



# **Bar bending & concreting**

## **LEVEL II**

# **Learning Guide-23**

**Unit of Competence: Prepare for stone masonry**  
**Construction process**

**Module Title:           Preparing for stone masonry**  
**Construction process**

**LG Code:                 EIS BBC2 MO7 LO2-LG-23**

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

## **LO 2: Prepare work area suitable**

## **for Construction process**



<b>Instruction Sheet</b>	<b>Learning Guide #23</b>
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This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

1. Identifying stonemasonry work activities
2. Preparing work area for construction process

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Plan, identify and carry out activities and procedures in work
- Prepare Work area for construction process

### **Learning Instructions:**

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 7.
3. Read the information written for each “Information Sheets given below
4. Accomplish the “Self-check after reading & understanding of each information sheet
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet
6. Lastly do the “LAP test
7. If you have any question ask your teacher



### 1.1. Identifying stonemasonry work activities

Good stone masonry requires advanced skills from a rural mason. The mason has to be able to determine the required wall and bond type in accordance with the drawings. The preparatory activities need to be carried out in a planned manner to ensure that the right material, tools and labor are available.

Stonewalls are usually not plastered and are therefore seen by everybody. The quality of these walls is therefore the 'business card' of the rural mason.

- **Wall and masonry types**

In rural housing works, stone masonry can be applied for:

- ✓ **Load bearing walls**, i.e. walls that support the weight of other building components, such as the roof.
- ✓ **Non-load bearing walls** which do not support any load but are merely there to separate rooms.
- ✓ **Columns** used in rural houses if the walls are long and therefore require intermediate support or to carry roof trusses.
- ✓ **Footings**, also called 'plinths', consisting of vertical extensions of the foundations up to the level of the floor inside the house.
- ✓ **Foundations**, serving the purpose of transferring the weight of the building to the ground.

Stone masonry can be classified in various ways, as for instance, according to the kind of stones used, surface finishing, bonding, etc.

Rubble masonry is composed of stones with any shape. They are found in quarries or in the open field. The quarried variety is preferable because they are stronger and usually of a more



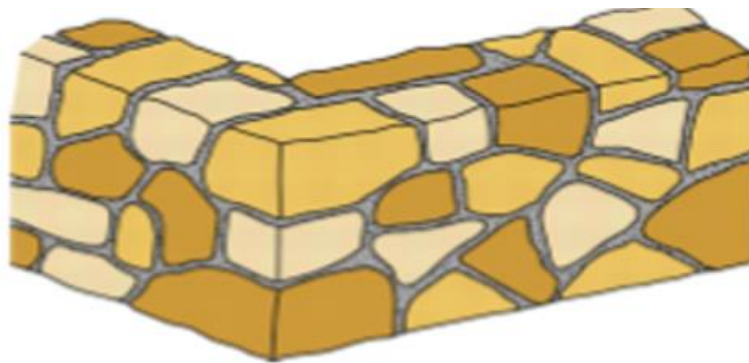
rectangular shape, which is better for masonry works. Their faces are sharper and form a better hold for the

mortar than the weather worn and smoother surfaces of field stones. However, in some areas, non-round field stones are also used for house construction.

- **There are three kinds of rubble masonry.** This are:
  - ✓ Undressed rubble
  - ✓ Random dressed rubble
  - ✓ Dressed rubble

- **Undressed rubble**

This kind of masonry covers all shapes and sizes of stones in which faces, joints and beds do not follow any particular pattern. No attention is given to the level of the courses. With good attention to the surface finish, it is still possible to achieve an attractive wall



**Fig 2.1. Undressed rubble**

- **Random Undressed rubble**

In this kind of rubble masonry all the stones have well shaped faces. In laying the stones special attention is given to bringing each course to as near level as possible.



The difference between undressed and random dressed rubble can be seen in the surface finish. In random dressed rubble smaller stones are used than in undressed rubble.

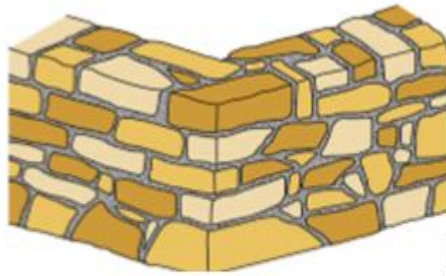


Fig 2.2. **Random Undressed rubble**

- **Dressed rubble**

With dressed rubble more efforts are given to shaping the stones. The faces are close to rectangular and the height of all the stones should be nearly the same. When laying the stones, special attention is given to the bond stones, the height of each course and a proper alignment.

In all the above types of masonry, bond stones should be used (long stones across the entire width of the wall, also called headers) at the rate of 120cm intervals to secure adequate strength in the wall.

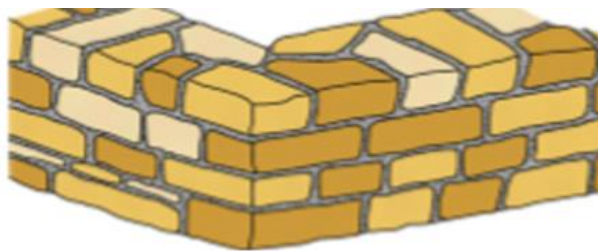


Fig 2.3. **Dressed rubble**



- **Preparatory activities for stone masonry works.**

Before starting the stone masonry works, it is necessary to prepare for it. For this some planning is required on a daily basis.

- Estimating the amount of material required:

- Estimate the quantity of rubble stone based on the size of the wall and size of stones, the type of bond and shape of stones.

Add 30% for wastage for un-coursed rubble and about 20% for random or coursed rubble.

- Calculate the amount of sand and cement, depending on the size of the wall, type of masonry and mortar mixture required.

- Make water available on site for mixing mortar and wetting the stones.

- **Assembling the necessary tools and protective equipment:**

- Special tools are required for quarrying and dressing the stones, such as crowbars, sledgehammers, chisels and club hammers. - Standard mason's tool set for stone masonry. - Measuring tools: tape measure, water tube level, straight edge with spirit level, mason's square, plumb bob, string line with pegs or clamps. - Protective equipment: helmet, facemask, goggles, good boots and gloves.

- **Setting out the walls to be built:**

Re-establish the wall corners and lines according to the site plan, using a string line. Mark the external side of the walls on top of the foundation. - Measure and mark where the openings (doors and windows) will be located.

- **Countercheck the levels**, e.g. the bottom of trenches and top of DPC. These surfaces should be horizontal. If necessary first make corrections to ensure the walls start with horizontal and uniform courses.

Standard tools for stone masonry work Stone masonry requires the same tools as for brickwork. In addition, the following tools are required:

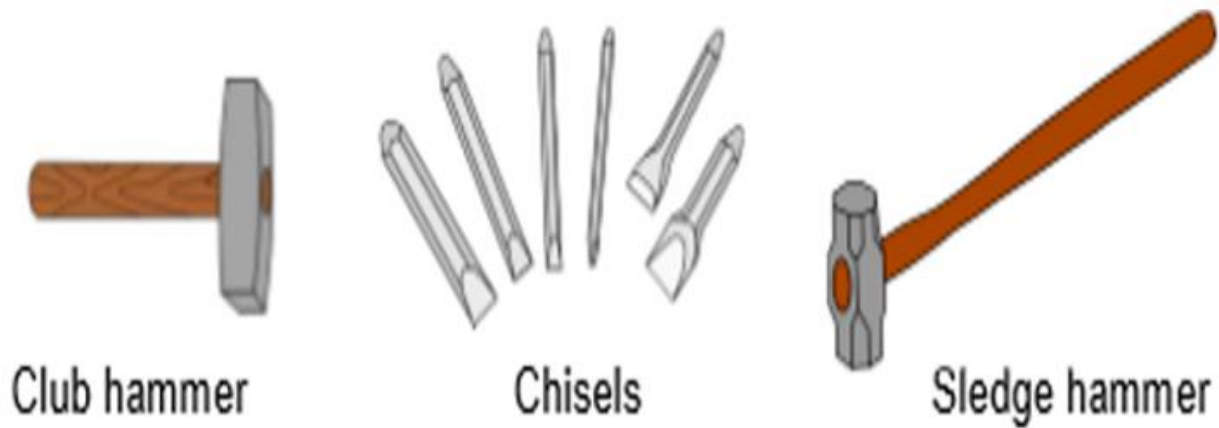
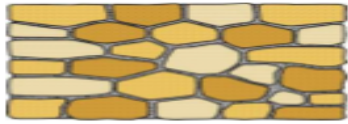
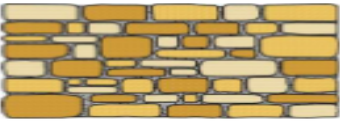


Fig 2.4.Dressing Tools

Material required for stone masonry		
Type	Width of joints	Material for 1m <sup>3</sup> of finished wall
<p><b>Undressed rubble stone masonry</b></p>  <p>The stone is not specifically cut or shaped. To build a wall with proper bonding using undressed rubble stone requires well-developed skills from a mason.</p>	1 to 4 cm	<p>Stone: approx. 1.3-1.5m<sup>3</sup> (includes waste)</p> <p>Mortar 1:6 Cement = 85 kg Sand = 0.35 m<sup>3</sup></p>
<p><b>Random dressed and dressed rubble stone masonry</b></p>  <p>The stone is shaped to a rectangular prism. It is easier to produce a wall with proper bonding and uniform surfaces using this stone.</p>	1 to 2.5 cm	<p>Stone: approx. 1.2 m<sup>3</sup> (includes waste)</p> <p>Mortar 1:6 Cement = 75 kg Sand = 0.32 m<sup>3</sup></p>

### Cement mortar

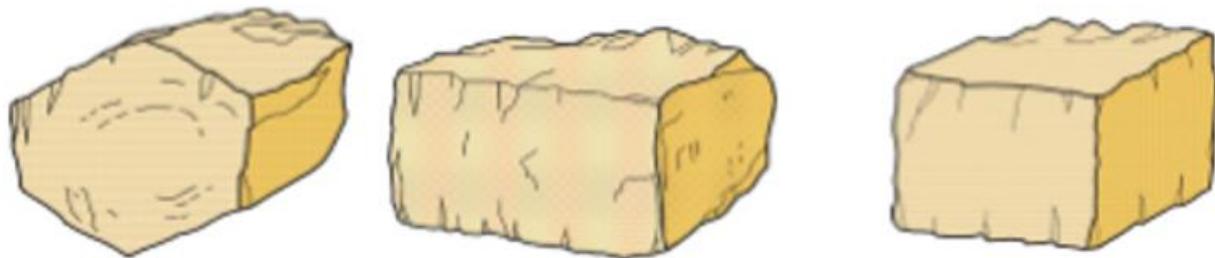
The same mortar is used for stone masonry as for brick/block masonry – refer to Section 3.3. with Worksheet M4 above for details on requirements and how to mix mortar.

### Preparing the stone

Shaping (dressing) stones takes time and patience. It is the task of the rural mason to prepare the stones to the required size and shape.



The following shapes of stones are used for construction



**Line stones**

**Corner stones**

Fig 2.5. Shapes of Masonry stones



**Line stones**

Stones placed between corner stones are referred to as line stones. They should have (but not necessarily) a flat and even surface. The combination of flat surfaces at the corners and rough hammer dressed line stones give the stone masonry an attractive appearance.

**Corner stones**

Two faces should be squared and shaped with a chisel and a club hammer to a flat surface, or at least hammer dressed to allow for accurate plumbing.





- **Stone quality**

A good stone should be hard. It should be possible to dress a stone without it crumbling. In general, stone found on the surface is less durable than quarried stone. Still, there are a number of rock types found on the surface that are of sufficient quality to be used in house. The hardness of stone can easily be checked with a hammer. Strong rock resists a hammer blow and does not disintegrate when being shaped.

Some types of rock such as sandstone are more porous and may absorb water. If the rock is hard enough, it can still be used, but it is then important to add a damp proof course on the plinth.

- **Steps for dressing:**

- ✓ Prepare the work ground, tools and safety equipment.
- ✓ Clean the stone to be dressed, e.g. using a brush and water.
- ✓ First cut it roughly on all sides, to the extent possible using its natural shape. Stones should be of size and weight that can be carried by one person.
- ✓ Dress the face to a plane and check it with a straight edge.
- ✓ Select the stones that could be used as corners and shape the reverse face.
- ✓ Make sure all dressed stones are clean and stockpile them neatly.
- ✓ Clean the work area from debris. Stone chips may be used as backfilling material for foundations or plinths.



Fig 2.6. Safety during dressing|

- **Laying stone**

The art of stone masonry is the accurate laying of rubble stone by ensuring:

- ✓ correct measurements as per plan,
- ✓ accurate vertical walls,
- ✓ horizontal courses,
- ✓ accurate levels, and
- ✓ good bonding.

The work methods for ensuring level and straight courses of stone and vertical walls are the same as for brick masonry. It is advisable to have one string for the inner wall and a second for the outer side, and to work with two masons at the same time. While one mason builds on the outside, the other mason builds the inside of the wall

- **Checkpoints for proper bonding in stone masonry:**

- ✓ Bond stones (also called headers) should extend not less than  $\frac{2}{3}$  of the thickness of the wall.
- ✓ Bond stones should be used (long stones across the entire width of the wall) at 120 cm intervals to ensure proper bonding.



- ✓ The vertical joints of each course should break with the joints of the course below.
- ✓ The largest stones should be used for the lowest courses.
- ✓ Stratified stones (deposited rock with horizontal layers) should be laid on their natural beds (layers to be horizontal – not vertical).

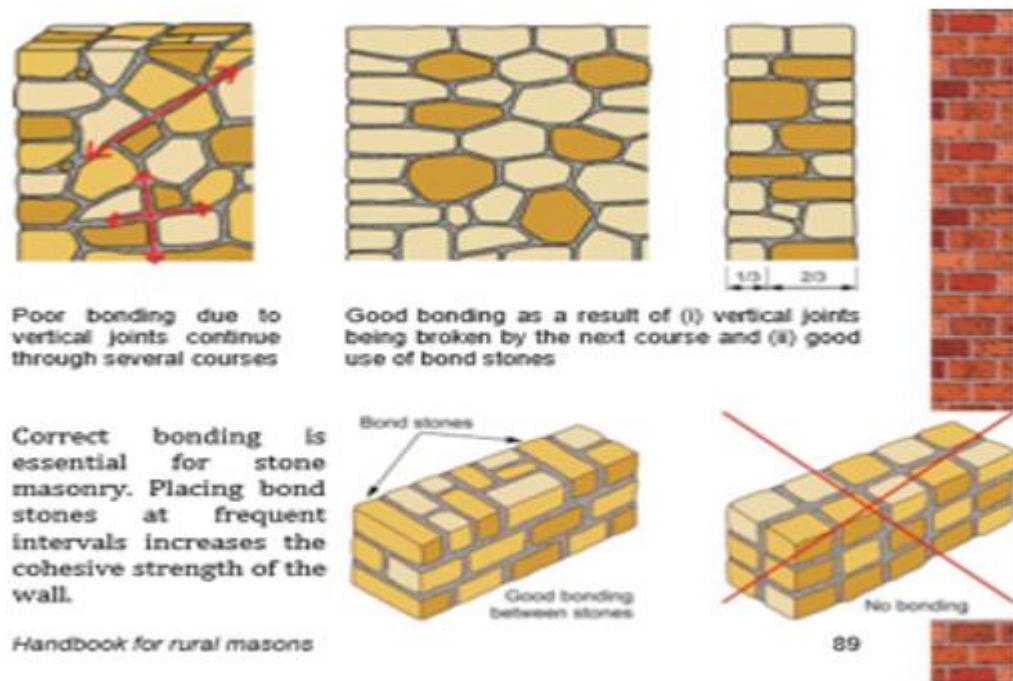
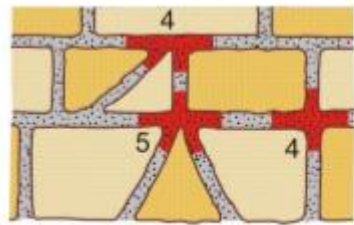
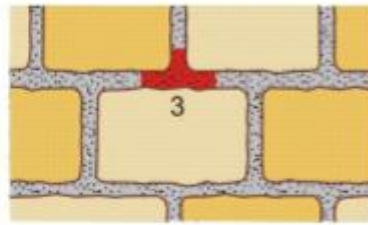


Fig 2.7. Proper bonding

The joints should be in staggered rows, thereby ensuring that stones in overlaying layers produce good overlap above joints in the underlying course. The ideal is to allow for a maximum of three intersecting joints. More intersecting joints will result in poor bonding and reduce the strength of the wall.



Incorrect



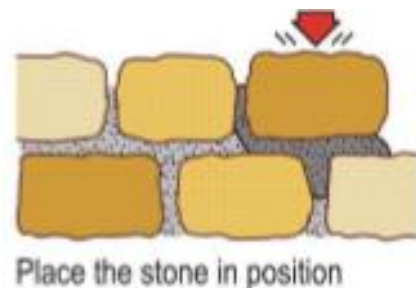
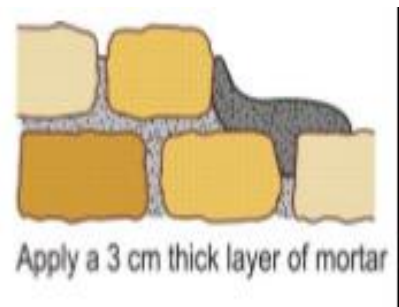
Correct

- Preparation

Set out exactly the proposed structure by marking the sides of the walls on the foundation or on the trench bed

Clean the foundation with a steel brush, wet it properly and if necessary rough it by chiseling.

Two masons should work at the same time on a wall, one inside and one outside.



Use crack-free and washed stone.

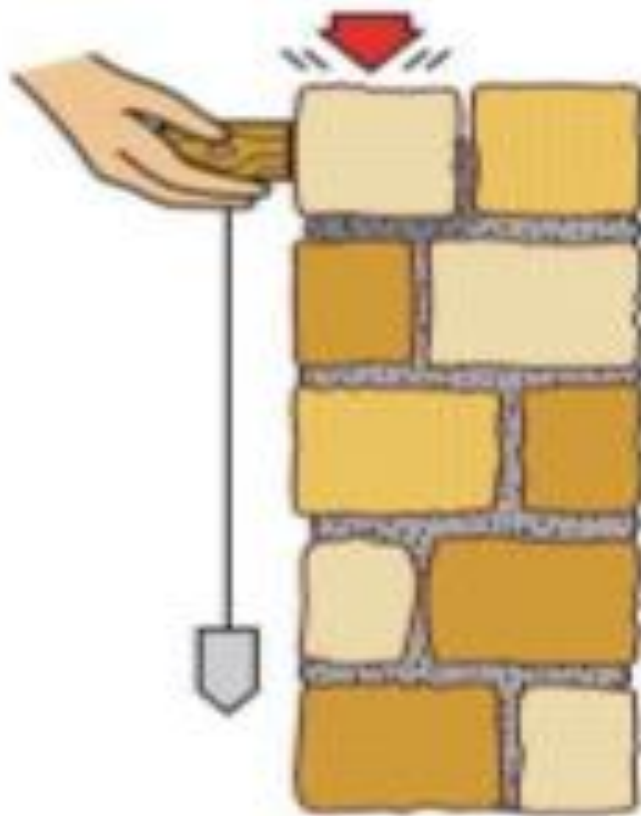
A stiff mortar should be used. Never fill the inside of the wall with slurry mortar because this will reduce the strength.



## Construction

Use the largest and straightest stones on the ground and as corner stones.

Use two-faced shaped and squared stone for corners as well as for the top of the wall.



Check that the wall is vertical with a plumb bob or spirit level



The stones are laid on a mortar bed and then tapped gently into the mortar with a hammer.

Build the corner stone's inside and outside, then stretch a string on each side and build in between these strings.



- **Pointing stone masonry**

Rake out the joints to a depth of about 3 to 4 cm. This is best to do not later than one day after the wall has been built, while the mortar is still relatively soft. 2. Clean the joints so they are free from dust and mortar debris. 3. Wet the joints and fill with a 1:2 mortar mix, using fine sand. 4. The pointing of the joints can be projecting, flush or keyed. 5. Smooth the joints with the pointing trowel 6. Brush all stones clean so there is no remaining mortar stains. There are three types of joints

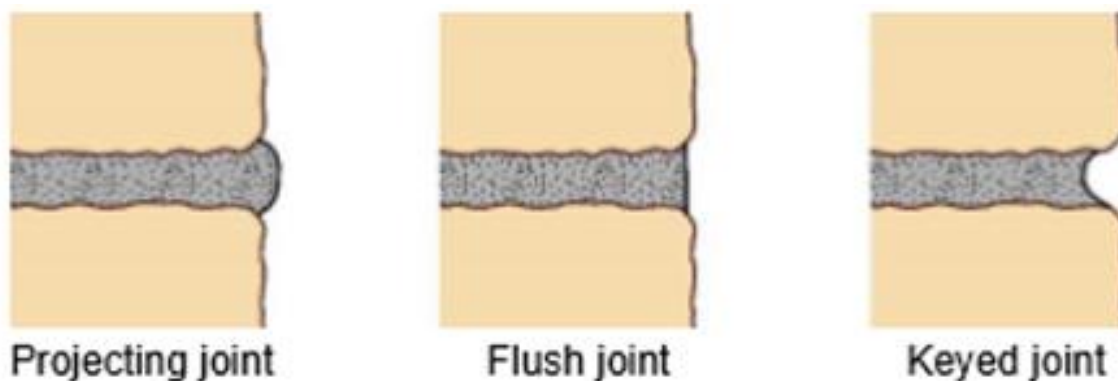


Fig.2.8.Pointing

The flush joint is the recommended pointing for masonry walls in rural house construction. Pointing the joints protect the wall from wind and moisture entering into or though the wall.

Pointed masonry foundations resist water from wet soils entering the wall.

**Labour:**

Rural mason and assistant

**Tools:**

- Standard masonry tool set
- Buckets with water to wet the joints
- Brush for cleaning joints and walls
- Canvas to cover the walls from direct sunshine or rain

**Material:**

- Mortar ready next to the mason
- Water for wetting joints

- **Other types of Stone finish**

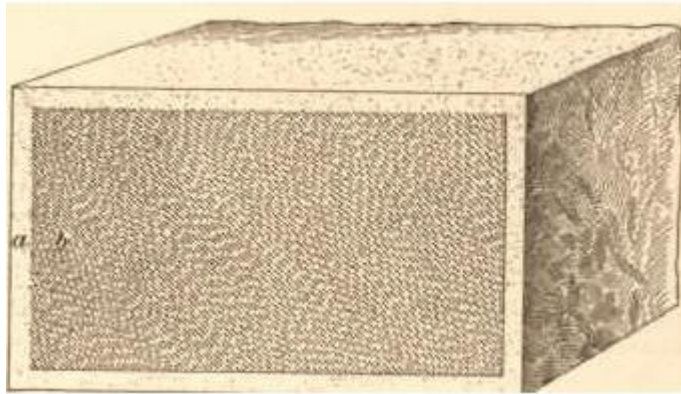
- i. Circular Finish of Stones**

The surface of stone is made into rounded shape. Circular finished stones are mainly used for columns.



- ii. Chisel-Drafted Margins for Stones**

Chisel drafted margins are provided on stones which represents uniform joints in stone masonry. These margins may be pitched or square or chamfered. This is done by using chisel.



### iii. Molded Finish for Stones

Using machines or tools, stone surfaces are molded into desired shapes which also provide good appearance to the work.



### iv. Hammer Dressed Finish for Stones

Hammer dressed finish is adopted to stones which does not contain sharp edges or corners. These types of stones are well suitable for masonry works. Waller's hammer is used for finishing. Hammer dressing contains square or rectangular shaped marks.





#### v. Quarry Faced Finish for Stones

Quarry faced finished stones are stones which have smooth surface and do not require any dressing. These types of stones are sometimes directly available from quarrying. These are also called as self-faced stones or rock faced stones.





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

1. The surface of stone is made into rounded shape:
  - A. Quarry Faced Finish for Stones
  - B Hammer Dressed Finish for Stones
  - C. Molded Finish for Stones
  - D, Circular Finish of Stones
2. which one have smooth surface and do not require any dressing?
  - A. Circular Finish of Stones
  - B. Molded Finish for Stones
  - C. Hammer Dressed Finish for Stones
  - D. Quarry Faced Finish for Stones
3. One of the following is not categories of rubble stone masonry:
  - A. Random rubble masonry
  - B. Coursed rubble masonry
  - C. Dry rubble masonry,
  - D. None
4. The art of stone masonry is the accurate laying of rubble stone by ensuring:
  - A. correct measurements as per plan,
  - B. accurate vertical walls,
  - C. accurate horizontal courses.
  - D. All are correct

**Note: Satisfactory rating – 2 points Unsatisfactory -2 below 3points**

**Answer Sheet**

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

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



## Operation Sheet- 1

dress stone masonry

### Procedure for dressing stone masonry

Step 1: Wear appropriate ppe.

Step 2: Use proper hand tool

Step 4. Select stone to be dressed

Step 1. Finish the work accurately

Step 2. Check for correction:

.



<b>Information Sheet-1</b>	Preparing work area for construction process
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## 2.1. Site clearing and excavation

### • Site clearing

- The preliminary site works for a construction project usually begins after the site facilities are set up.
  - ✓ All vegetation such as bushes and scrub; should be removed;
  - ✓ The roots of trees and bushes must be dug out and cleared away. If the new building is to be built on an area of already existing,
  - ✓ The old building has to be demolished,
  - ✓ The debris cleared away and existing services disconnected and removed.
  - ✓ Virgin site have to be cleared of grasses, trees, rocks and old vehicles.

Site clearing used to be carried out using manual labors with pickaxes and spades. Due to the mechanization of building operations, there are mechanical plants, which can carry out site clearance operation with comparative ease and safely. These plants are only medium and large sized firms can afford to own them. Site clearance is therefore largely done using manual labors (especially for housing projects).

- The building sits area and surrounding areas should be inspected for termites as part of the process of clearing the site.
- The ground a termite nest is usually treated with toxic chemicals and powders should be mixed in the open air.
- **Trial holes:** A contractor will dig trial holes as part of excavation. For example, if water appears in the trial holes, then the contractor may use pumps to keep them dry while the building workers are digging. If the soil is very loose, then the contractor will want to put in timber supports to strengthen the sides of the excavation.



Preparing work area for construction process See that work methods and safety precautions agreed before work is started and washing facilities, a place for preparing and consuming refreshments and do not exceed the safe height-to-base ratio in the instruction manual.

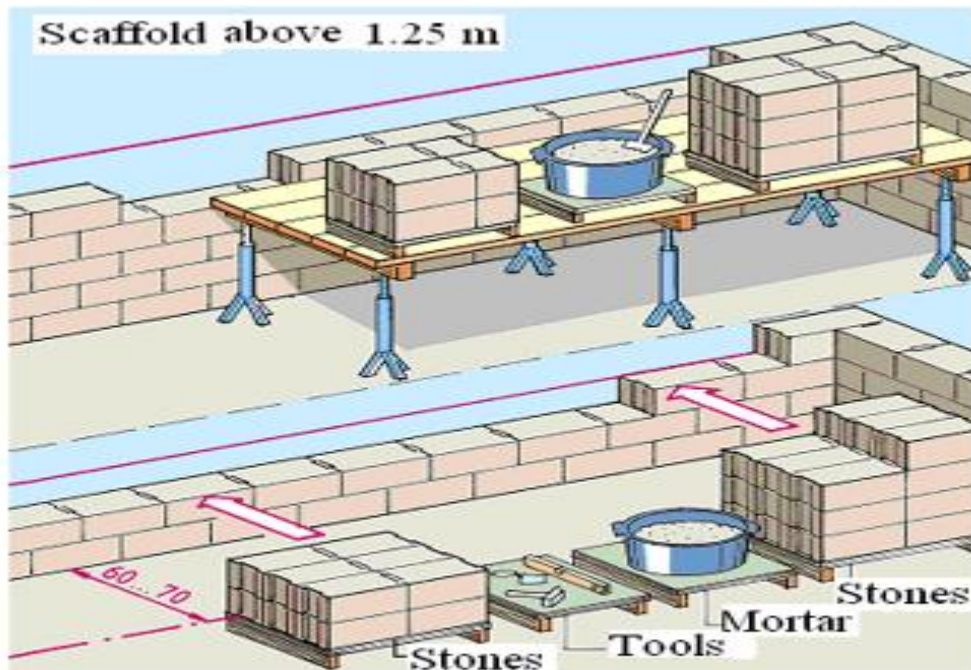
- **Laying out working area for stone masonry**

Sufficient working area and circulation access is very essential in any type of construction, i.e., to dispose materials tools etc. Therefore, working area or space for a mason should have enough space to accommodate materials, tools, and suitable stands for the working people including sufficient circulation space and accesses for the whole process. And this helps to carryout the work without delay, and to the desired quality. In general well-organized working area avoids accident, saves time and money.

As described above, in order to provide the mason with a setup which allow him to carry out the process required efficiently, effectively and economically, the site should be organized in proper manner. Under this organization of site, a working space arrangement or layout is important to carry out the work smoothly.

- It is essential to arrange the layout of masons working area properly, i.e.
  - ✓ Should be free of obstructions, which impede the masons and their helper.
  - ✓ Supplies of mortar mixing materials (sand, cement and lime) and masonry units (brick, blocks, stones etc.) should be placed near the mix site.
  - ✓ The Supply of masonry units when delivered to the job site should not be placed too close to the mortar mixing area as splashes of mortar during mixing can discolor the unit blocks.
  - ✓ The mortarboard or pan whichever used must be placed approximately 60-70cm from the wall. This provides a clear passage or access along the wall.

- ✓ Do not place stone blocks too close to the mortarboard in order to keep them clean.
- ✓ In general, the materials should be paced in a way that the mason may work with the fewest possible movements of the feet, hands or body in getting the materials to the wall.
- ✓ Use scaffolding for height **1.25 m**.



**Fig 1. well organized work site**

- **Working in Excavation**

To work safely, you should always: -

- ✓ Wear a hard hat to protect your head in case something is accidentally thrown or dropped in to the hole.
- ✓ Put supports against the sides of the excavation so that the soil cannot fall on you



- **Electrical hazards**

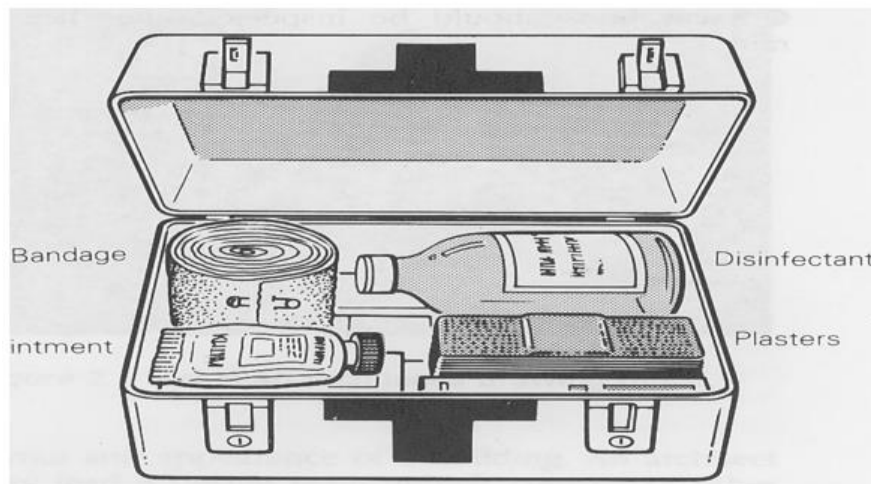
Because building sites are often wet place, electric shocks are possible. Therefore, it is important to inspect and check the condition of wiring at regular intervals.

- **First aid**

A building site should have a first aid box which as minimum contents: -

- ✓ Plasters;
- ✓ Bandages;
- ✓ Ointments;
- ✓ Disinfectant.

Someone on site should be in charge of the box and know how to with broken bones, burns and electric shocks.



**Fig 2 simple first aid box**



### Excavation:

Stones buried in earth or under loose overburden are excavated with pick axes, crow bars, chisels, hammers etc.



**Fig 3 Excavation hazard effects & prevention measure**

- **Wedging**

This method of quarrying is suitable for costly, soft and stratified rocks such as sandstone, limestone, laterite, marble and slate. About 10–15 cm deep holes, at around 10 cm spacing, are made vertically in the rock. Steel pins and wedges or plugs (conical wedges) and feathers (flat wedges) .The latter arrangement of plugs and feather is better. These plugs are then struck simultaneously with sledge hammer. The rock slab splits along the lines of least resistance through holes. In case of soft rocks, dry wooden pegs are hammered in the holes and water is poured over them. The pegs being wet swell and exert pressure causing the rocks to crack along the line of holes. Then, the wedges are placed on the plane of cleavage (the joint of two layers) on the exposed face of rock and are hammered. The slab is completely detached and taken out with the help of crow bars and rollers. In this method, the wastage is minimum and the slabs of required size and shape can be quarried.



## Images correspondent à .Wedging of stone



**Fig 4.Wedging of stone**

### Heating:-

Is most suitable for quarrying small, thin and regular blocks of stones from rocks, such as granite and gneiss. A heap of fuel is piled and fired on the surface of rock in small area. The two consecutive layers of the rock separate because of uneven expansion of the two layers. The loosened rock portions are broken into pieces of desired size and are removed with the help of pick-axes and crow-bars. Stone blocks so obtained are very suitable for coarse rubble masonry. Sometimes, intermediate layers are to be separated from the top and bottom layers. In such a case, the intermediate layer is heated electrically and the expansion separates it from the other two



**Fig.5. Heating of stone**



- **Blasting:-**

Explosives such as blasting powder, blasting cotton, dynamite and cordite are used. The operations involved are boring, charging, tamping and firing.

Holes are drilled or bored in the rock to be dislodged. For vertical holes, jumper is used whereas for inclined or horizontal holes, boring bars are used. One person holds the jumper exactly in the place where hole is to be made. The other person strikes it up and down and rotates it simultaneously. Water is poured in the hole regularly during the operation to soften the rock and facilitate drilling. The muddy paste generated in the process is removed from holes by scrapping. For hard rocks, machine drilling is employed instead of hand drilling. Accidents may take place during blasting.

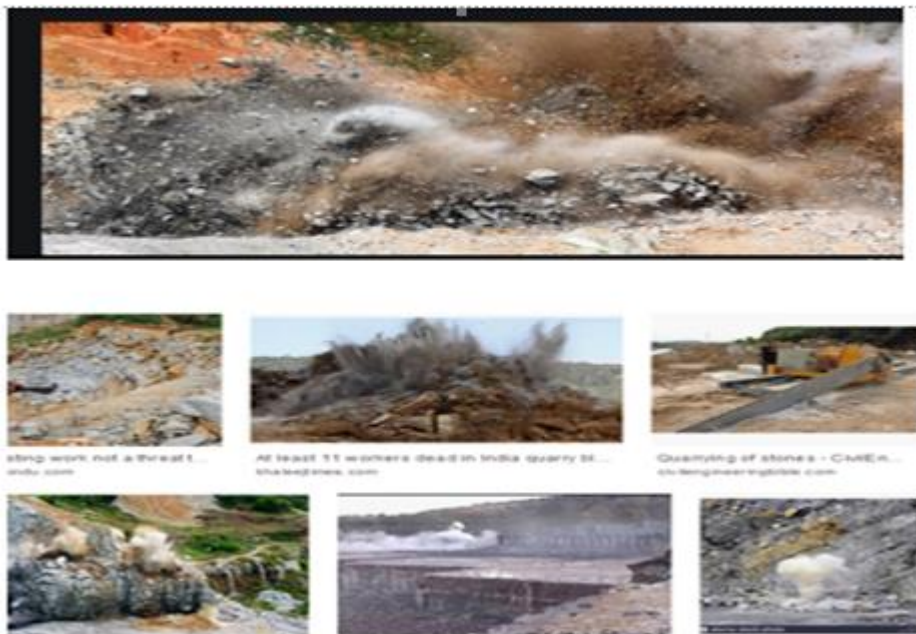


Fig 6 Blasting of stone



- **Precaution in Blasting**

- ✓ Blasting should not be carried out in late evening or early morning hours. The blasting hours should be made public and a siren should warn the workmen and nearby public timely to retire to a safe distance.
- ✓ The danger zone, an area of about 200 m radius, should be marked with red flags.
- ✓ First aid should be available.
- ✓ The number of charges fired, the number of charges exploded and the misfires should be recorded.
- ✓ Explosives should be stored and handled carefully.
- ✓ Detonators and explosives should not be kept together.
- ✓ Cartridges should be handled with rubber or polythene gloves.
- ✓ A maximum of 10 bore holes are exploded at a time and that also successively and not simultaneously.

- **Storage of explosive**

The explosives should be stored in a magazine (a special type of building) which should be away from residential areas, petrol depots, etc. The magazine should have ventilators at high levels and should have concealed wiring. It should be protected from lightning. Smoke or fire should not be allowed in the nearby area. Explosives should be protected from extreme heat or cold and also from moisture. They should be handled carefully and gently. The magazine should be surrounded by barbed wire and the entry should be restricted.



Fig 7 Explosive



- **Bulk excavation**

After the removal of the topsoil, there should be a firm sub soil that is strong enough to support the over site concrete and building loads.

- Use working drawing to see how deep the hard-core bed should be.
- Dig down part the topsoil to the recommended level in the sub soil.
- Inspect the ground to check that the sub soil is firm.
- Dig out any soft patches of ground and fill with tightly packed hard core.

The working can be done manually with:

- Spades;
- Shovels;
- Pick axes;
- Wheelbarrows.



**Fig-7 Bulk excavation**



Mechanical equipment's make the jobs much easier. A bulldozer can quickly push the topsoil out of the way for later disposal. It is possible to reduce levels with a mechanical shovel and the excavated material directly onto a tipper truck for removal.

## 2. Trench excavations

When to dig deeper into the sub soil to excavate trenches for strip foundation, the depth of excavation for the trenches will be indicated on the working drawings. Excavation by hand, using pickaxe, spades and shovels are good method for excavating trenches for the foundations of small buildings. If you want to achieve more speed than you can use a back actor. This is a particular good piece of machinery to use if the trenches are quit deeper.



**Fig.8 Trench excavations**

Use a leveling instrument to check the depth of the trench against the site datum

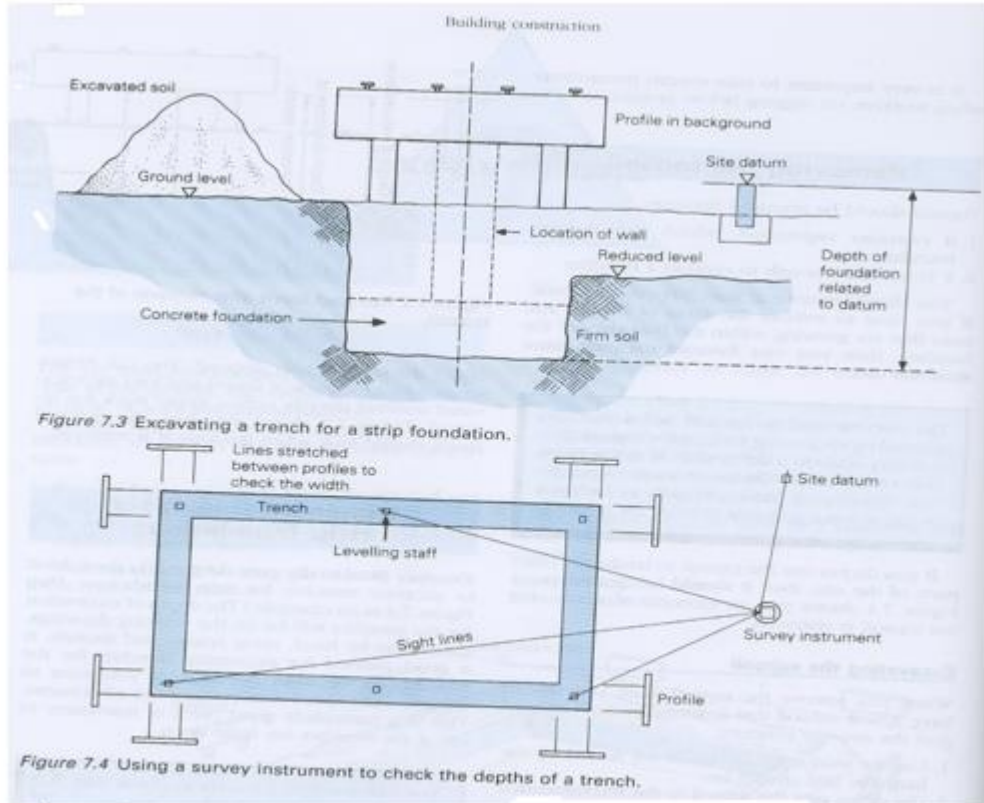


Fig 9 checking the depth of excavation



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

2. When to dig deeper into the sub soil to excavate trenches for strip foundation it is called:
  - A. Trench excavation
  - B Bulk excavation
  - C. Removal of top soil
  - D, Back filing
3. which one of the following hand tool is used for excavation?
  - A. Spades;
  - B. Shovels;
  - C. Pick axes;
  - D. All are correct
3. One of the following is not categories of rubble stone masonry:
  - A. Random rubble masonry
  - B. Coursed rubble masonry
  - C. Dry rubble masonry,
  - D. None
4. One is process of removing top soil to the depth of 20-30cm.
  - A. Trench excavation
  - B. Bulk excavation
  - C. Site clearance
  - D. None

**Note:** Satisfactory rating - 2points Unsatisfactory -2 below 3points

**Answer Sheet**

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

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



**Operation Sheet- 1**

Prepare work area for construction process

**Procedures for preparing area for construction process**

Step 1: Select the site

Step 2: Select appropriate clearing tools and equipment

Step 3. Clear and excavation the site

Step 1. Remove excavated material away from the site



<b>LAP Test</b>	<b>Practical Demonstration</b>
-----------------	--------------------------------

Name: _____
Date: _____
Time started: _____
Time finished: _____
<b>Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 2 hours.</b>
Task 1: dress stone masonry

<b>LAP Test</b>	<b>Practical Demonstration</b>
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Name: _____
Date: _____
Time started: _____
Time finished: _____
<b>Instruction I: Given necessary templates, tools and materials you are required to perform the following tasks within 8 hours.</b>
Task 2: Prepare work area for construction process



## References:

- Dimension Stone Design Manual, Version VIII (May 2016)
- Building materials 3rd ed.
- Handbook for rural masons New Delhi, March 2017
- Training rural Masonry works Learning Unit 3
- Natural Stone Fin
- ishesISBN: 978-981-11-6304-3



Name of trainers who prepared the material

<b>N0</b>	<b>Name</b>	<b>Qualification</b>	<b>Region</b>	<b>E.mail</b>
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