>Step 1: Preparation</p> <p>The area of the planned paving should be marked out in advance, allowing approximately 300mm over at each free edge to make the handling of materials easier.</p>	
<p>Step 2: Excavation</p> <p>Dig off as required and dispose of spoil.</p>	
<p>Step 3: Sub-base</p> <p>Spread, level and compact a minimum 100mm thick layer. There should be no voids within the sub-base - any such voids should be filled with stone dust or grit sand and compacted <i>before</i> placing the laying course.</p>	

<p>Step 4: Edging</p> <p>Set up taut string lines to guide line and level of edge courses. <u>Edge course</u> bricks and kerbs should be laid onto a concrete bed. Check that straight lines are indeed straight. Edge courses and kerbs should be haunched with concrete at least 75mm thick.</p>	
<p>Step 5: Laying Course</p> <p>Spread, level and compact laying course sand, and screed to correct level. When compacted, the laying course sand should be 25-40mm deep. The key to successful screeding is creating a smooth, even and flowing surface on which to lay the bricks.</p>	
<p>Step 6: Block laying</p> <p>Lay the blocks as per approved pattern.</p>	
<p>Step 7: Alignment</p> <p>Once all the full blocks are laid, they need to be checked for alignment by using a string line stretched along the diagonal courses.</p>	
<p>Step 8: Cutting-in</p> <p>Once the alignment has been checked and verified, the edges can be cut in.</p>	
<p>Step 9: Jointing</p> <p>This is done once all the cutting-in has been completed, and the compliance checks carried out. Kiln-dried jointing sand is spread over the block surface and swept into the joints using a soft brush.</p>	
<p>Step 9: Completing</p> <p>Excess jointing sand can be swept off the surface and it is now ready to be used.</p>	



Self-Check Quiz 2.3.1

Check your understanding by answering the following question:

Write the correct answer.

1. What is pavement?
2. What is the excavation depth for a typical domestic driveway?
3. Which tools are required for alignment checking?
4. What you will do to remove any excess sand from the paving surface?



Learning Outcome 2.4 - Complete Laying of Brick/Block



Contents:

- Fillers: sand, cement grout, polyurethane concrete crack sealant, polymer-based sealers
- Brick/block laying tolerances
- Basic structural bonds and joints
- Local weather condition
- Curing



Assessment criteria:

1. Gaps between bricks/blocks are filled up with appropriate fillers.
2. Final checks are made in respect of level and alignment of bricks/blocks.
3. Bricks or blocks are laid on the line at minimum allowance at 1/16 inch (2 mm).
4. Tools, equipment and any surplus resources and materials are checked in accordance with established procedures.
5. Curing is done before use of the newly built pavement.



Resources required:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, wooden float, pointed trowel, form work, batter board, guide post
- **Materials:** bricks/blocks, cement, sand and water



Learning Activity 2.4.1

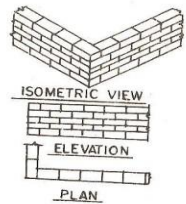
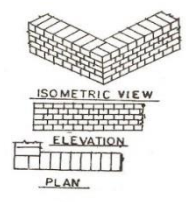
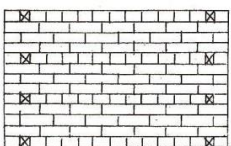
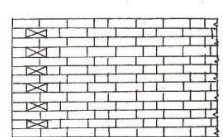
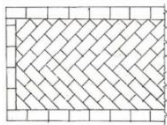
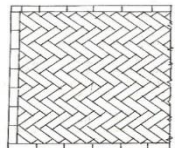
Learning Activity	Resources/Special Instructions/References
Complete laying of brick/block	<ul style="list-style-type: none"> ▪ Information Sheet: 2.4.1 ▪ Self-Check Quiz: 2.4.1 ▪ Answer Key: 2.4.1 ▪ www.theconstructioncivil.org/types-of-brick-bonds



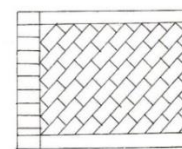
Information Sheet 2.4.1

Learning Objective: to fill up gaps between bricks/blocks with appropriate fillers, final checks in respect of level and alignment of bricks/blocks maintain the minimum allowance at joints and complete curing works for newly built pavement in a workplace.

- **Bond:** A brick bond is the pattern in which bricks are laid. It applies to both brick walls and brick paving, as well as to concrete block and other types of masonry construction. There are many different types of brick bonds, and each has its own look.
- **Types of bonds:**

<p>Stretching bond: In this arrangement of bonding, all the bricks are laid as stretchers. The overlap, which is usually of half brick, is obtained by commencing each alternate course with a half brick bat. Stretching bond is used for half brick wall only. This bond is also termed as running bond.</p>	 <p>Stretching bond</p>
<p>Heading bond: In this type of bonding all the bricks are laid as headers on the faces. The overlap, which is usually of half the width of the brick is obtained by introducing a three-quarter bat in each alternate course at quoins. This bond permits better alignment in curved walls. This bond is chiefly used for footings in foundations for better transverse distribution of load.</p>	 <p>Heading bond</p>
<p>English bond: The general arrangement of bricks in this type of bonding is one course of headers and next course of stretchers. A queen closer is placed next to the quoin header of the heading course to give the necessary lap.</p>	 <p>Elevation of a wall in English garden wall bond</p>
<p>Flemish bond: This consists of one header and one stretcher in throughout the length of each courses. Each alternate course contains a three-quarter bat placed next to the quoin header and a header is laid over the middle of each central stretcher.</p>	 <p>Elevation of wall in Flemish garden wall bond</p>
<p>Herring-bone bond: This type of bond is best suited for very thick walls usually not less than four bricks thick. In this arrangement of brick work, bricks are laid in course inclined at 45° in two directions from the centre. This bond is also commonly used for brick paving.</p>	 <p>Plan showing arrangement of bricks in Herring bone bond.</p>
<p>Zigzag bond: This is similar to herring-bone bond with the only difference that in this case the bricks are laid in a zigzag fashion. This is commonly adopted in brick paved flooring.</p>	 <p>Zig Zag Bond - Plan</p>

Diagonal bond: This bond is best suited for walls which are 2 to 4 bricks thick. This bond is usually introduced at every fifth or seventh course along the height of the wall. In this bond, the bricks are placed end to end in such a way that extreme corners of the series remain in contact with the stretchers.



Plan showing arrangement of bricks in Diagonal bond

□ **Orientation of Brick:**

Stretcher: Brick laid flat with the long face parallel to the wall are called stretchers. When all the brick in the course are laid in this manner, it is called a stretcher course.

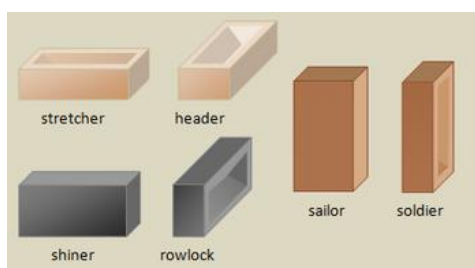
Header: A brick laid flat with its width at the face of the wall, or parallel to the face of the wall.

Soldier: A soldier course is one in which brick are laid standing on end with the narrow edge facing out.

Sailor: A sailor course is similar to the soldier course but with the wide edge facing out.

Rowlock: The rowlock is similar to the header course except that the brick is laid on narrow or face edge. This type of course is often used as the top course or cap of garden walls and as window and door sills.

Shiner: A brick laid on the long narrow side with the broad face of the brick exposed.



□ **Curing:** is the process of maintaining moisture levels inside cast concrete so that hydration can continue and/or a simple process of keeping the hardened concrete moist so that it can continue to gain strength.

□ **Water curing can be done using the following techniques:**

- **Immersion:** Immersion curing is usually done during concrete testing when curing concrete test specimens. You can easily put the test specimens under water for decided period.
- **Ponding:** To cure flat surfaces on jobs or controlled areas where water can be easily retained on top of the concrete slab. Sand or earth dykes surround the slab and a layer of water is maintained on top of the slab. Supply of water should be ensured until the period completed.
- **Fogging:** Fogging or misting is used in circumstances where temperatures are above freezing and there is low humidity.
- **Wet Covering:** Curing concrete with wet covering is done after concrete has hardened sufficiently and the water covering will not damage concrete's surface. A covering is usually sand, burlap, canvas or straw that is kept continuously damp during the curing process.

□ **Suggested duration of curing:**

Description	Duration
Brick/block wall	10 days
Cement plaster surface	14 days
Reinforced Cement Concrete work	28 days
Tiles work	7 days



Self-Check Quiz 2.4.1

Check your understanding by answering the following questions:

Write the correct answer.

1. Define brick bond.
2. What is called a stretcher?
3. At what angle bricks are laid in course inclined in herring bone bond, arrangement of brick work?
4. What is the meaning of curing?
5. Write the techniques for water curing.



Learning Outcome 2.5 - Clean Tools, Equipment and Workplace

Same as Learning Outcome 1.4 – Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 2.2.1

1. Layout of building
2. Baseline
3. Centre line
4. Batter boards

ANSWER KEY 2.2.2

1. Timber, steel, aluminium, bamboo, plywood
2. Coffor
3. 3 days
4. 28 days

ANSWER KEY 2.3.1

1. A pavement is any surfaced construction used to carry foot or vehicular traffic.
2. The excavation depth for a typical domestic driveway is 200-250mm below finished paving level.
3. String line and alignment bar are required for alignment checking.
4. Excess jointing sand can be swept off the surface with soft brush.

ANSWER KEY 2.4.1

1. A brick bond is the pattern in which bricks are laid.
2. Brick laid flat with the long face parallel to the wall are called a stretcher.
3. 45°
4. Curing is the process of maintaining moisture levels inside cast concrete so that hydration can continue.
5. The techniques of water curing are: immersion, ponding, fogging, and wet covering.

Module 3: Establish building lines, locate and build footer



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes to establish building lines, locate and build footer which includes preparing the location of the building lines, building concrete footer with pile foundation, laying of brick or block structure, finishing brick or block laying work and curing, and cleaning and maintaining workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 40 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 3.1 Prepare location of the building lines
- 3.2 Build up concrete footer
- 3.3 Laying of brick or block structure
- 3.4 Finish brick or block laying work and curing
- 3.5 Clean and maintain the workplace



PERFORMANCE CRITERIA:

1. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements
2. Tools and equipment are selected and prepared in accordance with job requirements
3. Bricks, paving tiles/blocks are selected, collected and gathered at worksite
4. Building plans read and correctly interpreted
5. Reference building lines are correctly identified and located as per job requirements
6. Lumber and form boards are installed in accordance to building plan
7. Bricks and blocks are positioned, laid and levelled as per job requirements
8. Curing is done in accordance with workplace specifications
9. Tools, equipment and workplace are properly cleaned in accordance with job requirements



Learning Outcome 3.1 - Prepare Location of the Building Lines



Contents:

- Building drawing: site plans, floor plans, foundations plans, elevation and section through the entire building, working drawings, reference building lines and building lay-out



Assessment criteria:

1. Building plans are read and interpreted correctly.
2. Building lines are located in accordance with the building plan.
3. Established proper alignment and dimension as per job requirements.
4. Horizontal and perpendicular guide for brick or block is properly installed.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, measuring tap, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, form work, mason's square, compass
- Building drawing set and drawing instruments and accessories



Learning Activity 3.1.1

Learning Activity	Resources/Special Instructions/References
Prepare location of the building lines	<ul style="list-style-type: none"> ▪ Information Sheets: 3.1.1, 3.1.2, 3.1.3 ▪ Self-Check Quiz: 3.1.1 ▪ Answer Key: 3.1.1



Information Sheet 3.1.1

Learning Objective: to select and check usability of personal protective equipment used in the workplace.

- **Personal Protective Equipment (PPE):**

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Self-Check Quiz 3.1.1

Check your understanding by answering the following questions:

State the uses of the following.

1. Eye Protector/goggles/safety glasses
2. Dust Mask
3. Hand gloves
4. Safety shoes/footwear/boots
5. Ear protector/ear plugs/ear muffs




Information Sheet 3.1.2

Learning Objective: to identify, collect and check usability of tools and equipment used in the workplace.

☐ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 9 – 10)

<p><u>Concrete vibrator machine:</u> This is a power-driven equipment used for compacting of concrete.</p>	
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Information Sheet 3.1.3


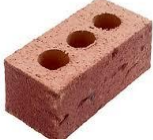

Learning Objective: to identify, collect and check materials used in the workplace.

☐ **Masonry materials:**

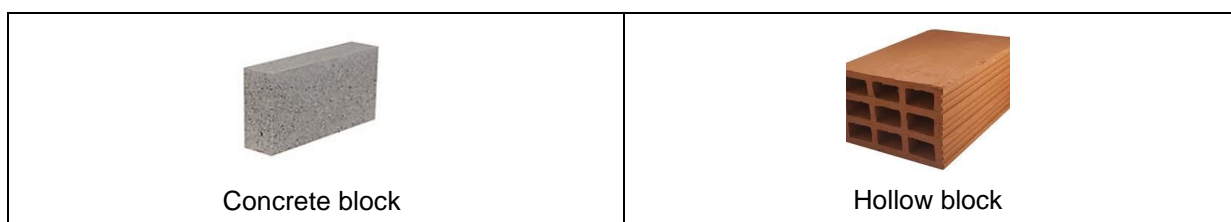
The following materials are used in workplace to establish building lines, locate and build footer.

☐ **Brick:**

Same as Information Sheet 2.1.3 – Set-up base for paving work and prepare raw materials (page 31 – 32)

 <p>Solid Brick</p>	 <p>Hollow Brick</p>	 <p>Part of a Brick wall</p>
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- **Block:** is a similar term referring to a rectangular building unit composed of similar materials but is usually larger than a brick.



- **Cement:**
Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)
- **Aggregates:**
Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)
- **Water:**
Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)
- **Water–cement ratio:** is the *ratio* of the weight of *water* to the weight of *cement* used in a concrete mix. A lower *ratio* leads to higher strength and durability but may make the mix difficult to work with and form. Workability can be resolved with the use of plasticizers or super-plasticizers.
- **Bleeding:** is one form of segregation, where water comes out to the surface of the concrete, being lowest specific gravity among all the ingredients of concrete. Bleeding can be easily identified in the field by the appearance of a thin layer of water in the top surface of freshly mixed concrete.
- **Segregation:** of *concrete* is separation of ingredients of *concrete* from each other. In more severe cases, segregation of aggregates can also occur, with the heavier coarse particles moving towards the bottom of the concrete, leaving a cement sand paste layer on the top surface.

Did you know?

- More fineness modulus (FM) value indicates that the aggregate is coarser and small value of fineness modulus indicates that the aggregate is finer.



Learning Outcome 3.2 – Build-up Concrete Footer



Contents:

- Building lay-out
- Formwork installation
- Ingredients of concrete
- Proportion of concrete



Assessment criteria:

1. Locations of the concrete footers are identified in accordance with the building plan.
2. Lumber and form boards are installed and levelled as per job requirements.
3. Width and depth of footer is set in accordance to workplace specifications.
4. Concrete mix or mortar is poured properly.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, shovel/spade, mixer, measuring tap, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, form work, hand saw, rip saw, mason's square, trowel, wheel barrow, sieve, bucket, mug, steel pan
- **Materials:** cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water
- Building drawing set



Learning Activity 3.2.1

Learning Activity	Resources/Special Instructions/References
Build up concrete footer	<ul style="list-style-type: none"> ▪ Information Sheets: 3.2.1, 3.2.2, 3.2.3, 3.2.4 ▪ Self-Check Quizzes: 3.2.1, 3.2.2, 3.2.3, 3.2.4 ▪ Answer Key: 3.2.1, 3.2.2, 3.2.3, 3.2.4



Information Sheet 3.2.1

Learning Objective: to build up concrete footer and preparation of raw materials uses.



Self-Check Quiz 3.2.1

Check your understanding by answering the following questions:

1. What is meant by building layout?
2. What is base line?
3. Why batter boards are erected?



Information Sheet 3.2.2

Learning Objective: to build up concrete footer and preparation of raw materials uses.

Formworks:

Same as Information Sheet 2.2.2 – Set-up base for paving work and prepare raw materials (page 34 – 35)



Self-Check Quiz 3.2.2

Check your understanding by answering the following questions:

1. What are the major materials used in formworks?
2. Write the period of removal of formwork for walls, columns and vertical sides of beams.
3. Write the period of removal of formwork for slabs spanning over 4.5m.
4. What is the unit of formworks?



Information Sheet 3.2.3

Learning Objective: to build up concrete footer and preparation of raw materials uses.

- **Concrete:** is a construction material composed of cement (binding materials), sand (fine aggregate), gravel/chips (coarse aggregate) and water. Concrete has two main stages (a) fresh concrete (b) hardened concrete.
 - Cement: The cement used, and the type selected should be appropriate for the intended use.
 - Sand: Sand is referred to as fine aggregates. Size of particles is less than 5mm. It should be free from dust, clay and silt.
 - Coarse aggregates: Crushed hard stone and gravel are common materials used as coarse aggregates for concrete work.
 - Water: Municipal water supplied for drinking purpose is generally considered fit for construction purpose.
 - Bricks: Bricks should be sound, hard and well burnt. They should be uniform in size, shape and colour. The bricks when struck together should produce a good metallic ringing sound.
 - Steel: Mild steel, medium tensile steel bars and hard-drawn steel wire for concrete reinforcement generally used.
 - Admixtures: Different kinds of admixtures are used for the intended use.
 - Segregation: Segregation can be defined as separating out of the ingredients of a concrete mix.
 - Bleeding: Bleeding is due to the rise of water in the mix to the surface because of the inability of the solid particles in the mix to hold all the mixing water during settling of particles.

- **Pouring and consolidation:** Formwork must be in good condition to prevent leakage. Limit of vertical free fall of concrete should exceed half a meter.
- **Compaction of concrete:** Concrete vibrators are used for compaction of concrete. Types of vibrator: 1. Internal vibrators, 2. External vibrators, 3. Surface vibrators, 4. Vibrating table.
- **Curing of concrete:** Curing is essential to attain strength of concrete. Normally curing is done by ponding, immersion, wet coverings and sprinkling with period as decided.



Self-Check Quiz 3.2.3

Check your understanding by answering the following questions:

1. What is concrete?
2. How can you perform the field test of sand?
3. What kind of water is suitable for construction purposes?
4. Define the term 'segregation'.
5. Name the vibrators used for concrete compaction.



Information Sheet 3.2.4

Learning Objective: to build up concrete footer and preparation of raw materials uses.

- **Proportion of concrete:** It depends on design strength. Normally the following proportions are used.

1:3:6 (plain cement concrete or cement concrete)
 1:2:4 (reinforced cement concrete in medium strength)
 1:1.5:3 (reinforced cement concrete in higher strength)
 1:1.25:2.5 (reinforced cement concrete in higher strength)

- **Clear cover** to main reinforcement: It requires protecting the reinforcing steel used in concrete. Clear cover apply to main reinforcement for different components are as follows:

- Footings: 75mm
- Raft foundation (top): 75mm
- Raft foundation (bottom/sides): 75mm
- Grade beam: 50-75mm
- Column: 40mm
- Shear wall: 38-40mm
- Inner side --outer side-40-50mm
- Beams: 40mm
- Slabs: 20-25mm
- Flat slab: 25mm
- Staircase: 25mm
- Retaining wall: 50mm on earth (Inner: 20, Outer 50mm)
- Water tank or reservoir: 50-75mm

- **Development length of M.S rod:**

For compression zone: 40d
 For tension zone: 60d

Where 'd' is the diameter of rod used.

- **Pile Foundation:**

Piling is a type of deep foundation, used to transfer the load to a deeper level than is possible with a traditional shallow foundation. In modern civil engineering, piles of timber, steel or concrete are

driven into the ground to support a structure; bridge piers may be supported on groups of large-diameter piles.

A pile cap is a thick concrete mat that rests on concrete or timber piles that have been driven into soft or unstable ground to provide a suitable stable foundation. It usually forms part of the foundation of a building, typically a multi-story building, structure or support base for heavy equipment.

A concrete piling is a concrete column that are pushed into the ground under a foundation.

Classification of pile: concrete, steel or wood, or a combination.

The concrete pile can be divided into cast-in-situ and pre-cast pile.



Self-Check Quiz 3.2.4

Check your understanding by answering the following questions:

Read and analyse the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. For Plain cement concrete works the ratio of the materials:
 - a. Cement: Sand: Chips (1:3:6)
 - b. Cement: Sand: Chips (1:1:2)
 - c. Cement: Sand: Chips (1:1.25:2.5)
 - d. Cement: Sand: Chips (1:1.5:3)
2. Clear cover to main reinforcement for RCC footing:
 - a. 15
 - b. 25
 - c. 50
 - d. 100
3. Development length of M.S rod in compression zone is:
 - a. 20d
 - b. 38d
 - c. 60d
 - d. 100d
4. Development length of M.S rod in tension zone is:
 - a. 20d
 - b. 38d
 - c. 60d
 - d. 100d



Learning Outcome 3.3 - Laying of Brick or Block Structure



Contents:

- Types of brick: based on using and manufacturing
- Classification of bricks on shape
- Types of concrete block
- Procedures in installing horizontal/vertical guide for brick/block
- Brick/block laying procedures
- Definition of pile and classification



Assessment criteria:

1. Bricks or blocks laid on the line at minimum allowance at 1/16 inch (2mm).
2. Mortar is spread and filled on the base and gaps according to job specifications.
3. Bricks/blocks are positioned/laid according to designed specifications.
4. Appropriate levelling device is used in each course.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, wooden float, pointed trowel, form work, batter board, guide post
- **Materials:** bricks/blocks, cement, sand and water



Learning Activity 3.3.1

Learning Activity	Resources/Special Instructions/References
Laying of brick or block structure	<ul style="list-style-type: none"> ▪ Information Sheet: 3.3.1 ▪ Self-Check Quiz: 3.3.1 ▪ Answer Key: 3.3.1 ▪ www.bunnings.com.au/diy-advice/home-improvement/walls/how-to-build-a-brick-wall



Information Sheet 3.3.1

Learning Objective: to perform laying of brick or block in a workplace.

□ **How to lay brick/block?**

- Always lay bricks so the vertical joints are staggered, this gives the brickwork added strength and support. If the bricks you are using don't have holes through them but have an indentation (known as a frog), lay the bricks with the frog at the top. The last course of bricks can be laid with the frog at the bottom to give the brickwork a smooth finish on the top.
- Lay one brick at each end of the course with a string line stretched between them along the top edge. This gives you a guide as you lay each course of bricks. When you place the mortar on the foundation or next course of bricks, make a V shaped trough along the mortar with your trowel. This allows the bricks to be tapped into position/level more easily. Spread mortar onto the end of each brick as you lay them for the vertical joint. Once you have laid the first course of bricks check the level along the top of the course and along the face or outside edge.







□ **Cutting bricks to size:**






You may have to cut some bricks to size (to obtain the staggered vertical joints). To do this, mark the cut on the brick and place it on firm ground or a solid base. Align the cutting edge of chisel with the mark and give it a sharp blow with hammer. Chip off the rough edges.

□ **Finishing off:**

Fill any holes in the seams then strike/point them with either the piece of pipe or the trowel to give brickwork a professional finish. Brush the brickwork down with a soft hand brush to remove any excess mortar from the brickwork face.

How to build a brick wall (Pictorial representation):

<p>Step 1: Lay out the bricks at both ends of your wall where the pillars will start. Using your string line, make a straight guideline at brick height between the two outside bricks.</p>	
<p>Step 2: Heap five shovels full of sand and one of cement on an old board. Turn shovel to mix to a consistent colour. Form a central hollow, pour in water and mix. Repeat for a smooth, creamy texture that's wet but not too loose.</p>	
<p>Step 3: Lay a 1-2cm mortar bed along the string line. Starting at one end, lay the first brick and tap slightly to 'bed in'. 'Butter up' one end of the next brick with mortar and abut it to the first. Repeat using string line as a guide.</p>	
<p>Step 4: At the point where you want your pillars to start, place a brick side-on to the end of the wall. As you build up the wall, each consecutive course of pillar bricks must be laid in the opposite direction.</p>	
<p>Step 5: When building pillars, at certain courses you'll need to lay half-bricks. To make a cut, place the brick on its side, locate the bolster at the split point and strike the head firmly with a club hammer. It should split cleanly first time.</p>	
<p>Step 6: Always build at least a course higher on the pillars. Move the string line up as you build, bedding it into the mortar on the pillars. For a stretcher bond, the end of each brick should be over the centre of the one beneath.</p>	

<p>Step 7: Vertical mortar joints should be 10mm thick. With standard bricks there should be 75mm from the top of one to the top of that beneath. If your bricks soak up moisture fast, you may want to 'joint up' (step 10) as you go.</p>	
<p>Step 8: When you reach the top of the pillars, you may want to add a coping stone to finish. Alternatively, you could create a pleasant effect at less cost by bedding bricks into the mortar on their sides.</p>	
<p>Step 9: Adding a 'soldier course' is an attractive option to top the main part of a garden wall. Turn your bricks vertically lengthways and lay along the full length. Use a second, higher string line to keep a uniform finish.</p>	
<p>Step 10: To finish the beds, use the rounded edge of a brick jointer to scrape mortar into the joints. Start with the horizontal lines and follow with the vertical – it's easier to remove any excess mortar this way.</p>	
<p>Step 11: Give the finished wall a gentle brush over and clean up any mortar that has fallen onto the floor before it dries. You can use water to wash cement away from the floor but be sure to keep it away from your newly-built wall.</p>	



Self-Check Quiz 3.3.1

Check your understanding by answering the following questions:

1. Why it needs to avoid the vertical joints in same line or arranged bricks in a staggered way?
2. Which is the best position of laying a frog marked brick?
3. When should you check the level along the top of the course and along the face or outside edge?
4. What you will do to remove any excess mortar from the brickwork face?



Learning Outcome 3.4 - Finish Brick or Block Laying Work and Curing



Contents:

- Lay of bricks/blocks
- Process of mortar spreading
- Checking level periodically with the help of spirit level and plumb bob
- Brick/block laying tolerances
- Basic structural bonds and joints
- Curing methods and time



Assessment criteria:

1. Final checks are made with the foreman to ensure that works conform with instructions and to workplace requirements.
2. Mortar is spread and filled on the base and gaps according to job specifications.
3. Standard procedures are followed on bricks/blocks laying works.
4. Appropriate levelling device is used in each course.
5. The structure is cured in accordance to job specifications.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, shovel/spade, mixer, measuring tap, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, form work, hand saw, rip saw, mason's square, trowel, wheel barrow, sieve, bucket, mug, steel pan
- **Materials:** cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water
- Building drawing set



Learning Activity 3.4

Learning Activity	Resources/Special Instructions/References
Finish brick or block laying work and curing	<ul style="list-style-type: none"> ▪ Information Sheet: 3.4.1 ▪ Self-Check Quiz: 3.4.1 ▪ Answer Key: 3.4.1 ▪ www.theconstructioncivil.org/types-of-brick-bonds



Information Sheet 3.4.1

Learning objective: to fill up gaps between bricks/blocks, final checks in respect of level and alignment of bricks/blocks, maintain the minimum allowance at joints and complete curing works.

Same as Information Sheet 2.4.1 – Complete laying of brick/block (page 41 – 42)

☐ **How Brick Bonds Work?**

Most brick bonds require bricks (or other masonry units) of the same size, or at least compatible sizes. Uniform sizing creates a regular, repeatable pattern that can be applied over any size of area. Many bond patterns include some method of interlocking each row of brick to the neighbouring courses. If you stack up bricks in single-file columns, the stacks can easily topple. But if you stack them so that the joints are staggered, or offset, between neighbouring courses, the bricks are essentially woven together. In this way, the bond adds strength to the construction to make a mortared wall even stronger. When using mortar between bricks, keep in mind that the thickness of the mortar is added to the unit size of each brick.



Learning Outcome 3.5 - Clean and Maintain Workplace

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 3.1.1

1. Eye protector/goggles/safety glasses is used to protect eyes from flying particles which may cause injury to the worker.
2. Dust mask is used to protect oneself from inhalation of harmful particulates.
3. Hand gloves are used to protect the hands while working.
4. Safety shoes/footwear/boots are used to protect one's feet from sharp object to fall.
5. Ear protector/ear plugs/ear muffs protects workers' ears while working from unwanted sounds that are created in the workplace.

ANSWER KEY 3.2.1

1. To transfer the plan, length and width of its foundation on the ground so that the foundation can be excavated for construction of a building as per drawing is known as building layout.
2. Base line is a straight reference line simply joining two points with respect to which corners of the building are located on the ground.
3. Batter boards are erected to relocate the points after the excavation near each offset peg.

ANSWER KEY 3.2.2

1. Timber, steel, aluminium, bamboo, plywood
2. 3 days
3. 28 days
4. Area

ANSWER KEY 3.2.3

1. Concrete is a composite construction material composed primarily of cement, aggregates (sand and brick/stone chips) and water, admixtures.
2. A simple field test for sand can be done by holding some of the sand in hand, rub it and just throw it. Check the palm. Good sand will not stick to the palm.
3. Municipal water supplied for drinking purpose is generally considered fit for construction purpose. The water must be free of oil, acids, salts or organic impurities and sea-water and ground water should preferably not be used for construction purposes.
4. Segregation can be defined as separating out of the ingredients of a concrete mix, so that the mix is no longer in a homogeneous condition.
5. Compaction of concrete can be done by using: 1. Internal vibrators 2. External vibrators 3. Surface vibrators 4. Vibrating table.

ANSWER KEY 3.2.4

1. A
2. C
3. B
4. C

ANSWER KEY 3.3.1

1. The vertical joints are staggered, which gives the brickwork added strength and support.
2. Lay the bricks with the frog mark at the top.
3. Once laid the first course of bricks, then it needs to check the level along the top of the course and along the face or outside edge.
4. To remove any excess mortar from the brickwork face, brush the brickwork down with a soft hand brush.

Module 4: Carry out brick/block works



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes to carry out stone and brick works which includes gathering masonry working tools, equipment and materials, organizing bricks/blocks, creating cement mortar/stucco, preparing brick/block for installation, carrying-out brick/block installation work, and cleaning and maintaining workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 40 hours



Learning Outcomes:

Upon completion of the module, the student/trainee should be able to:

- 4.1 Gather masonry working tools, equipment and material
- 4.2 Organise bricks/blocks at worksite
- 4.3 Create cement mortar/stucco
- 4.4 Prepare brick/block for installation
- 4.5 Carry out brick/block installation work
- 4.6 Clean and maintain workplace



Performance Criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Bricks and blocks are selected, collected and gathered at worksite.
3. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements.
4. Proper transport is used for carrying materials.
5. Scaffolding is set as per job requirements.
6. Bricks/blocks are organised at work site as per job requirements.
7. Cement, sand and water are mixed according to specified proportion and consistency/workability.
8. Centre lines, string lines are measured and marked as per drawing.
9. Cement mortar is applied uniformly.
10. Closer and bats are used to maintain specified bond.
11. Joints are filled up with mortar/stucco for better adhesion and raking out brick/block joints is done as per instruction.
12. Tools and equipment are properly cleaned, and waste materials are disposed of in proper place as per instruction.



Learning Outcome 4.1 - Gather Masonry Working Tools, Equipment and Materials



Contents:

- List of main tools and equipment required pavement laying works
- Different types of bricks and blocks
- Names and uses of personal protective equipment (PPE)
- Name of different types of cement and their uses
- Quality of water necessary in construction works
- Classification of sand and their uses



Assessment criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Bricks and blocks are selected, collected and gathered at worksite.
3. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements.
4. Proper transport is used for carrying materials.
5. Scaffolding is set as per workplace requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, steel pan, mug, measuring box, shovel/spade, sieve, mortar mixer and mortar mixing box/containment, measuring tools, plumb bob, spirit level, nylon string, nail, mason's hammer, pointed trowel
- **Materials:** bricks/blocks, cement, sand, water and scaffolding materials



Learning Activity 4.1.1

Learning Activity	Resources/Special Instructions/References
Gather masonry making tools, equipment and materials in line with the work task	<ul style="list-style-type: none"> ▪ Information Sheets: 4.1.1, 4.1.2, 4.1.3, 4.1.4 ▪ Self-Check Quizzes: 4.1.1, 4.1.2 ▪ Answer Key: 4.1.1, 4.1.2 ▪ https://theconstructor.org/building/types-of-scaffolding-in-construction ▪ https://www.youtube.com/watch?v=BWWkoelZwtY



Information Sheet 4.1.1

Learning Objective: to select and check usability of personal protective equipment used in the workplace.

☐ **Personal Protective Equipment (PPE):**

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Information Sheet 4.1.2

Learning Objective: to identify, collect and check usability of tools and equipment used in the workplace.

☐ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 – 12)



Information Sheet 4.1.3

Learning Objective: to identify, collect and check materials used for carryout stone and brick works.

Materials:

☐ **Brick:**

Same as Information Sheet 2.1.3 – Gather pavement laying tools, equipment and materials (page 30 – 31)

☐ **Block:**

Same as Information Sheet 2.1.3 – Gather pavement laying tools, equipment and materials (page 30 – 31)

☐ **Cement:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Aggregates:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Water:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)



Self-Check Quiz 4.1.1

Check your understanding by answering the following questions:

Write the appropriate answer.

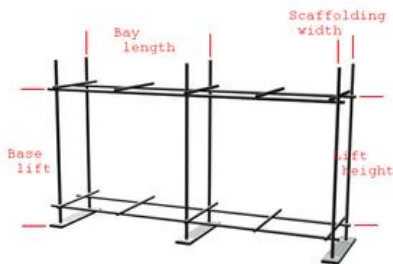
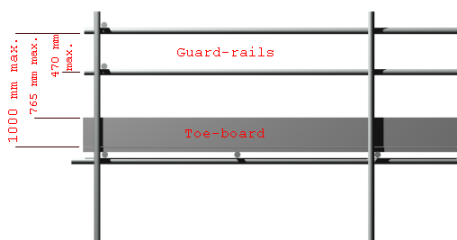




1. What is cement?
2. Classify fine aggregates as per grain sizes and mention their suitability of various uses.
3. What are the coarse aggregates generally used for making concrete?
4. State the quality of water that is suitable for mixing masonry materials and curing purposes.
5. Mention the main disadvantages of mixing too much water in mortar and concrete.



Information Sheet 4.1.4

Learning Objective: to identify and set scaffold for carryout stone and brick works in the workplace.

- **Scaffolds:** is a temporary or movable platform either supported from below or suspended from above, on which workers sit or stand when performing tasks at heights above the ground.
- **Terms related to scaffolding:**
 1. **Standard:** It is a vertical member supported on the ground.
 2. **Ledgers:** Ledgers are the longitudinal horizontal members connected with standards.
 3. **Braces:** Braces are the diagonal members that are connected with standards to stiffen the structure.
 4. **Put Logs:** Put logs are the transverse horizontal members that are 90 cm in length and are generally spaced 120 cm apart. They are provided to support the working platform.
 5. **Transoms:** When both the ends of put logs are connected with ledgers, it is called transoms.
 6. **Boarding:** Boarding is a horizontal member supported by put logs. It is used to enable the mason and materials.
 7. **Guard Rail:** It is similar to ledgers, used for a better protection at the working level.
 8. **Toe Board:** It is a long horizontal board of wood used at the different working level.

 <p>Basic scaffold dimensioning terms. No boards, bracing or couplers shown</p>	 <p>Scaffolding showing required protection of a working platform with maximum dimensions. Butt-board not visible. No couplers shown</p>		
 <p>Tube & clamp scaffold</p>	 <p>Metal pole scaffold</p>	 <p>Wooden pole scaffold</p>	 <p>Bamboo scaffold with nylon knots</p>

- **Types of scaffolding:**
 1. **Brick layer's Scaffolding or Single Scaffolding:**

This type of scaffolding consists of *standards* firmly secured in the grounds at 2.4m to 3m. The standards are connected to each other by ledgers at every rise of 120 to 150cm.
 2. **Mason's Scaffolding or Double Scaffolding:**

Since it is difficult to leave holes in the stone masonry to provide a bearing for the putlogs, in mason's scaffolding two frames of standards, at a distance of 1.5m from the first one. Thus, the mason's scaffolding is entirely independent of the stone wall.

3. **Steel or Tubular Scaffolding:**

The construction of steel scaffolding is essentially similar to that of timber scaffolding. In this case, the wooden members are replaced by 38mm to 64mm diameter steel tubes and instead of rope-lashings, special types of steel couplets or fittings are used for connecting different members.

4. **Needle Scaffolding or Cantilever Scaffolding:**

When scaffolding is to provide for a building on the side of a busy street where the construction of ordinary scaffolding will obstruct the traffic on road, needle scaffold is used. The scaffold is erected from window corners of string courses by means of projecting needles.



Self-Check Quiz 4.1.2

Check your understanding by answering the following questions:

Write the correct answer.

1. Scaffolding is a temporary structure built for construction purposes. Is the statement true or false?
2. Which type of scaffolding is suitable to provide for a building on the side of a busy street?
3. What is standard in connection with scaffolding?
4. What are the braces?
5. What are put logs?



Learning Outcome 4.2 - Organise Bricks/Blocks at Work Site



Contents:

- Types of brick: based on using and manufacturing
- Classification of bricks on shape
- Types of concrete block
- Cleaning and soaking of brick



Assessment criteria:

1. Quality of bricks/blocks are checked and segregated as per workplace requirements.
2. Bricks/blocks are cleaned and soaked in accordance to specification.
3. Bricks/blocks are organized at worksite as per job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, wooden float, pointed trowel, form work, batter board, scaffolds, guide post
- **Materials:** bricks/blocks, cement, sand and water



Learning Activity 4.2.1

Learning Activity	Resources/Special Instructions/References
Organize bricks/blocks at work site	<ul style="list-style-type: none"> ▪ Information Sheet: 4.2.1 ▪ Self-Check Quiz: 4.2.1 ▪ Answer Key: 4.2.1



Information Sheet 4.2.1

Learning Objective: to organize bricks/blocks at work site for ready use in construction in the workplace.

- ☐ **Classification of bricks:** as per conventional standards or based on manufacturing:

1. Sundried or katcha bricks: The bricks dried only in sun are called sundried or katcha bricks. They are only suitable for constructing enclosures etc.
2. Burnt or pacca brick: The bricks which are burnt in a kiln after holding and drying are called burnt or pacca bricks. These are generally used in permanent walls.
3. First class bricks: The bricks which are well burnt, uniform size and shape are known as first class bricks. These are suitable for masonry works.
4. Second class bricks: The bricks which not well burnt, not uniform in shape and size are known as second class bricks. These bricks are used in interior wall.
5. Third class bricks: The bricks which are under burnt, not uniform in shape and size are called third class bricks. These bricks are used in temporary building construction.
6. Over burnt or jhama bricks: The bricks which are over burnt, irregular in shape and size are called over burnt or jhama bricks. They are used as aggregates and as road metal.



Stack of bricks

- **Special brick:** are some other bricks which are in different shapes and sizes used for particular type of construction.



Different types of bricks / blocks

- **Soaking of bricks:**

Bricks or blocks are soaked to remove dirt from the surfaces and stopped absorption of water from mortar. If dry bricks or blocks are used, then they start to absorb water from mortar which would lead to less strength development.

- **Frog marks:**

Brick frogs create indentation of the brick and create stronger bond between bricks.

The frog indentation provides a very suitable location to stamp the makers name into every brick produced.

Individual Activity:

- The student/trainee may visit a brick field in his/her locality and share or submit a report to the trainer.



Self-Check Quiz 4.2.1

Check your understanding by answering the following questions:

1. Define first class bricks.
2. What happens when dry bricks or blocks are used in masonry works?
3. Which type of brick is more suitable for construction of circular brick masonry pillar and brick chimneys?
4. Considering reduction of the transmission of heat, sound and damp which bricks are very helpful?
5. What are the reasons of using frog mark on bricks?



Learning Outcome 4.3 - Create Cement Mortar/Stucco

Same as Learning Outcome 1.3 – Make mortar/stucco (page 17 – 21)



Self-Check Quiz 4.3.1

Check your understanding by answering the following questions:

Put the correct word(s) in the blank space.

1. For cement mortar to carryout stone and brick works in foundations the ratio is _____.
2. For cement mortar to plaster brick walls the ratio is _____.
3. For cement mortar to plaster RCC surfaces the ratio is _____.
4. RCC works for a simple building the ratio of the ingredients is _____.
5. Amount (percent) of water by weight of cement is just sufficient to give it necessary consistency for 1:4 mortars _____.



Learning Outcome 4.4 - Prepare Brick/Block for Installation



Contents:

- Building drawing:
 - Location drawings and general arrangement drawings
 - Block plans
 - Site plans
 - Floor plans
 - Foundations plans
 - Roof plans
 - Elevations
 - Section through the entire building
- Preliminary drawings
- Sketch drawings
- Working drawings
- Building lay-out
- Reference building lines
- Centre lines
- Linear, angular and offset measurements



Assessment criteria:

1. Centre lines are measured and marked as per drawing.
2. Reference of level is identified and set out as per job requirements.
3. Linear and angular measurements are marked as required.
4. String lines are established in accordance with job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level or levelling instrument, nylon string, nail, mason's hammer, pointed trowel, form work, reference of level point
- Building drawing set



Learning Activity 4.4.1

Learning Activity	Resources/Special Instructions/References
Prepare for brick/block installation	<ul style="list-style-type: none">Information Sheet: 4.4.1Self-Check Quiz: 4.4.1Answer Key: 4.4.1www.youtube.com/watch?v=ACcDtyMwvyc



Information Sheet 4.4.1

Learning Objective: to prepare for brick/block installation in the workplace.

- ☐ **Floor plan:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Layout of Building:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Base Line:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Batter boards and offset pegs:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Extending lines:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Centre Line:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **Orientation of Building:**
Same as Information Sheet 2.2.1 – Set-up base for pavement work and prepare raw materials (page 33 – 34)
- ☐ **How to Use a String Line Level?**
 1. Gather a line level, a length of string, a tape and two wooden posts.
 2. Secure the string to one side or corner of the area you want levelled.
 3. Attach the line level to the middle of the string.
 4. Pull the string tight while sliding the level up the string within eyeshot.
 5. Pull tightly enough to avoid any sag in the string.
 6. Hold the end of the string against the post or wall and adjust up and down until the bubble rests between the black lines on the line level.
 7. Secure the string and have found level between the two points.

Individual Activity:

- The student/trainee can watch the video on 'How to tie a string line' and summarise the key points (if facilities available).

**Self-Check Quiz 4.4.1**

Check your understanding by answering the following questions:

Put the correct word(s) in the blank space.

1. To transfer the plan, length and width of its foundation on the ground so that the foundation can be excavated for construction of purposed building as per drawing is known as _____.
2. _____ is a straight reference line simply joining two points with respect to which corners of the building are located on the ground.
3. To relocate the points after the excavation has been done _____ are normally erected near each offset peg.
4. Centre line divides the plan into two equal parts and can be marked in the field with the help of _____.



Learning Outcome 4.5 – Carry Out Brick/Block Installation Work



Contents:

- Lay of bricks/blocks
- Process of mortar spreading
- Checking level periodically
- Raking out joints
- Basic structural bonds and Joints
- Closers and bats



Assessment criteria:

1. Bricks/blocks are watered as per instruction.
2. Cement mortar is applied uniformly.
3. Bricks/blocks are laid and aligned along the set-out lines following specified bond.
4. Closer and bats are used to maintain specified bond.
5. Joints are filled up with mortar/stucco for better adhesion.
6. Raking out brick/block joints is done as per instruction.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, trowel, mason's square, bucket, mug, wheel barrow, broom and scaffold
- **Materials:** bricks/blocks, cement, sand and water



Learning Activity 4.5.1

Learning Activity	Resources/Special Instructions/References
Carryout brick/block installation work	<ul style="list-style-type: none"> ▪ Information Sheet: 4.5.1 ▪ Self-Check Quiz: 4.5.1 ▪ Answer Key: 4.5.1 ▪ www.self-build.co.uk/how-build-brick-wall ▪ www.bunnings.com.au/diy-advice/home-improvement/walls/how-to-build-a-brick-wall



Information Sheet 4.5.1

Learning Objective: to carry out brick/block installation work in the workplace.

□ How to lay brick/block?

- Always lay bricks so the vertical joints are staggered, this gives the brickwork added strength and support.
- If the bricks you are using don't have holes through them but have an indentation (known as a frog), lay the bricks with the frog at the top.
- The last course of bricks can be laid with the frog at the bottom to give the brickwork a smooth finish on the top.
- Lay one brick at each end of the course with a string line stretched between them along the top edge. This gives you a guide as you lay each course of bricks.
- When you place the mortar on the foundation or next course of bricks, make a V shaped trough along the mortar with your trowel. This allows the bricks to be tapped into position/level more easily.
- Spread mortar onto the end of each brick as you lay them for the vertical joint.
- Once you have laid the first course of bricks check the level along the top of the course and along the face or outside edge.

□ Cutting bricks to size:

You may have to cut some bricks to size (to obtain the staggered vertical joints). To do this, mark the cut on the brick and place it on firm ground or a solid base. Align the cutting edge of chisel with the mark and give it a sharp blow with hammer. Chip off rough edges.

□ Finishing off:

Fill any holes in the seams then strike/point them with either the piece of pipe or the trowel to give brickwork a professional finish. Brush the brickwork down with a soft hand brush to remove any excess mortar from the brickwork face.

□ Raking out joints:

Brick joints are raked and apply new mortar with the help of raking and pointing tools.



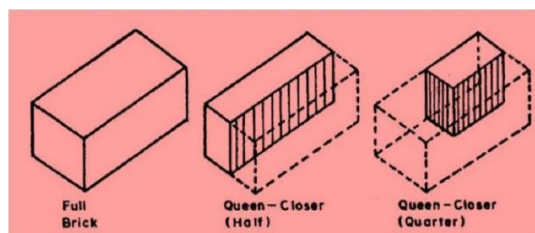
Raked joints have a uniform depth

□ How to carry out brick/block installation work (Pictorial representation):

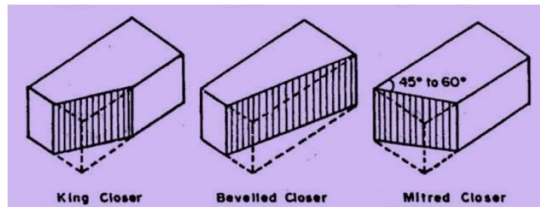
Same as Information Sheet 3.3.1 – Laying of brick or block structures (page 55 – 56)

□ CLOSER: It is the portion of the brick cut along the length in such a way as one long face remains intact.

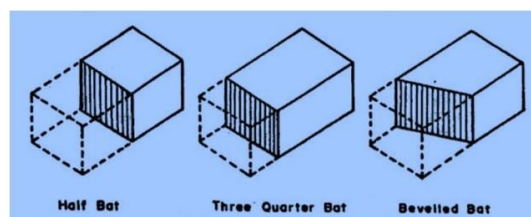
1. Queen closer: When a brick is cut along its length, making it two equal halves then it is called queen closer.
2. Queen closer quarter: If a queen closer is broken into two equal pieces then it is known as queen closer quarter.



3. King closer: If a brick is cut in such a way that the width of one end becomes half that of a full brick, while the width at the other end is equal to the full width, then it is called as *king closer*.
4. Beveled closer: It is a form of king closer in which the whole length of the brick is chamfered or beveled in such a way that half width is maintained at one end and full width is maintained at the other end.
5. Mitered closer: It is a portion of a brick whose one end is cut splayed or mitered for full width. The angle of splay may vary from 45° to 60° .



- **BAT:** When a brick is cut across the width, the resulting piece is called bat.
1. Half bat: If the length of the bat is equal to half the length of the original brick, it is known as half bat.
 2. Three-quarter bat: It is a form of brick bat having its length equal to three quarter of the length of a full brick.
 3. Beveled bat: A brick bat is called *beveled bat*, when its width has beveled.



Individual Activity:

- Make sample closers for each type and display with labels (if facilities available)



Self-Check Quiz 4.5.1

Check your understanding by answering the following questions:

1. Why it needs to avoid the vertical joints in same line or arranged bricks in a staggered way?
2. Which is the best position of laying a frog marked brick?
3. When should you check the level along the top of the course and along the face or outside edge?
4. What you will do to remove any excess mortar from the brickwork face?
5. How can you differentiate between king and queen closers?



Learning Outcome 4.6 - Clean Tools, Equipment and Workplace

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 4.1.1

1. Cement is a binder substance used in construction which sets, hardens and adheres to other materials and binding them together.
2. As per grain size types of fine aggregates (sand) are given below:
 - Fine sand (FM: 1.5) suitable for plastering
 - Medium sand (FM: 2.0) suitable for brick work
 - Coarse sand (FM: 2.5) suitable for concrete casting
2. The coarse aggregates that are generally using for making concrete: Gravel stone chips, broken stone chips and broken brick chips (khoa) of $\frac{3}{4}$ " down sizes.
3. Water for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel.
4. Too much water in mortar and concrete are the causes of bleeding and segregation problems and shorten the life due to lower strength.

ANSWER KEY 4.1.1

1. True.
2. Needle Scaffolding or Cantilever Scaffolding.
3. In scaffolding, standard is a vertical member supported on the ground.
4. Braces are the diagonal members that are connected with standards to stiffen the scaffold.
5. Put logs are the transverse horizontal members and provided to support the working platform.

ANSWER KEY 4.2.1

1. The bricks which are well burnt and are of uniform size and shape are known as first class bricks.
2. If dry bricks or blocks are used then they start to absorb water from mortar which would lead to less strength development.
3. Curved brick is more suitable for construction of circular brick masonry pillar and brick chimneys.
4. For reduction of the transmission of heat, sound and damp hollow bricks are very much helpful.
5. The reasons of using frog mark on bricks are- create an indentation, save the material, reduce the drying and firing time, easier to grasp and increase strong bond.

ANSWER KEY 4.3.1

1. 1:4
2. 1:6
3. 1:4
4. 1:2:4
5. 75%

ANSWER KEY 4.4.1

1. Layout of building
2. Baseline
3. Batter boards
4. Baseline

ANSWER KEY 4.5.1

1. The vertical joints are staggered, which gives the brickwork added strength and support.
2. Lay the bricks with the frog mark at the top.
3. Once laid the first course of bricks, then it needs to check the level along the top of the course and along the face or outside edge.
4. To remove any excess mortar from the brickwork face, brush the brickwork down with a soft hand brush.
5. If a brick is cut in such a way that the width of one end becomes half that of a full brick, while the width at the other end is equal to the full width, then it is called as king closer. On the other hand, when a brick is cut along its length, making it two equal halves then it is called queen closer.

Module 5: Accomplish masonry surface plastering



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes to accomplish masonry surface plastering which includes preparing the masonry surface, mixing mortar, applying plaster on plain surfaces and corners, and cleaning and maintaining the workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 40 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 5.1 Prepare masonry surfaces for plastering
- 5.2 Mix mortar for plastering on masonry surface
- 5.3 Apply plaster on plain surfaces and corners
- 5.4 Clean and maintain workplace



Performance Criteria:

1. Personal protective equipment (PPE) is identified, gathered and used properly
2. Scaffolding is prepared as per job requirements
3. Materials, tools and equipment are selected and prepared in line with job requirements
4. Raking out the joints and chipping are performed as required
5. Masonry surface is cleaned and washed for plastering
6. Foreign materials are separated from sand by sieving/screening
7. Dry cement and sand are mixed until the mixture is uniform
8. Water is gradually added and mixed to form specified consistency
9. Uneven surface is scratched and repeated while plaster is still soft
10. Corner is properly finished by using corner trowel
11. Alignment, perpendicular, angularity is adjusted as required
12. Finished plaster is cured in accordance to workplace specifications
13. Tools and equipment are cleaned and stored accordingly
14. Waste materials are disposed of and entire work area is cleaned as per instruction



Learning Outcome 5.1- Prepare Masonry Surfaces for Plastering



Contents:

- Names and uses of personal protective equipment (PPE)
- List of main tools & equipment required cement plastering
- Collection, checking and selection for usability of the necessary tools and equipment
- Name of different types of cement and their uses
- Classification of sand and their uses
- Quality of water necessary in construction works
- Name different types of scaffolding
- Procedure of raking out of joints



Assessment criteria:

1. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements.
2. Quantity and quality of tools & equipment identified and gathered according to work requirements.
3. Quantity and quality of different types of materials to be used are placed in designated area.
4. Necessary tools and equipment are checked for their usability.
5. Scaffolding is set as required.
6. Joints are raked out as using appropriate tools and following standard procedures.
7. Surface is cleaned and washed for plastering.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, cold chisel, chipping hammer, steel brush, broom, scaffolding, hose pipe, bucket, mug, wheel barrow
- **Materials:** Cement, sand and water



Learning Activity 5.1.1

Learning Activity	Resources/Special Instructions/References
Prepare masonry surfaces for plastering	<ul style="list-style-type: none"> Information Sheets: 5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5 Self-Check Quiz: 5.1.1 Answer Key: 5.1.1 https://www.youtube.com/watch?v=BWWkoelZwtY https://theconstructor.org/building/types-of-scaffolding-in-construction



Information Sheet 5.1.1

Learning Objective: to select and check usability of personal protective equipment used for surface preparation in the workplace.

□ **Personal Protective Equipment (PPE):**

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Information Sheet 5.1.2

Learning Objective: to identify, collect and check usability of tools and equipment used in the workplace.

□ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 – 12)



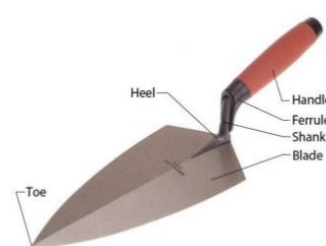
Information Sheet 5.1.3

Learning Objective: to identify and check hand tools and power tools for the usability in the workplace.

□ **Plastering tools and equipment:**









The masonry trowel is used in brick or stone work for levelling, spreading and shaping mortar or concrete. They come in several shapes and sizes depending on the task. The following is a list of the more common masonry trowels:

- **Brick trowel:** or mason's trowel is a point-nosed trowel for spreading mortar on bricks or concrete blocks with a technique called "buttering".
- **Bucket trowel:** a wide-bladed tool for scooping mortar from a bucket; it is also good for buttering bricks and smoothing mortar.
- **Concrete finishing trowel:** is used to smooth a surface after the concrete has begun to set.
- **Corner trowels:** used for shaping concrete around internal or external corners.



Components of a Bricklaying Trowel



<ul style="list-style-type: none">• Gauging trowel: a round-nosed trowel used for mixing mortar and applying small amounts in confined areas.• Margin trowel: a flat-nosed trowel used to work mortar in tight spaces and corners where a larger pointed trowel will not fit.• Pointing trowel: useful for filling in small cavities and repairing crumbling mortar joints.• Pool trowel or round trowel: is a concrete finishing trowel; rounded blade prevents it from digging into wet concrete.• Step trowel: similar to the corner trowel, it is used for shaping inside angles on concrete steps.• Tile setter: a brick trowel with an extra-wide blade to hold more mortar than a standard brick trowel.• Tuck pointer: used for neatly packing mortar between bricks and blocks when repointing and repairing crumbling mortar in masonry walls.	<p>Mason's Trowel</p>  <p>Different types of trowel</p>  <p>Outside corner trowel</p>  <p>Inside corner trowel</p>	
<p>Floats: are available in different sizes and used for plastering on masonry surfaces to get smooth planes. Floating is the first step in finishing the concrete after the screeding is done.</p>		
 <p>Wooden float</p>	 <p>Steel float</p>	 <p>Aluminum Darby</p>
<p>Plumb bob: is a weight, usually with a pointed tip on the bottom, suspended from a string and used as a vertical reference line, or plumb-line.</p>		
<p>Spirit level: A spirit level, bubble level or simply a level is an instrument designed to indicate whether a surface is horizontal (level) or vertical (plumb).</p>		



Self-Check Quiz 5.1.1

Check your understanding by answering the following questions:

Fill in the blanks with the correct answer.

1. _____ is a point-nosed trowel for spreading mortar on bricks or concrete blocks.
2. For filling in small cavities and repairing crumbling mortar joints _____ trowel is most useful.
3. Trowels are used for shaping concrete around internal or external corners are called _____.
4. _____ is used for neatly packing mortar between bricks and blocks when repointing and repairing crumbling mortar in masonry walls.

5. _____ are play important role for plastering on masonry surfaces to get smooth planes.



Information Sheet 5.1.4

Learning Objective: to select quality materials for plastering on masonry surface in a workplace.

☐ **Cement:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Aggregates:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Water:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)



Information Sheet 5.1.5

Learning objective: to identify and set scaffold for plastering on masonry surface in a workplace.

☐ **Scaffolds:**

Same as Information Sheet 4.1.4 – Gather masonry work tools, equipment and materials (page 65 – 67)



Learning Outcome 5.2 - Mix Mortar for Plastering on Masonry Surface



Contents:

- Foreign materials
- Cement
- Sand
- Water
- Proportion of cement and sand
- Mortar mixing ratio:
 - For brick laying, below ground and superstructure (thickness of wall)
 - For plastering, inner sides and outer sides (thickness of plaster)
 - For concrete (lime concrete, cement concrete, reinforced cement concrete)
- Methods of mixing mortar:
 - Mixing a batch by hand
 - Mixing a batch with a Mixer
- Water ratio:
 - Maintain the correct water ratio
 - Demerits of excess or less water added



Assessment criteria:

1. Foreign materials are separated from sand by sieving/screening.
2. Quantity of sand is placed in a dry and plane platform as per requirement.
3. Cement is equally spread on sand in accordance to specification.
4. Dry cement and sand are mixed until the mixture is uniform.
5. Water is gradually added and mixed to form specified consistency.
6. Prepared mortar is used within the schedule period.



Resources required:

Students/trainees must be provided with the following resources:

- One bagger concrete mixer, mixing box/containment, shovel/spade, pails (bucket, mug), water storage drum, potable water, cement, aggregates (sand suitable for masonry works), measuring box



LEARNING ACTIVITY 5.2.1

Learning Activity	Resources/Special Instructions/References
Mix mortar for plastering on masonry surface	<ul style="list-style-type: none">Information Sheet: 5.2.1Self-Check Quiz: 5.2.1Answer Key: 5.2.1https://www.youtube.com/watch?v=X0q_2VuFUOIhttps://www.youtube.com/watch?v=IORIZ1shRIM&t=8s



Information Sheet 5.2.1

Learning Objective: to mix mortar for plastering on masonry surface in a workplace.

☐ **Mixing of mortar:**

Same as Learning Outcome 1.3 – Make mortar/stucco (page 17 – 21)



Self-Check Quiz 5.2.1

Check your understanding by answering the following questions:

Read and analyse the statements carefully. Choose the best answer and write the letter only on your answer sheet.

- For cement mortar to lay bricks in foundations the ratio is used
a. Cement: Sand (1:3) b. Cement: Sand (1:6) c. Cement: Sand (1:4) d. Cement: Sand (1:8)
- For cement mortar to plaster brick walls the ratio is used
a. Cement: Sand (1:8) b. Cement: Sand (1:3) c. Cement: Sand (1:4) d. Cement: Sand (1:6)
- For cement mortar to plaster RCC surfaces the ratio is used
a. Cement: Sand (1:1) b. Cement: Sand (1:4) c. Cement: Sand (1:8) d. Cement: Sand (1:10)
- For cement mortar to water proofing works the ratio is used
a. Cement: Sand (1:2) b. Cement: Sand (1:5) c. Cement: Sand (1:7) d. Cement: Sand (1:6)
- Amount (percent) of water by weight of cement is just sufficient to give it necessary consistency for 1:4 mortars
a. 80% b. 60% c. 40% d. 75%



Learning Outcome 5.3 - Apply Plaster on Plain Surface and Corners



Contents:

- Process of applying of plaster
- Ground work for plaster: fixation of dots and screeds
- Application of first coat or under coat or rendering coat
- Application of second coat or finishing or fine coat



Assessment criteria:

1. Surface level is checked using appropriate levelling tools.
2. Uneven surface is scratched and repeated while plaster is still soft.
3. Wooden trowel and wetted foam are used to finish the surface.
4. Corner is initially set using a flat trowel and finished by using corner trowel.
5. Alignment, perpendicular, angularity is adjusted as required.
6. Finished plaster is cured in accordance to workplace specification.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, mixer, broom, bucket, mug, different types of trowel, outside & inside corner trowel, wooden float, steel float, plumb bob, nail, foam/soft brush, scaffold
- Cement mortar/stucco



Learning Activity 5.3.1

Learning Activity	Resources/Special Instructions/References
Apply plaster on plain surface and corners	<ul style="list-style-type: none"> ▪ Information Sheet: 5.3.1 ▪ Self-Check Quiz: 5.3.1 ▪ Answer Key: 5.3.1 ▪ https://www.youtube.com/watch?v=2r4nreZCyho ▪ https://www.youtube.com/watch?v=P8_DX.. ▪ https://www.youtube.com/watch?v=d2Aq82WTFH0



Information Sheet 5.3.1

Learning Objective: to apply cement plaster on plain surface and corners in a workplace.

❑ **How to apply cement plaster on wall surface?**

❑ **Traditional standard method (manual):**

Cement plastering is commonly used as ideal coating for external and internal surface of wall. Cement plaster is usually applied in a single coat or double coat. Double coat plaster is applied where thickness of plaster is required to be more than 15mm or when it is required to get a very fine finish.

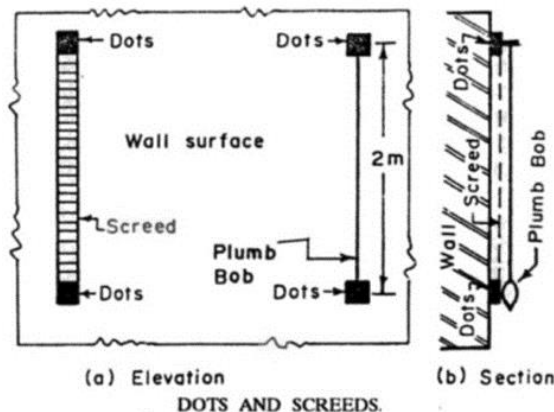
❑ **Step by step guide for cement plastering:**

Step 1 (preparation of surface):

1. Keep all the mortar joints of wall rough so as to give a good bonding to hold plaster.
2. Clean all the joints and surfaces of the wall with a wire brush, there should be no oil or grease etc. left on wall surface.
3. If the surface is smooth or the wall to be plastered is old one, then rake out the mortar joint to a depth of at least 12mm to give a better bonding to the plaster.
4. If the projection on the wall surface is more than 12mm, then knock it off so to obtain a uniform surface of wall. This will reduce the consumption of plaster.
5. If there exist any cavities or holes on the surface, then fill it in advance with appropriate material.
6. Roughen the entire wall to be plastered.
7. Wash the mortar joints and entire wall to be plastered, and keep it wet for at least 6 hours before applying cement plaster.

Step 2 (ground work):

1. To get uniform thickness of plastering throughout the wall surface, first fix *dots* on the wall. A dot means patch of plaster of size 50mm x 50mm and having thickness of about 10mm.
2. Dots are fixed on the wall first horizontally and then vertically at a distance of about 2 meters covering the entire wall surface.
3. Check the verticality of dots, one over the other, by means of plumb-bob.
4. After fixing dots, the vertical strips of plaster, known as *screeds*, are formed in between the dots. These screeds serve as the gauges for maintaining even thickness of plastering being applied.



Step 3 (first coat or under coat or rendering coat):

1. In case of brick masonry, the thickness of first coat plaster is in general 12mm and in case of concrete masonry this thickness varies from 9 to 15mm.
2. The ratio of cement and sand for first coat plaster varies from 1:3 to 1:6.
3. Apply the first coat of plaster between the spaces formed by the screeds on the wall surface. This is done by means of trowel.
4. Level the surface by means of flat wooden floats and wooden straight edges.

5. After levelling, left the first coat to set but not to dry and then roughen it with a scratching tool to form a key to the second coat of plaster.

Step 4 (second coat or finishing coat or fine coat):

1. The thickness of second coat or finishing coat may vary between 2 to 3mm.
2. The ratio of cement and sand for second coat plaster varies from 1:4 to 1:6.
3. Before applying the second coat, damp the first coat evenly.
4. Apply the finishing coat with wooden floats to a true even surface and using a steel trowel, give it a finishing touch.
5. As far as possible, the finishing coat should be applied starting from top towards bottom and completed in one operation to eliminate joining marks.

□ **Automatic method (machine):**

Plastering can also be done by automatic machine. The advantages of plastering with machine, includes time saving, cost reduces giving the highest quality of products.



- After completion of the plastering work, it is kept wet by sprinkling water for at least 14 days in order to develop strength and hardness.



Self-Check Quiz 5.3.1

Check your understanding by answering the following questions:

1. What is means for dots?
2. State the use of plumb bob for plastering work.
3. Write the advantages of plastering with machine.
4. How many days need to keep wet the surface after completion of plaster?



Learning Outcome 5.4 - Clean and Maintain Work Area

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 5.1.1

1. Brick trowel or mason's trowel
2. Pointing trowel
3. Corner trowels
4. Tuck pointer
5. Floats

ANSWER KEY 5.2.1

1. C
2. D
3. B
4. A
5. D

ANSWER KEY 5.3.1

1. Dot means a patch of plaster of size 50mm x 50mm and having thickness of about 12mm.
2. Plumb-bob is suitable for check the verticality of dots.
3. The advantages of plastering with machine includes time saving, cost reduces and giving the highest quality of products.
4. After completion of the plastering work, it is kept wet by sprinkling water for at least 14 days.

Module 6: Perform pattern stone finishing work



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes required to perform pattern stone finishing work which includes planning out pattern stone work, gathering tools, equipment and materials, mixing pattern stone materials, pouring cement mixture, curing of concrete, and cleaning and maintaining the workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 32 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 6.1 Plan out for pattern stone work
- 6.2 Gather tools, equipment and materials
- 6.3 Mix pattern stone materials
- 6.4 Pour cement mixture for pattern stone and curing
- 6.5 Clean and maintain workplace



Performance Criteria:

1. Building drawings are read and interpreted according to work requirements
2. Materials, tools, equipment and man-hours are correctly estimated for completing the job
3. Quality of cement, sand, coarse aggregate and water are checked and determined required quantity
4. Tools and equipment are gathered, checked and prepared in accordance with job requirements
5. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements
6. Cement, sand, coarse aggregate and water are mixed according to specified proportion and consistency
7. Test cubes/cylinder are made, and slump test is performed under direct supervision
8. Proper transporting method of concrete is used
9. Concrete admixtures are identified and used in accordance to job requirements
10. Formwork is checked in accordance with job specifications
11. Mixed materials are placed in layers and vibrated to avoid air trapping
12. Poured mixture is levelled using appropriate levelling device
13. Tools and equipment are cleaned and stored following the standard procedures



Learning Outcome 6.1- Plan Out for Pattern Stone Work



Contents:

- Building drawing:
 - Plan
 - Elevation
 - Section
- Methods of estimate:
 - Materials
 - Equipment
 - Man-hours
- Quality of materials:
 - Cement
 - Sand
 - Khoa/chips
 - Water



Assessment criteria:

1. Building drawings are interpreted according to work requirements.
2. Materials, tools, equipment and man-hours are correctly estimated for completing the job.
3. Quality of cement, sand, coarse aggregate and water are checked and placed in designated area.
4. Quantity of cement, sand, coarse aggregate and water are determined as per job requirement.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, pan, mug, measuring box, shovel/spade, sieve, mortar mixer and mortar mixing box/containment
- **Materials:** cement, sand, coarse aggregate and water
- Building drawings



Learning Activity 6.1.1

Learning Activity	Resources/Special Instructions/References
Plan out for pattern stone work	<ul style="list-style-type: none">▪ Information Sheet: 6.1.1▪ Self-Check Quiz: 6.1.1▪ Answer Key: 6.1.1

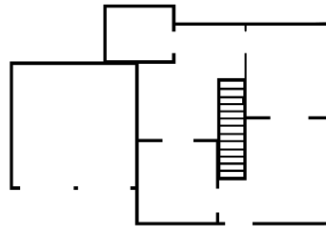


Information Sheet 6.1.1

Learning Objective: to plan out for pattern stone work in a workplace.

□ **Building drawing:**

- A floor plan is a drawing to scale, showing a view from above, of the relationships between rooms, spaces and other physical features.
- Dimensions are usually drawn between the walls to specify room sizes and wall lengths.
- Floor plans may include notes for construction to specify finishes, construction methods, or symbols for electrical items.
- A plan which is a measured plane typically projected at the floor height of 4 ft (1.2 m), shows room or space dimensions.
- It is a full or part horizontal section of a building.



Floor plan of a common house

□ **Building Layout:**

- Layout of a building or a structure shows the plan of its foundation on the ground surface according to its drawings, so that excavation can be carried out exactly where required and position and orientation of the building is exactly specified.
- It is set out according to foundation plan drawings and specifications provided by the engineer or an architect.

□ **Plan, Elevation and Section:**

- A plan is the view from top or horizontal section through an object or building. Length and breadth of the object or building can be found from this.
- A section is a vertical slice through an object or building with one half removed so we can look inside. Length and height or breadth and height of the object or building can be found from this.
- An elevation is the outside views from the front or sides of an object or building. Outside length and height or breadth and height of the object or building can be found from this.



Pictorial view of a building



SELF-CHECK QUIZ 6.1.1

Check your understanding by answering the following questions:

1. Define plan of a building.
2. What is elevation of a building?
3. What is section of a building?



Learning Outcome 6.2 - Gather Tools, Equipment and Materials



Contents:

- List of main tools and equipment required for pattern stone works
- Different types of pattern stones
- Names and uses of personal protective equipment (PPE)
- Name of different types of cement and their specific uses
- Quality of water necessary in construction works
- Classification of sand according to grain size and sources and their proper uses



Assessment criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Pattern stones are selected, collected and gathered at work site.
3. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, steel pan, mug, measuring box, shovel/spade, sieve, mortar mixer and mortar mixing box/containment, measuring tools, plumb bob, spirit level, nylon string, nail, mason's hammer, pointed trowel
- **Materials:** pattern stones, cement, sand, coarse aggregates and water



Learning Activity 6.2.1

Learning Activity	Resources/Special Instructions/References
Gather tools, equipment and materials	▪ Information Sheets: 6.2.1, 6.2.2, 6.2.3



Information Sheet 6.2.1

Learning Objective: to identify the personal protective equipment used in the workplace.

- ☐ **Personal Protective Equipment:**



Information Sheet 6.2.2

Learning Objective: to identify and gather appropriate tools and equipment used in the workplace.

☐ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 – 12)



Information Sheet 6.2.3

Learning Objective: to identify and gather appropriate materials used in pattern stone works.

☐ **Cement:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Aggregates:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Water:**







Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Pattern stones:**

- Material: Glass, Marble, Porcelain/Ceramic, Crystal, Metal, Oxalic acid, White cement.
- Size: 30 x 30mm, 25 x 25mm, 15 x 15mm, 20 x 20mm, 100 x 100mm, and more.
- Shape: Square, Flat, Strip, Irregular, Round, Rhombus.
- Style: European, Modern, Mediterranean, Pastoralism, American and more.
- Thickness: 8mm, 4mm, 6mm, 5mm and more.
- Color: Mixed, Brown, Blue, White, Yellow, and more.
- Usage: Wall, Floor and Ceiling.
- Application: Living Room, Bathroom, Dining Room, Outside, Kitchen.

☐ **Sample of different types of pattern stone:**

		
PVC Stone Colour Pattern Vinyl Floor Tile	Granite Pattern Kitchen Tops Quartz Stone	Design Pattern Marble Stone Mosaic

 <p>Round Pattern Marble Stone Mosaic Floor Tile</p>	 <p>Natural Travertine & Marble Stone Mosaic Pattern for Floor Decoration</p>	 <p>Stone Marble Mosaics / Glass Mosaic Art Pattern Tile</p>
 <p>Special Pattern Full Polished Glazed Natural Stone Tile</p>	 <p>Luxury Vinyl Tile Flooring Stone Pattern</p>	 <p>Marble Stone Water Jet Medallions Pattern for Flooring</p>



Learning Outcome 6.3 – Mix Pattern Stone Materials



Contents:

- Bulking of sand
- Mixing proportions
- Water cement ration
- Test cube or cylinder
- Slump test
- Concrete admixtures



Assessment criteria:

1. Mixing tools and equipment to be used are checked according to job requirements
2. Materials are laid on mortar mixing box as per instruction
3. Cement, sand, coarse aggregate and water are mixed according to specified proportion and consistency
4. Test cubes/cylinder are made, and slump test is performed under direct supervision
5. Proper transporting method of concrete is used
6. Concrete admixtures are identified and used in accordance to job requirements



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, trowel, mason's square, bucket, mug, wheel barrow, broom, cube and cylinder moulds and slump test equipment set
- **Materials:** cement, sand, coarse aggregate, water and mixtures



Learning Activity 6.3.1

Learning Activity	Resources/Special Instructions/References
Mix pattern stone materials	<ul style="list-style-type: none"> ▪ Information Sheet: 6.3.1 ▪ Self-Check Quiz: 6.3.1 ▪ Answer Key: 6.3.1



Information Sheet 6.3.1

Learning Objective: to mix pattern stone materials as per workplace requirements.

- **Bulking of sand:**
 - When volume of sand increases due to absorption of some water, this is known as bulking of sand.
- **Water cement ratio:**
 - The water–cement ratio is the ratio of the weight of water to the weight of cement used in a concrete mix.
 - A lower ratio leads to higher strength and durability but may make the mix difficult to work with and form.
 - In practice, it is seen that more water is mixed to make the mix workable.
 - This is a bad practice and additional water weakens the strength of cement paste.
 - Extra water also weakens adhesive quality.
- **Concrete Admixtures (Additives):**
 - Admixtures are added to concrete batch immediately before or during mixing concrete.
 - Concrete admixtures can improve concrete quality, manageability, acceleration or retardation of setting time among other properties that could be altered to get specific results.
- **Types of admixtures used in concrete:**
 - Set retarding: delay the chemical reaction and allow more time for finishing concrete pavements.
 - Air entrained: increase the freeze-thaw durability of concrete.
 - Water-reducing: create a desired slump at a lower water-cement ratio and used primarily in bridge decks and patching concrete.
 - Accelerating: increase the rate of concrete strength development or to reduce concrete setting time.
 - Shrinkage reducing: reduce early and long-term drying shrinkage.
 - Super plasticizers: produce flowing concrete with a high slump.
 - Corrosion-inhibiting admixtures: use to slow corrosion of reinforcing steel in concrete.
- **Tests on Concrete:**
 - **Slump Test to know consistency and workability of concrete:**

The slump test is done to make sure a concrete mix is workable. The measured slump must be within a set range or tolerance from the target slump.
 - **Cube/Cylinder Test to find compression strength of concrete:**

The cube or cylinder is made with freshly made concrete using standard mould. After curing the sample, compression testing is done in a laboratory off-site.
- **How to mix cement concrete?**
 - **Method 1: Preparing the dry mix**

Step 1. Open the cement, gravel and sandbags that will use for mixing concrete.

Use small spade to shovel a ratio of 1 part cement, 2 parts sand and 3 parts gravel into the wheelbarrow.

Step 2. Mix the ingredients thoroughly with spade to ensure they are well combined.

It's a good idea to have the dry mix thoroughly incorporated before adding the water.
 - **Method 2: Incorporating water into the dry mix**

Step 1. Pour a small amount of water, roughly half of a 5-gallon (22 litre) bucket into the wheelbarrow.

Be sure to measure out a known amount, so that it can replicate the same consistency with successive batches of concrete.

 - If pouring water into a bucket before incorporating into the dry mix, mark the water level on the bucket. This way, it can quickly fill the bucket without measuring out the water each time mix a new batch.

Step 2. In a wheelbarrow or other mixing container, agitate about 3/4 of the dry mix with the water. This first mix will appear a bit soupy because of the excess water but it should be easy to mix.

Step 3. Once incorporated, add the remaining 1/4 of dry mix to the soupy cement mix and continue mixing until the finished cement is thick and wet but no longer soupy.

Step 4. Pour the mixed cement immediately into test cube and/or slump cone as per standard procedures. This step needs to be completed as soon as possible after mixing.



JOB SHEET 2

Qualification:	Masonry
Learning unit:	Tests on Concrete (Consistency and Workability): Slump Test
Learner name:	
Personal protective equipment (PPE):	Hand gloves, visibility vest, safety goggles, safety boots, hard hat and dust mask
Materials:	Cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water
Tools and equipment:	<ul style="list-style-type: none"> ▪ Standard slump cone (100 mm top diameter x 200 mm bottom diameter x 300 mm high) ▪ Small scoop ▪ Bullet-nosed rod (600 mm long x 16 mm diameter) ▪ Rule ▪ Slump plate (500 mm x 500 mm)
Performance criteria:	<ol style="list-style-type: none"> 1. Mixing tools and equipment to be used are checked according to job requirements. 2. Materials are laid on mortar mixing box as per instruction. 3. Cement, sand, coarse aggregate and water are mixed according to specified proportion and consistency. 4. Test cubes/cylinder are made, and slump test is performed under direct supervision 5. Proper transporting method of concrete is used. 6. Concrete admixtures are identified and used in accordance to workplace requirement.
Measurement:	<ul style="list-style-type: none"> ▪ Carefully take the measurement of materials used
Notes:	<ul style="list-style-type: none"> ▪ Complete the job as per schedule time and instruction of the trainer
Procedure:	<ol style="list-style-type: none"> 1. Collect PPE, tools, equipment and all other materials used in slump test 2. Clean the cone. Dampen with water and place on the slump plate. The slump plate should be clean, firm, level and non-absorbent. Collect a sample of concrete to perform the slump test. 3. Stand firmly on the foot pieces and fill 1/3 the volume of the cone with the sample. Compact the concrete by 'rodding' 25 times. Rodding means to push a steel rod in and out of the concrete to compact it into the cylinder, or slump cone. Always rod in a definite pattern, working from outside into the middle. 4. Now fill to 2/3 and again rod 25 times, just into the top of the first layer. 5. Fill to overflowing, rodding again this time just into the top of the second layer. Top up the cone till it overflows. 6. Level off the surface with the steel rod using a rolling action. Clean any concrete from around the base and top of the cone, push down on the handles and step off the foot pieces. 7. Carefully lift the cone straight up making sure not to move the sample. 8. Turn the cone upside down and place the rod across the up-turned cone.

	<p>9. Take several measurements and report the average distance to the top of the sample. If the sample fails by being outside the tolerance (i.e. the slump is too high or too low), another must be taken. If this also fails, the remainder of the batch should be rejected.</p> <p>10. While working use personal protective equipment for safety</p> <p>11. Clean tools, equipment and workplace, and restore tools, equipment and excess materials properly.</p>		
Learner signature:		Date:	
Assessor signature:		Date:	
Quality Assurer signature:		Date:	
Assessor remarks:			



JOB SHEET 3

Qualification:	Masonry
Learning unit:	Tests on Concrete (Compression): Cube/Cylinder Test
Learner name:	
Personal protective equipment (PPE):	Hand gloves, visibility vest, safety goggles, safety boots, hard hat and dust mask
Materials:	Cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water
Tools and equipment:	<ul style="list-style-type: none"> ▪ Cube, 150 mm x 150 mm x 150 mm (inner) / Cylinders, 150 mm diameter (inner) x 300 mm high ▪ Small scoop ▪ Bullet-nosed rod (600 mm x 16 mm diameter) ▪ Steel float
Performance criteria:	<ol style="list-style-type: none"> 1. Mixing tools and equipment to be used are checked according to job requirements. 2. Materials are laid on mortar mixing box as per instruction. 3. Cement, sand, coarse aggregate and water are mixed according to specified proportion and consistency. 4. Test cubes/cylinder are made, and slump test is performed under direct supervision 5. Proper transporting method of concrete is used. 6. Concrete admixtures are identified and used in accordance to workplace requirement.
Measurement:	<ul style="list-style-type: none"> ▪ Carefully take the measurement of materials used
Notes:	<ul style="list-style-type: none"> ▪ Complete the job as per schedule time and instruction of the trainer
Procedure:	<ol style="list-style-type: none"> 1. Collect PPE, tools, equipment and all other materials used in cylinder/cube test 2. Clean the cylinder mould and coat the inside lightly with form oil, then place on a clean, level and firm surface, i.e. the steel plate. Collect a sample. 3. Fill 1/2 the volume of the mould with concrete then compact by rodding 25 times. Cylinders may also be compacted by vibrating using a vibrating table. 4. Fill the cone to overflowing and rod 25 times into the top of the first layer, then top up the mould till overflowing. 5. Level off the top with the steel float and clean any concrete from around the mould. 6. Cap and clearly tag the cylinder and put it in a cool dry place to set for at least 24 hours. 7. After the mould is removed the cylinder is sent to the laboratory where it is cured and crushed to test compressive strength. 8. While working use personal protective equipment for safety 9. Clean tools, equipment and workplace, and restore tools, equipment and excess materials properly.

Learner signature:		Date:	
Assessor signature:		Date:	
Quality Assurer signature:		Date:	
Assessor remarks:			



Self-Check Quiz 6.3.1

Check your understanding by answering the following questions:

1. RCC works for a simple building the ratio of the ingredients used are _____.
2. What is bulking of sand?
3. Why admixtures are added to concrete?
4. Why the slump test is done?



Learning Outcome 6.4 – Pour Cement Mixture for Pattern Stone



Contents:

- Different types of formworks
- Setting time of cement
- Importance of vibration of concrete
- Methods of vibration
- Curing process



Assessment criteria:

1. Formwork is checked in accordance with job specifications.
2. Mixed materials are placed in layers and vibrated to avoid air trapping.
3. Poured mixture is levelled using appropriate levelling device.
4. Pattern stone surface is finished properly.
5. Curing is done as per instruction.



Resources required:

Students/trainees must be provided with the following resources:

- 1



Learning Activity 6.4.1

Learning Activity	Resources/Special Instructions/References
Pour cement mixture for pattern stone	<ul style="list-style-type: none"> ▪ Information Sheets: 6.4.1, 6.4.2, 6.4.3 ▪ Self-Check Quizzes: 6.4.1, 6.4.2, 6.4.3 ▪ Answer Keys: 6.4.1, 6.4.2, 6.4.3



Information Sheet 6.4.1

Learning Objective: to pour cement mixture for pattern stone.

Formwork:

Same as Information Sheet 2.2.2 – Set-up base for paving work and prepare raw materials (page 34 – 35)



Self-Check Quiz 6.4.1

Check your understanding by answering the following questions:

1. What are the major materials used in formworks?
2. Write the period of removal of formwork for walls, columns and vertical sides of beams.
3. Write the period of removal of formwork for slabs.
4. What is the unit of formworks?



Information Sheet 6.4.2

Learning Objective: to identify setting time of cement.

- **Setting time of cement**
 - Initial setting time is that period between the time water is added to cement and time at which 1 mm square section needle fails to penetrate the cement paste, placed in the Vicat's mould 5 mm to 7 mm from the bottom of the mould.
 - Final setting time is that time period between the time water is added to cement and the time at which 1 mm needle makes an impression on the paste in the mould, but 5 mm attachment does not make any impression.
- **Procedure to determine initial and final setting time of cement**
 - (i) Prepare a cement paste by gauging the cement with 0.85 times the water required to give a paste of standard consistency.
 - (ii) Start a stop-watch, the moment water is added to the cement.
 - (iii) Fill the Vicat mould completely with the cement paste and gauge it with the mould resting on a non-porous plate and smooth off the surface of the paste making it level with the top of the mould. The cement block thus prepared in the mould is the test block.
- **Initial setting time**
 - Place the test block under the rod bearing the needle.
 - Lower the needle gently in order to contact the surface of the cement paste and release quickly, allowing it to penetrate the test block.
 - Repeat the procedure till the needle fails to pierce the test block to a point $5.0 \pm 0.5\text{mm}$ measured from the bottom of the mould.
 - The period elapsing between the time, water is added to the cement and the time, the needle fails to pierce the test block by $5.0 \pm 0.5\text{mm}$ measured from the bottom of the mould, is the initial setting time.
- **Final setting time**
 - Replace the above needle by the one with an annular attachment.
 - The cement should be considered as finally set when, upon applying the needle gently to the surface of the test block, the needle makes an impression therein, while the attachment fails to do so.
 - The period elapsing between the time, water is added to the cement and the time, the needle makes an impression on the surface of the test block, while the attachment fails to do so, is the final setting time.
- Initial and final setting time is different for different types of cement depending on use.
 - $0 < \text{Initial Setting time} < 45\text{minutes}$ (Portland Cement)
 - $0 < \text{Final Setting time} < 10\text{hrs}$ (Portland Cement)
- **Tests on setting time of cement:**

Generally setting time is determined by using Vicat's Apparatus.



- **Initial setting time:**

1. Cement is mixed with 0.85 times the water required for standard consistency.
2. As per Vicat's test "the time elapsed since the addition of water to the cement up to the time at which the needle cannot penetrate 5 to 7 mm from the bottom of the Vicat's mould.

- **Final setting time:**

1. Determined by Vicat's apparatus using Vicat's needle with annular collar of 5cm diameter.
2. As per Vicat's test "the time elapsed since the addition of water to the cement up to the time at which the needle with annular collar can only make a mark on the hard cement surface.

Note for Trainer:

Trainer will demonstrate setting time of cement and trainees will observe the demonstration.



Self-Check Quiz 6.4.2

Check your understanding by answering the following questions:

1. What is called initial setting time of cement?
2. What is the called final setting time of cement?
3. Write the initial and final setting time of Portland cement.
4. Write the name of apparatus used to determine the setting time of cement.





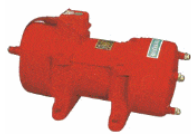

Information Sheet 6.4.3

Learning Objective: to use concrete vibrators to avoid air trapping.

- **Concrete vibrators:**

Different types of vibrators are used in concrete compaction for different types of construction and structural requirements. Since concrete contains particles of different sizes, the most effective compaction of concrete can be achieved by using vibrators with different speeds of vibration.

□ **Types of vibrators:**

<p>(i) Immersion or Needle Vibrators:</p> <p>Immersion or Needle Vibrators are most commonly used vibrator for concrete. The period of vibration required may be of the order of 30 seconds to 2 minutes. The concrete should be placed in layers not more than 600mm high.</p>	 <p>Immersion or Needle Vibrators</p>
<p>(ii) External or Shutter Vibrators</p> <p>These vibrators are clamped rigidly to the form work at the pre-determined points so that the form and concrete are vibrated. The external vibrators are suitable for pre-casting concrete.</p>	 <p>External or Shutter Vibrators</p>
<p>(iii) Surface Vibrators</p> <p>These are placed directly on the concrete mass. These are used when the depth of concrete to be vibrated is more than 250 mm.</p>	 <p>Surface Vibrators</p>
<p>(iv) Vibrating Table</p> <p>The vibrating table is very efficient in compacting stiff and harsh concrete mixes.</p>	 <p>Vibrating Table</p>

□ **Curing:**

Same as Information Sheet 2.4.1 – Complete laying of brick/block (page 41 – 42)



Self-Check Quiz 6.4.3

Check your understanding by answering the following questions:

1. What is the maximum thickness of a layer of concrete to use vibrator?
2. Identify the suitability of use of the external vibrators.
3. What is the highest depth of concrete that can be vibrating with a surface vibrator?
4. What is the use of a vibrating table?
5. What is curing?



Learning Outcome 6.5 - Clean and Maintain Workplace

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 6.1.1

1. A plan which is a measured plane typically projected at the floor height of 4 ft (1.2 m), shows room or space dimensions. It is a full or part horizontal section of a building.
2. An elevation which is a measured plane projected from the side of a building, along its height and shows the side views with length and height or breadth and height of the building.
3. A section or cross section where a building, is cut along an axis to reveal the interior structure. It is a vertical slice through a building with one half removed so we can look inside.

ANSWER KEY 6.3.1

1. Cement: Sand: Chips (1:2:4)
2. The increase in volume of sand due to moisture content is called bulking of sand. Another way, the volume of dry sand increases due to absorption of moisture. This volume increase of dry sand is known as *bulking of sand*.
3. Admixtures are added to concrete to improve the quality, manageability, acceleration or retardation of setting time among other properties that could be altered to get specific results.
4. The slump test is done to check the consistency of freshly made concrete and to make sure a concrete mix is workable.

ANSWER KEY 6.4 .1

1. Timber, steel, aluminium, bamboo, plywood
2. 3 days
3. 28 days
4. Area

ANSWER KEY 6.4.2

1. Initial setting time is that time period between the time water is added to cement and time at which 1 mm square section needle fails to penetrate the cement paste, placed in the Vicat's mould 5 mm to 7 mm from the bottom of the mould.
2. Final setting time is that time period between the time water is added to cement and the time at which 1 mm needle makes an impression on the paste in the mould, but 5 mm attachment does not make any impression.
3. The initial and final setting time of Portland cement is 45 minutes and 10 hours respectively.
4. Setting time of cement is determined by using Vicat's Apparatus.

ANSWER KEY 6.4.3

1. The concrete should be placed in layers not more than 600mm high.
2. The external vibrators are suitable for pre-casting concrete.
3. Surface vibrator should not be used when the depth of concrete to be vibrated is more than 250.
4. The vibrating table is used in compacting stiff and harsh concrete mixes.
5. Curing is the process of keeping the hardened concrete moist so that it can continue to gain strength.

Module 7: Perform wall panelling using bricks/stones



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes to perform wall panelling using bricks/stones which includes gathering tools and materials, organizing for wall panelling works using bricks/stones, preparing wall surface for brick/stone panelling, mixing mortar/bonding components, accomplishing wall panelling works, and cleaning and maintaining the workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 32 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 7.1 Gather tools, equipment and materials
- 7.2 Organise for wall panelling works using bricks/stones
- 7.3 Prepare wall surface for brick/stone panelling
- 7.4 Mix mortar/bonding components
- 7.5 Accomplish wall panelling works
- 7.6 Clean/maintain the workplace



Performance Criteria:

- 1. Tools and equipment are gathered, checked and prepared in accordance with job requirements
- 2. Bricks and blocks are selected, collected and gathered at worksite
- 3. Scaffolding is set as per workplace requirements
- 4. Appropriate personal protective equipment (PPE) is used and demonstrated according to job requirements
- 5. Plans and drawings are read and interpreted according to job requirements
- 6. Bricks/stones are checked for usability/quality and organised at worksite
- 7. Cement mortar/bonding materials are prepared and mixed in accordance to workplace specifications
- 8. Setting time of cement is identified
- 9. Brick/stone panelling base is soaked in water
- 10. Brick/stone is installed in accordance with workplace specifications
- 11. Closer and bats are used to maintain specified bond
- 12. Grooves are filled up with mortar for better adhesion
- 13. Tools and equipment are cleaned and stored following the standard procedures
- 14. Waste materials are disposed of and workplace is cleaned and kept in safe state



Learning Outcome 7.1 – Gather Tools, Equipment and Materials



Contents:

- List of main tools and equipment required for brick/stone panelling works
- Different types of bricks and stones
- Names and uses of personal protective equipment (PPE)
- Name of different types of cement and their specific uses
- Quality of water necessary in construction works
- Classification of sand according to grain size and sources and their proper uses
- Types of scaffolding and materials uses



Assessment criteria:

1. Tools and equipment are gathered, checked and prepared in accordance with job requirements.
2. Bricks and blocks are selected, collected and gathered at worksite.
3. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements.
4. Proper transport is used for carrying materials.
5. Scaffolding is set as per workplace requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** wheel barrow, bucket, steel pan, mug, measuring box, shovel/spade, sieve, mortar mixer and mortar mixing box/containment, measuring tools, plumb bob, spirit level, nylon string, nail, mason's hammer, pointed trowel
- **Materials:** bricks/blocks, cement, sand, water and scaffolding materials



Learning Activity 7.1.1

Learning Activity	Resources/Special Instructions/References
Gather tools, equipment and materials	<ul style="list-style-type: none"> ▪ Information Sheets: 7.1.1, 7.1.2, 7.1.3, 7.1.4 ▪ Self-Check Quizzes: 7.1.1, 7.1.2 ▪ Answer Key: 7.1.1, 7.1.2 ▪ https://www.youtube.com/watch?v=BWWkoelZwtY ▪ (https://theconstructor.org/building/types-of-scaffolding-in-construction)



Information Sheet 7.1.1

Learning Objective: to select and check usability of personal protective equipment used in the workplace.

□ **Personal Protective Equipment (PPE):**

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Information Sheet 7.1.2

Learning Objective: to identify, collect and check usability of tools and equipment used in the workplace.

□ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 – 12)




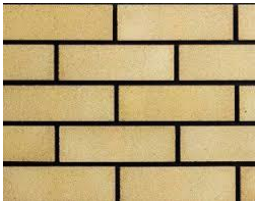


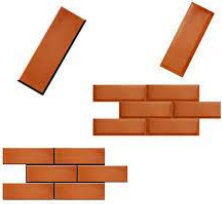

Information Sheet 7.1.3

Learning Objective: to identify, collect and check materials used for wall panelling works.

□ **General information**

- A wall panel is single piece of material, usually flat and cut into a rectangular shape, that serves as the visible and exposed covering for a wall. Wall panels are functional as well as decorative, providing insulation and soundproofing, combined with uniformity of appearance, along with some measure of durability or ease of replace ability.
- Use of wall panels can reduce construction costs by providing a consistent appearance to the panelled surface without requiring the application of paint or another finishing material. Wall panels may be finished on only one side, if the other side is going to be against a brick or concrete wall, or a comparable structure.
- Wall panelling can be done using brick, stone, wood, aluminium, glass fibres, eco-friendly recycled products for both internal and external walls considering local weather condition.






□ **Materials for wall panelling:**

 <p>Bricks</p>	 <p>Brick</p>	 <p>Brick</p>
		

		
Wood	Wood	Wood

☐ **Stone:**

- Stone or rock is a natural substance a solid aggregate of one or more minerals or mineraloids.
- The Earth's outer solid layer, the lithosphere, is made of rock. Stone has been used by mankind throughout history.
- There are three major groups of rocks: igneous, sedimentary and metamorphic.

		
Stones	Stones	Stones
		
Stone panelling	Stone panelling	Stone panelling

☐ **Cement:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Aggregates:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Water:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)



Self-Check Quiz 7.1.1

Check your understanding by answering the following questions:

1. What is wall panel?
2. What is a stone?
3. What is cement?
4. Classify fine aggregates as per grain sizes and sources of availabilities. Also mention their suitability of uses.
5. State the quality of water that suitable for mixing masonry materials and curing purposes.



Information Sheet 7.1.4

Learning Objective: to identify and set scaffold for carryout stone and brick works.

☐ **Scaffolds:**

Same as Information Sheet 4.1.4 – Prepare masonry work tools, equipment and material (page 64 – 66)



Learning Outcome 7.2 – Organise for Wall Panelling Works Using Bricks/Stones



Contents:

- Types of brick:
 - Common Burnt Clay
 - Sand Lime (Calcium Silicate)
 - Engineering
 - Concrete
 - Fly ash Clay
- Based on using:
 - Facing
 - Engineering
 - Common
 - Paving
- Based on manufacturing:
 - Unburnt
 - Burnt
 - First class
 - Second class
 - Third class
- Classification on shape:
 - Solid
 - Hollow
 - Curved
 - Perforated
- Types of stones or rocks:
 - Igneous
 - Sedimentary
 - Metamorphic



Assessment criteria:

1. Quality of bricks/stones are checked and segregated as per job requirements.
2. Bricks/stones are cleaned and soaked in accordance to specification.
3. Bricks/stones are organized at work site as per job requirements.
4. Building plans and drawings are read and correctly interpreted.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, mixing board, mixer, shovel/spade, sieve, measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, wooden float, pointed trowel, form work, batter board, scaffolds, guide post
- **Materials:** bricks, stones, cement, sand and water



Learning Activity 7.2.1

Learning Activity	Resources/Special Instructions/References
Organize for wall panelling works using bricks/stones	<ul style="list-style-type: none"> ▪ Information Sheets: 7.2.1, 7.2.2 ▪ Self-Check Quizzes: 7.2.1, 7.2.2 ▪ Answer Keys: 7.2.1, 7.2.2



Information Sheet 7.2.1

Learning Objective: to organize for wall panelling works using bricks/stone in the workplace.

- **Classification of bricks** as per conventional standards or based on manufacturing:
 1. Sundried or katcha bricks: The bricks dried only in sun are called sundried or katcha bricks. They are only suitable for constructing enclosures etc.
 2. Burnt or pacca brick: The bricks which are burnt in a kiln after holding and drying are called burnt or pacca bricks. These are generally used in permanent walls.
 3. First class bricks: The bricks which are well burnt, uniform size and shape are known as first class bricks. These are suitable for masonry works.
 4. Second class bricks: The bricks which not well burnt, not uniform in shape and size are known as second class bricks. These bricks are used in interior wall.
 5. Third class bricks: The bricks which are under burnt, not uniform in shape and size are called third class bricks. These bricks are used in temporary building construction.
 6. Over burnt or jhama bricks: The bricks which are over burnt, irregular in shape and size are called over burnt or jhama bricks. They are used as aggregates and as road metal.
- *There are some other bricks which are in different shapes and sizes used for specific types of construction works.*



Different types of bricks/blocks

□ **Soaking of bricks:**

- Bricks or blocks are soaked to remove dirt from the surfaces and stopped absorption of water from mortar.
- If dry bricks or blocks are used, then they start to absorb water from mortar which would lead to less strength development.

□ **Frog marks:**

- Brick frogs create indentation of the brick and create stronger bond between bricks.
- The frog indentation provides a very suitable location to stamp the makers name into every brick produced.



Self-Check Quiz 7.2.1

Check your understanding by answering the following questions:

1. Define first class bricks.
2. What happens when dry bricks or blocks are used in masonry works?
3. Which type of brick is more suitable for construction of circular brick masonry pillar and brick chimneys?
4. Considering reduction of the transmission of heat, sound and damp which bricks are very helpful?
5. What are the reasons of using frog mark on bricks?



Information Sheet 7.2.2

Learning Objective: to read and interpret construction drawings in a workplace.

□ **Floor Plan:**

Same as Information Sheet 2.2.1 – Set-up base for paving work and prepare raw materials (page 34 – 35)

□ **Layout of Building:**

Same as Information Sheet 2.2.1 – Set-up base for paving work and prepare raw materials (page 34 – 35)

□ **Plan, Elevation and Section:**

Same as Information Sheet 6.1.1 – Plan out for pattern stone work (page 94)



Self-Check Quiz 7.2.2

Check your understanding by answering the following questions:

1. Define plan of a building.
2. What is elevation of a building?
3. What is section of a building?



Learning Outcome 7.3 – Prepare Wall Surface for Brick/Stone Panelling



Contents:

- Foreign materials:
 - Dust
 - Oil
 - Cement
 - Sand
 - Dirt
- Cleaning of bricks/tiles/blocks
- Surface cleaning
- Priming of surfaces



Assessment criteria:

1. Wall surfaces are ensured for free of any foreign materials.
2. Wall panelling bricks/tiles/blocks are cleaned before uses.
3. Wall surfaces are cleaned and primed in accordance to workplace specifications.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring tools, plumb bob, level hose, spirit level, nylon string, nail, mason's hammer, cold chisel, chipping hammer, steel brush, broom, scaffolding, hose pipe, bucket, mug, wheel barrow
- **Materials:** water and other priming materials



Learning Activity 7.3.1

Learning Activity	Resources/Special Instructions/References
Prepare wall surface for brick/stone panelling	<ul style="list-style-type: none">▪ Information Sheet: 7.3.1



Information Sheet 7.3.1

Learning Objective: to prepare wall surface for brick/stone panelling in a workplace.

☐ **Prepare wall surface:**

Remove the foreign materials: All sorts of foreign materials like dust, oil, cement, sand, dirt etc. to be removed using proper tools and techniques. Then carefully wash the surface with water.

☐ **Clean bricks or stones:**

Before using the bricks or stones it needs to clean those by scrapping. After that more grime or algae on brick and stone surfaces to be washed with water.

- Cleaning can be done by the following methods:
 1. Pressure washing: standard steps to be followed.
 2. Using hand and hose: proper cleaning materials and procedures to be followed.



Learning Outcome 7.4 – Mix Mortar/Bonding Components

☐ **Mixing of mortar:**

Same as Learning Outcome 1.3 – Make mortar/stucco (page 17 – 21)



Learning Outcome 7.5 – Accomplish Wall Panelling Works



Contents:

- Setting time of cement
- Bonding materials:
 - Cement
 - Lime
 - Sand
 - Pozzolanic fly ash
 - Bonding products (adhesive/admixture)
- Installation of bricks/stones
- Closers and bats



Assessment criteria:

1. Setting time of cement is identified.
2. Appropriate bonding materials for panelling works are used in accordance to workplace specifications.
3. Cement mortar/adhesive is applied uniformly as per standard practices.
4. Bricks/stones are installed in accordance to workplace specifications.
5. Closer and bats are used as per job requirements.
6. Grooves are filled up with cement mortar for better adhesion.
7. Level and alignment are done in accordance with established procedures.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** measuring box, shovel/spade, mixer, mixing board, broom, bucket, mug, trowel, wooden float, steel float, plumb bob, nail, foam/soft brush, scaffold, sieve, wheel barrow
- **Materials:** cement, sand, water, bricks and/or stones



Learning Activity 7.5.1

Learning Activity	Resources/Special Instructions/References
Accomplish wall panelling works	<ul style="list-style-type: none"> ▪ Information Sheet: 7.5.1



Information Sheet 7.5.1

Learning Objective: to install bricks/stones in accordance with workplace specification.

□ General information

- Real bricks and stone are heavy and need solid support.
- When a house is under construction and a natural stone or brick facing is planned, the builder usually builds the brick ledge into the foundation by extending the foundation past the house framing.
- Use a masonry brush to dampen the back of the stone, but do not saturate it.
- This prevents the stone from pulling moisture away from the mortar allowing it to dry naturally and with a stronger bond.
- To lay the stone, use a masonry trowel to butter the back of the stone with 1/2" to 1" layer of mortar.



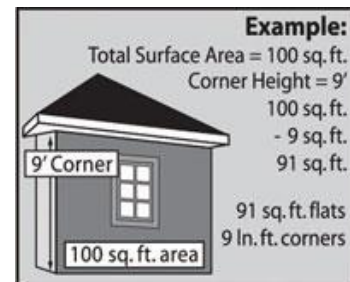
□ How to install stone veneer:

Step 1: Calculating Materials

Before starting the installation of wall panelling works, it will need to calculate the amount of materials required for desired wall area.

How much stone will need?

Begin by figuring the square footage of the area plan to cover with stone (length x height).



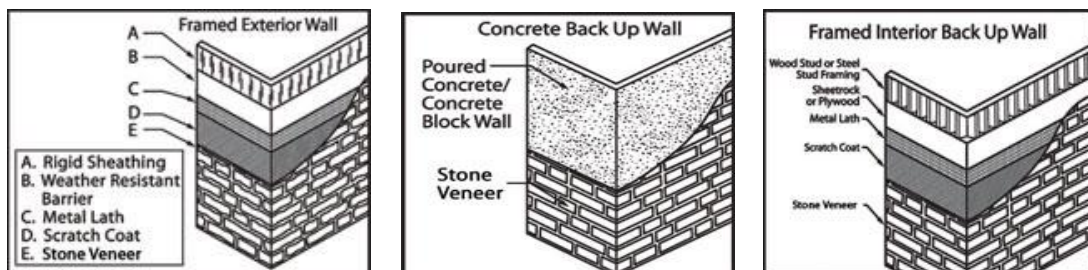
Step 2: Surface Preparation

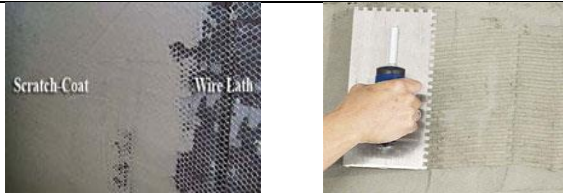




There may be various types of surfaces to be used wall panelling.

Surface type 1: framed exterior wall including plywood panelling, wall sheathing or flush metal siding.

Surface type 2: interior or exterior cleaned and untreated concrete, masonry or stucco.

Surface type 3: framed interior wall including plywood, fiber cement board.



<p>Step 3: Scratch Coat</p> <p>A scratch coat will be needed when metal lath is used. This step is not necessary when applying stone veneer to a cleaned concrete, masonry or stucco surface.</p>		
<p>Step 4: To Apply the Stone</p> <p>Mixing the mortar: mix the mortar according to workplace requirements.</p> <p>Applying the stone: before applying the stone, it is a good idea to lay the stone out flat to determine the sizing and colors of each individual piece, how they will be laid out and attempt to keep joints in a consistent height and width.</p> <p>Trimming the stone: to cut the stone, use a skill saw with either a dry or wet cut diamond or masonry blade.</p> <p>Clean the stone: the surface of the stone must be free of dust, dirt or any loose particles. Wash the stone completely and allow drying.</p> <p>Installing the stone: install all corner pieces first before installing the field and work from the bottom to top.</p>		
		
<p>Step 5: Grouting & Tooling</p> <p>The joints or gaps between the stone to be filled with grout.</p> <p>Filling the joints: fill all the joints between the stones with about a 1/2" layer of mortar (more or less depending on the effect and joint size).</p> <p>Tooling the joints: as the grout stiffens, tool to the desired depth using a joint tool. Brush the joints with a broom to smooth them out and clean away any loose mortar.</p>		



Learning Outcome 7.6 – Clean and Maintain Workplace

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 7.1.1

1. A wall panel is single piece of material, usually flat and cut into a rectangular shape, that serves as the visible and exposed covering for a wall.
2. Stone is a natural substance, a solid aggregate of one or more minerals or mineraloids.
3. Cement is a binder substance used in construction which sets, hardens and adheres to other materials and binding them together.
4. Types of fine aggregates (sand) are given below:
According to grain size:
 - Fine sand (0.075 to 0.425 MM) suitable for plastering
 - Medium sand (0.425 to 2 MM) suitable for brick work
 - Coarse sand (2.0 to 4.75 MM) suitable for concrete castingAccording to source:
 - Pit sand used for brick work and concrete casting
 - River sand used for plastering
 - Sea sand should avoid for construction works
5. Water for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel.

ANSWER KEY 7.2.1

1. The bricks which are well burnt and are of uniform size and shape are known as first class bricks.
2. If dry bricks or blocks are used then they start to absorb water from mortar which would lead to less strength development.
3. Curved brick is more suitable for construction of circular brick masonry pillar and brick chimneys.
4. For reduction of the transmission of heat, sound and damp hollow bricks are very much helpful.
5. The reasons of using frog mark on bricks are:
 - a. Create an indentation in the brick
 - b. Save the brick maker material
 - c. Reduce the drying and firing time of the brick
 - d. Bricks become lighter and easier to grasp
 - e. Increase strong bond between bricks.

ANSWER KEY 7.2.2

1. A plan which is a measured plane typically projected at the floor height of 4 ft (1.2 m), shows room or space dimensions. It is a full or part horizontal section of a building.
2. An elevation which is a measured plane projected from the side of a building, along its height and shows the side views with length and height or breadth and height of the building.
3. A section or cross section where a building, is cut along an axis to reveal the interior structure. It is a vertical slice through a building with one half removed so we can look inside.

ANSWER KEY 7.4.1

1. C
2. A
3. B
4. D
5. D

Module 8: Apply waterproofing activities in construction



MODULE CONTENT

Module Descriptor: This module covers the knowledge, skills and attitudes required for a worker in applying waterproofing activities in construction which includes organising work area for waterproofing, preparing concrete prior to waterproofing, applying waterproofing material, performing other waterproofing considerations, and cleaning and maintaining the workplace. It also includes information sheets, job sheets, self-check quizzes and answer keys.

Nominal Duration: 32 hours



Learning Outcomes:

Upon completion of the module, the student/trainee will be able to:

- 8.1 Organise work area for waterproofing
- 8.2 Prepare concrete prior to waterproofing
- 8.3 Applying waterproofing material
- 8.4 Perform other waterproofing considerations
- 8.5 Clean and maintain workplace



Performance Criteria:

1. Building drawing, work instructions and operational details relevant information is collected, read and considered as per job requirements
2. Signage and barricade requirements are identified and removed as required
3. Required tools and equipment are selected for waterproofing purposes
4. Appropriate materials for waterproofing works and personal protective equipment (PPE) for safety purposes are identified, obtained and prepared as per workplace requirements
5. Related environmental requirements are identified and conformed in accordance to specifications
6. Waterproofing materials is identified as per job requirements
7. Potential faults, contingencies and techniques are identified as per requirements
8. Waterproofing materials is checked for conformity and compatibility with substrate materials
9. Substrates to be water proofed are prepared and prime coated with waterproofing materials in accordance to job specifications
10. Waterproofing materials are mixed and applied in accordance to specification and job requirements
11. Quality of works is checked, and defects are rectified
12. Finishing requirements are applied in accordance to waterproofing plan
13. Suitable roof sealer is applied if cast is used in place of concrete
14. Proper flow of water is ensured and checked the drainage system in line with job requirements
15. Tools and equipment are cleaned and stored as per organisational procedures
16. Waste materials are disposed of in proper place and the work area is cleaned



Learning Outcome 8.1- Organise Work Area for Waterproofing



Contents:

- Names and uses of personal protective equipment (PPE)
- List of main tools and equipment required to prepare mortar/stucco
- Collection, checking and selection for usability of the necessary tools and equipment
- Name of different types of cement and their uses
- Procedures of storage of cement
- Quality of water necessary in construction works
- Classification of sand and their uses



Assessment criteria:

1. Appropriate personal protective equipment (PPE) are used and demonstrated according to job requirements.
2. Quantity and quality of tools and equipment identified and gathered according to job requirements.
3. Quantity and quality of different types of materials to be used are placed in designated area.
4. Necessary tools and equipment are checked for their usability.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth/apron, hand gloves, dust mask, safety glasses, ear plugs/ear muffs
- **Tools and equipment:** wheel barrow, sieve, measuring box, mortar mixing box/containment, bucket, mug, steel pan, shovel/spade, trowel and mortar mixer
- **Materials:** cement, sand and water



Learning Activity 8.1.1

Learning Activity	Resources/Special Instructions/References
Organise work area for waterproofing	<ul style="list-style-type: none"> ▪ Information Sheets: 8.1.1, 8.1.2, 8.1.3 ▪ Self-Check Quizzes: 8.1.1 ▪ Answer Key: 8.1.1



Information Sheet 8.1.1

Learning Objective: to identify and make a list of personal protective equipment (PPE) for painting works.

☐ **Personal Protective Equipment:**

Same as Information Sheet 1.1.1 – Gather mortar making tools, equipment and materials (page 9 – 10)



Information Sheet 8.1.2

Learning Objective: to identify and gather appropriate tools and equipment for making mortar in the workplace.

☐ **Tools and equipment:**

Same as Information Sheet 1.1.2 – Gather mortar making tools, equipment and materials (page 10 – 12)



Information Sheet 8.1.3

Learning Objective: to identify and gather appropriate masonry materials for making mortar in the workplace.

☐ **Masonry materials:**

☐ **Cement:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Aggregates:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Water:**

Same as Information Sheet 1.1.3 – Gather mortar making tools, equipment and materials (page 12 – 14)

☐ **Asphalt / Bitumen:**

- Asphalt is produced in a plant that heats, dries and mixes aggregate, bitumen and sand into a composite mix.
- Bitumen is a black or dark-coloured (solid, semi-solid, viscous), amorphous, cementations material that can be found in different forms.
- The primary use of asphalt/bitumen is in road construction, but other main uses are for bituminous waterproofing products, including production of roofing felt and for sealing flat roofs.



☐ **Signage** is the design or use of signs and symbols to communicate a message to a specific group.

☐ **Barricade** is a temporary wall, fence, or similar structure that is built to prevent people from entering a place or area.



Self-Check Quiz 8.1.1

Check your understanding by answering the following questions:

1. What is cement?
2. Classify fine aggregates as per grain sizes and sources of availability. Also state their suitability of uses.
3. What are the coarse aggregates generally used for in making concrete?
4. State the quality of water that is suitable for mixing masonry materials and curing purposes.
5. What are some of the uses of asphalt/bitumen?



Learning Outcome 8.2- Prepare Concrete Prior to Waterproofing



Contents:

- Types of mortar:
 - Lime
 - Lime-cement
 - Cement
 - Lime concrete
 - Cement concrete
- Mortar mixing ratio:
 - For brick laying, below ground and superstructure (thickness of wall)
 - For plastering, inner sides and outer sides (thickness of plaster)
 - For concrete (lime concrete, cement concrete, reinforced cement concrete)
- How to mix mortar:
 - Step 1: Gather materials and tools needed for mortar
 - Step 2: Mix the dry ingredients
 - Step 3: Add water to the dry ingredients
 - Step 4: Use the mortar
 - Step 5: Clean the tools and workplace
- Methods of mixing mortar:
 - Mixing a batch by hand
 - Mixing a batch with a Mixer



Assessment criteria:

1. Mixing tools and equipment to be used are checked according to job requirements.
2. Materials are laid on mortar mixing box as per instruction.
3. Cement, sand and water are mixed according to specified proportion and consistency/workability.
4. Proper handling and use of mixing tools and equipment are observed.



Resources required:

Students/trainees must be provided with the following resources:

- **Tools and equipment:** One bagger concrete mixer, mixing box/containment, shovel/spade, pails (bucket, mug), water storage drum, potable water, measuring box
- **Materials:** Cement, aggregates (sand suitable for masonry works), aggregates (brick/stone chips)



Learning Activity 8.2.1

Learning Activity	Resources/Special Instructions/References
Prepare concrete prior to waterproofing	<ul style="list-style-type: none"> Information Sheet: 8.2.1 Self-Check Quiz: 8.2.1 Answer Key: 8.2.1



Information Sheet 8.2.1

Learning Objective: to maintain proportion of materials, water-cement ratio for making concrete in the workplace.

□ Mortars:

- Mortars are typically made from a mixture of sand, a binder and water.
- The basic mix ratio for concrete is one-part cement, two parts sand and three parts gravel with enough water added until the mixtures reaches the consistency of thick mud.
- The cement or mortar is mixed by first adding a portion of the water.
- The sand and cement are then poured into the water and the mixture is stirred for several minutes.
- More water, cement or sand can be added if the mixture is too wet or dry.
- The mixture should not be too stiff or too sloppy.
- Too much water results in weak concrete and too little water results in a concrete that is unworkable.

□ Mortar Mixing Ratio:

1. For cement mortar to lay bricks in foundations the ratio is used: Cement: Sand (1:4)
2. For cement mortar to plaster brick walls the ratio is used: Cement: Sand (1:6)
3. For cement mortar to plaster RCC surfaces the ratio is used: Cement: Sand (1:4)
4. For cement mortar to waterproofing works the ratio is used: Cement: Sand (1:2)
5. For Lime concrete works on roof the ratio of the ingredients is used: Lime: Surki: Khoa (2:2:7)
6. For Mass cement concrete works the ratio of the ingredients are used: Cement: Sand: Chips (1:3:6)
7. RCC works for a simple building the ratio of the ingredients is used: Cement: Sand: Chips (1:2:4)
8. RCC works for a high rise building the ratio of the ingredients is used: Cement: Sand: Chips (1:1.5:3)
9. RCC works with very thin members the ratio of the ingredients is used: Cement: Sand: Chips (1:1.5:3)
10. Amount (percent) of water by weight of cement is just sufficient to give it necessary consistency for 1:4 mortars: 75%.

□ Mixing Mortar Tips

- If the mortar does begin to dry while applying, add more water.
- Try to use the same materials and use the exact amount of material batch after batch.
- Use a pail bucket to make sure you are using the same amount of material for subsequent batches.
- Mix mortar for not less than three minutes and not more than five minutes after the last materials have been introduced into the mixer.
- Mortar is good for one and a half hour. Once that time has passed, discard mortar because it starts to lose some of its characteristics.

□ **How to Mix Cement**






□ **Preparing the Dry Mix**






- Step 1. Prepare a leakproof level platform.
- Step 2. Collect required amount of cement, sand and gravel.
- Step 3. Sieve the sand to remove the foreign materials
- Step 4. Open the cement, gravel, and sandbags.
- Step 5. Mix the ingredients thoroughly with spade to ensure they are well combined.

□ **Incorporating Water into the Dry Mix**

- Step 1. Pour a small amount of water into the wheelbarrow. Be sure to measure out a known amount, so that can replicate the same consistency with successive batches of concrete.
- Step 2. Start with 3/4 of the dry mix. In a wheelbarrow or other mixing container, agitate about 3/4 of the dry mix with all of the water. This first mix will appear a bit soupy because of the excess water, but it should be easy to mix.
- Step 3. Add the remaining 1/4 of dry mix to the soupy cement mix.
- Step 4. Pour the mixed mortar immediately into the assigned place.
- Step 5. Clean up the tools and equipment as soon as possible.

□ **How to Mix Concrete (with pictures):**

Number	Description of Task	Pictures
Step 1	Spread a plastic sheet on the ground: A large sheet of polythene keeps the ground clean, prevents contamination of the concrete by leaves, mud and other debris and can be scrape up all the leftovers	
Step 2	Measure Out the Materials: It's a good idea to use 3 buckets: One for cement, water and stone/sand	
Step 3	Place the stone and sand on the sheet: Measure out the stone first and tip the sand on top. Keep the pile to one side of centre so you can mix sideways	
Step 4	Place the cement on top of the sand and stone: Measure out the cement on top	
Step 5	Shovel to one side from the edge of the pile and repeat three times: Shovel the pile to one side, taking the material from the bottom edge. Do these four times in total	

Step 6	<p>Make a deep crater and add water:</p> <p>Make a crater in the pile and add water</p>	
Step 7	<p>Fold the mix in from the sides:</p> <p>Shovel the mixture from the edges into the centre of the crater</p>	
Step 8	<p>Continue to fold inwards and chop the pile to distribute water through the mix:</p> <p>Chop the pile with the edge of the shovel to help distribute the water. Continue to add water</p>	
Step 9	<p>Continue to add water as needed and walk around the perimeter of the pile, folding the mixture towards the centre and chopping</p>	
Step 10	<p>Eventually the mix should look like this</p>	



JOB SHEET 4

Qualification:	Masonry		
Learning unit:	Prepare concrete prior to waterproofing		
Learner name:			
Personal protective equipment (PPE):	Hand gloves, visibility vest, safety goggles, safety boots, hard hat and dust mask		
Materials:	Cement, fine aggregate (sand), coarse aggregate (brick/stone chips), water		
Tools and equipment:	One bagger concrete mixer, mixing box/containment, shovel/spade, pails (bucket, mug), measuring box, wheel barrow		
Performance criteria:	<ol style="list-style-type: none"> 1. Mixing tools and equipment to be used are checked according to job requirements. 2. Materials are laid on mortar mixing box as per instruction. 3. Cement, sand and water are mixed according to specified proportion and consistency / workability. 		
Measurement:	<ul style="list-style-type: none"> Carefully take the measurement of materials used 		
Notes:	<ul style="list-style-type: none"> Complete the job as per schedule time and instruction of the trainer 		
Procedure:	<ol style="list-style-type: none"> 1. Collect PPE, tools, equipment and all other materials used 2. Take one bag of cement, which has a volume of nearly 0.035m³. 3. Then measure required quantity of dry sand using a box measure. A box has a volume of 0.035m³. For example, if you are preparing a cement concrete of the ratio 1:2:4 (i.e. 1-part cement, 2 parts of sand and 4 parts of coarse aggregate), then for one bag of cement take 2 boxes of sand and 4 boxes of coarse aggregate. 4. First spread the measured amount of coarse aggregate on a water tight platform or on a steel trough in equal thickness and then spread the sand over the coarse aggregate in same way. 5. Spread the cement over the sand in equal thickness. 6. Then mix them dry by turning over & over, backward & forward several times by a shovel/spade/mixer, till the mixture looks uniform in colour. 7. Out of this dry cement & sand mix, take out only that amount of mix which can be used within 30 minutes, and form it into a heap. 8. Make a small depression on top of the heap. 9. Add required amount of water so as to give it <u>required consistency</u>, to the centre of the heap. 10. Mix the whole mass thoroughly for 5 to 10 minutes by means of a shovel/spade/mixer. 11. Water of amount 75% of weight of cement is just sufficient to give it necessary consistency. 12. While working use personal protective equipment for safety 13. Clean tools, equipment and workplace, and restore tools, equipment and excess materials properly. 		
Learner signature:		Date:	

Assessor signature:		Date:	
Quality Assurer signature:		Date:	
Assessor remarks:			



Self-Check Quiz 8.2.1

Check your understanding by answering the following questions:

Read and analyse the statement carefully. Choose the best answer and write the letter only in your answer sheet.

1. For Mass cement concrete works the ratio of the ingredients are used
 - a. Cement: Sand: Chips (1:2:4)
 - b. Cement: Sand: Chips (1:3:6)
 - c. Cement: Sand: Chips (1:4:8)
 - d. Cement: Sand: Chips (1:1.5:3)
2. RCC works for a simple building the ratio of the ingredients is used
 - a. Cement: Sand: Chips (1:1.5:3)
 - b. Cement: Sand: Chips (1:3:6)
 - c. Cement: Sand: Chips (1:4:8)
 - d. Cement: Sand: Chips (1:2:4)
3. RCC works for a high rise building the ratio of the ingredients are used
 - a. Cement: Sand: Chips (1:1.5:3)
 - b. Cement: Sand: Chips (1:3:6)
 - c. Cement: Sand: Chips (1:2:4)
 - d. Cement: Sand: Chips (1:4:8)
4. RCC works with very thin members the ratio of the ingredients is used
 - a. Cement: Sand: Chips (1:1.5:3)
 - b. Cement: Sand: Chips (1:3:6)
 - c. Cement: Sand: Chips (1:2:4)
 - d. Cement: Sand: Chips (1:4:8)



Learning Outcome 8.3- Apply Waterproofing Material



Contents:

- Substrates
- Prime coat
- Membrane
- Roof sealer
- Topographic conditions
- Procedure of waterproofing



Assessment criteria:

1. Water proofing materials is checked for conformity and compatibility with substrate materials.
2. Substrates to be water proofed are prepared and prime coated with waterproofing materials in accordance to job specification.
3. Water proofing materials are mixed and applied in accordance to specification and job requirements.
4. Water proofing membrane is prepared as per requirements.
5. Quality of work is checked, and defects are rectified.
6. Finishing requirements are applied in accordance to waterproofing plan.
7. Suitable roof sealer is applied if cast is used in place of concrete.
8. Proper flow of water is ensured and checked the drainage system in line with job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, mixer, broom, bucket, mug, trowel, wooden float, steel float, plumb bob, nail, foam/soft brush
- **Materials:** cement/concrete mortar, sealing materials



Learning Activity 8.3.1

Learning Activity	Resources/Special Instructions/References
Prepare concrete prior to waterproofing	<ul style="list-style-type: none"> ▪ Information Sheets: 8.3.1, 8.3.2 ▪ Self-Check Quiz: 8.3.1 ▪ Answer Key: 8.3.1



Information Sheet 8.3.1

Learning Objective: to identify waterproofing materials, potential faults, contingencies and techniques.

- **Waterproofing:** is a treatment of a structure or a surface to prevent the passage of liquid water under hydrostatic pressure.

In buildings/structures waterproofing is generally required for:

- Basement of structure
- Walls
- Bathrooms and kitchen
- Balconies, decks
- Terrace or roofs
- Green roofs
- Water tanks
- Swimming pools

- **Waterproofing methods used in construction:**

1. **Cementations Waterproofing method:**

It is the easiest method of waterproofing in construction. The materials for cementations waterproofing are easily available from suppliers of masonry products and they are easy to mix and apply. This method is often used in the internal wet areas such as toilets.



2. **Liquid Waterproofing Membrane method:**

Liquid membrane is a thin coating which consists of usually a primer coat and two coats of top coats which are applied by spray, roller or trowel.



3. **Bituminous Coating Waterproofing method:**

It is an excellent protective coating and waterproofing agent, especially on surfaces such as concrete foundations. Bituminous coating is made of bitumen-based materials and it is not suitable for exposure to sunlight.



4. Bituminous Membrane Waterproofing method:

Bituminous membrane waterproofing is a popular method used for low-sloped roofs.



5. Polyurethane Liquid Membrane Waterproofing method:

Polyurethane liquid membrane method of waterproofing is used for the flat roof area and exposed to weathering. This waterproofing method is expensive.



Self-Check Quiz 8.3.1

Check your understanding by answering the following questions:

Write the correct answer for the following questions:

1. What is the meaning of waterproofing?
2. Which is the easiest method of waterproofing in construction?
3. Which method is popular and mostly used for low-sloped roofs?
4. Which is the expensive method of waterproofing in construction?
5. Which type of waterproofing method is suitable for concrete foundations.



Information Sheet 8.3.2

Learning Objective: to prepping concrete, choosing waterproofing and finishing up with other considerations in the workplace.

□ How to Waterproof a Concrete House:

Part 1: Prepping Concrete

1. Determine if your concrete house needs waterproofing.
2. Prepare the walls for the coating you have selected.
 - Caulking - to fill any expansion joints or larger cracks up to $\frac{1}{4}$ inch, with a good quality polyurethane caulking.
 - Concrete patching - to fill any joints larger than $\frac{1}{4}$ inch, making sure the concrete patch is completely dried before proceeding.

- Grinding - to smooth out any rough, uneven concrete so that waterproofing membrane or slurry has an even surface to adhere to.
3. Thoroughly clean the surface before waterproofing and let dry to proceeding.

Part 2: Choosing Waterproofing

1. Use a liquid membrane for quickness and economy.
2. Use a self-adhering sheet membrane for consistency.
3. Try using cementitious waterproofing.

Part 3: Finishing Up and Other Considerations

1. Know which walls or parts of the structure to apply waterproofing to.
2. Apply the waterproofing at least one foot from any wall or surface that does need waterproofing to.
3. Apply a suitable roof sealer if it is a concrete roof in place and maintain sufficient slope to allow water to drain off.



Learning Outcome 8.4- Perform Other Waterproofing Considerations



Contents:

- Finishing requirements
- Roof sealer
- Drainage



Assessment criteria:

1. Finishing requirements are applied in accordance to waterproofing plan.
2. Suitable roof sealer is applied if cast is used in place of concrete.
3. Proper flow of water is ensured and checked the drainage system in line with job requirements.



Resources required:

Students/trainees must be provided with the following resources:

- **Personal protective equipment (PPE):** helmet, safety shoes, safety cloth, hand gloves, dust mask, safety glasses
- **Tools and equipment:** shovel/spade, mixer, broom, bucket, mug, trowel, wooden float, steel float, plumb bob, nail, foam/soft brush
- **Materials:** cement/concrete mortar, sealing materials



Learning Activity 8.4.1

Learning Activity	Resources/Special Instructions/References
Apply water proofing material	▪ Information Sheet: 8.4.1



Information Sheet 8.4.1

Learning Objective: to apply finishing requirements in accordance to waterproofing plan, application of suitable roof sealer in place of concrete and ensure the proper flow of water in line with job requirements.













☐ **Finishing requirements:**

Following are the characteristics and performance of wet area wall finishes:

☐ **Concrete**

- Not damaged by water
- Does not allow water to percolate
- Suitable for areas not normally wet

- Suitable for splash areas if it has a steel-trowelled dense finish
- Suitable for shower if it has a steel-trowelled dense finish
- A robust finish
- **Concrete masonry**
 - Not damaged by water
 - May support bacterial and fungal growth as roughness of surface may be difficult to clean
 - Allows water to percolate
 - Suitable for areas not normally wet if suitably coated
 - Suitable for splash areas if suitably coated
 - Suitable for shower if suitably coated
- **Cement plaster**
 - Not damaged by water
 - May support bacterial and fungal growth as roughness of surface may make the wall difficult to clean
 - May absorb water if not sealed
 - Suitable for areas not normally wet
 - Suitable for splash areas if coated
 - Suitable for shower if it has an impervious coating system
- **Tiles – ceramic**
 - Not damaged by water
 - Doesn't support bacterial and fungal growth
 - Doesn't allow water to percolate but does through grouted joints
 - Suitable for areas not normally wet
 - Suitable for splash areas – waterproof membrane recommended
 - Suitable for showers with waterproof membrane and durable substrate
 - Must include control joints
- **Particle board**
 - Damaged by water if inadequately coated
 - Supports bacterial and fungal growth if wetted
 - Can absorb moisture if unprotected, and moisture may enter at sheet joints
 - Suitable for areas not normally wet with correct coating
 - Not suitable for splash areas
 - Not suitable for showers
- **Timber boarding**
 - Damaged by water if inadequately coated
 - Supports bacterial and fungal growth if wetted
 - Moisture may enter through board joints
 - Suitable for areas not normally wet if suitably coated
 - Not recommended for splash areas
 - Not suitable for showers
 - Opening of joints due to movement may allow moisture entry
- **Following images are the example of water proofing in construction works:**

		
 Concrete floor	 Basement wall	 Tile wall
 Foundation wall	 Basement wall	 Brick Wall (Exterior)
 Basement floor	 Crack filling	 Sweet home



Learning Outcome 8.5 – Clean and Maintain Workplace

Same as Learning Outcome 1.4 - Clean and maintain workplace (page 22 – 25)



ANSWER KEYS

ANSWER KEY 8.1.1

1. Cement is a binder substance used in construction which sets, hardens and adheres to other materials and binding them together.
2. Types of fine aggregates (sand) are given below:
According to grain size:
 - Fine sand (FM: 1.5) suitable for plastering
 - Medium sand (FM: 2.0) suitable for brick work
 - Coarse sand (FM: 2.5) suitable for concrete castingAccording to source:
 - Pit sand used for brick work and concrete casting
 - River sand used for plastering
 - Sea sand should avoid for construction works.
3. The following coarse aggregates are generally using for making concrete: gravel stone chips, broken stone chips and broken brick chips (khoa) of $\frac{3}{4}$ " downgraded sizes.
4. Water for mixing and curing should be clean and free from injurious quantities of alkalis, acid, oils, salt, sugar, organic materials, vegetable growth and other substances that may be deleterious to bricks, stone, concrete or steel.
5. The asphalt/bitumen is mainly used in road construction and used for bituminous waterproofing products, including production of roofing felt and for sealing flat roofs.

ANSWER KEY 8.2.1

1. B
2. D
3. A
4. A

ANSWER KEY 8.3.1

1. Treatment of a structure or a surface to prevent the passage of liquid water under hydrostatic pressure is called is 'waterproofing'.
2. Cementations waterproofing is the easiest method of waterproofing in construction.
3. Bituminous membrane waterproofing is a popular method used for low-sloped roofs.
4. Polyurethane liquid membrane is the expensive method of waterproofing in construction.
5. Bituminous coating waterproofing method is suitable for concrete foundations.