Draft Study Material

BRICK MASONRY

(Qualification Pack: Ref. Id. CON/Q0113)

Sector: Construction

(Grade XI)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Module 1 STONE MASONRY

Module Overview

This module provides foundational knowledge and essential skills related to stone masonry. It covers the materials required, various classifications of stone masonry, and the types of joints used in construction. The content also includes guidance on the proper methods for laying stones and the maintenance practices necessary to ensure durability of stone masonry constructions.

Learning Outcomes

After completing this module, you will be able to:

1. List the materials used in stone masonry work.
2. Explain the types of stone masonry.
3. Identify different joints used in stone masonry.
4. Describe how to maintain stone masonry structures.
5. Understand the step-by-step process of laying stones in masonry work.

Module Structure

1.1 Materials required for Stone Masonry
1.2 Classification of Stone Masonry
1.3 Joints in Stone Masonry
1.4 Maintenance of Stone Masonry Construction
1.5 Laying of Stone Masonry.

Stone is an economical material for construction of various parts of a building. In some parts of the country, stones are abundantly available in nature. These stones are cut and dressed to the proper shapes and sizes as per need and requirement.

1.1 Materials Required for Stone Masonry

For stone masonry following two materials are required:

1. Stones

2. Mortar

1. Stones: The stones to be used in the work should be hard, durable, tough and free from any defects. Selection of stone for stone masonry depends upon (a) availability (b) ease of working (c) appearance (d) strength and stability (e) polishing characteristics (f) economy and (g) durability.

The table given below informs the different types of stones used for different purposes.

Sr.No	Purpose	Stone Used
1.	Heavy engineering work, e.g. docks, break waters, light houses, bridge piers.	Granite and gneiss.
2.	Building situated in industrial towns.	Granite and compact sand stones
3.	Pavements railway ballast, door sills and steps	Granite and ballast.
4.	Fire resistance works.	Compact sand stone.
5.	Carving and ornamental works	Marble and laterite.
6.	Face work and architectural purpose	Marble, granite and closer grained sand stone.

2. Mortar: Mortar is required to keep the stones in position. It is prepared by mixing lime or cement with sand and after adding water. Mortar is placed in the joints. The type of mortar to be used will depend on the strength required, load coming on the structure, resistance desired for weathering agencies etc. Usual varieties are: lime mortar, cement mortar, cement lime mortar, lime cement mortar.

In cement lime mortar a portion of cement is replaced by hydrated lime. It spreads more easily under the trowel and produces a more plastic material. In lime cement mortar a portion of lime is replaced by cement. It makes the mortar stronger, more plastic and workable and also the mortar sets earlier.

Stones are categorized as per use in structural members and location. These are discussed herewith**:**

1. Sill
2. Corbel

3. Cornice
4. Coping
5. String Course
6. Through Stone

1. Sill: The bottom surface of a door or a window opening is known as a sill (Fig.1.1) and the sill stones are so dressed that they prevent the entry of water to the interior of building.

2. Corbel: A corbel is a projecting stone which is usually provided to serve as a support for roof truss, beam and weather sheds etc. as shown in Fig.1.2. The corbels are generally moulded and are given ornamental treatment. The corbels should extend at least two-thirds of their length into wall.

3. Cornice: A cornice is a course of stone provided at the top of wall. It is generally moulded and is given ornamental treatment. It is weathered and threaded to dispose of rain water. In order to prevent the overturning of the cornice sufficient bearing and extra weight at the top in the form of a parapet wall should be provided.

4. Coping: A coping is a course of stone which is laid at the top of the wall, so as to protect the wall from rain water. This course is generally provided at the top of a compound wall or a parapet wall and it is suitably weathered and threaded as shown in Fig.1.4.

5. String Course: The horizontal course provided at suitable levels between the plinth and cornice is termed as a string course. It breaks the monotony of a plane surface and it is sometimes moulded and given architectural treatment.

6. Through Stone: A stone that is set with its longest dimension perpendicular to the face of wall and whose length is equal to the thickness of the wall (Fig.1.3). Such stones are known as through stones. The through stone should be strong and of sufficient thickness so as to avoid the danger of fracture due to any slight settlement of the wall.

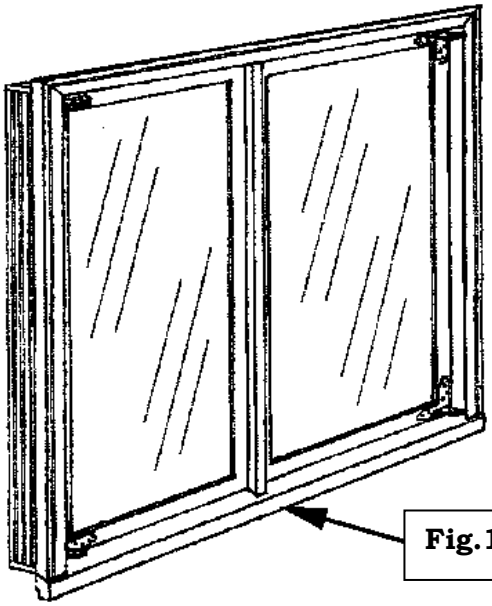


Fig.1.1: Sill

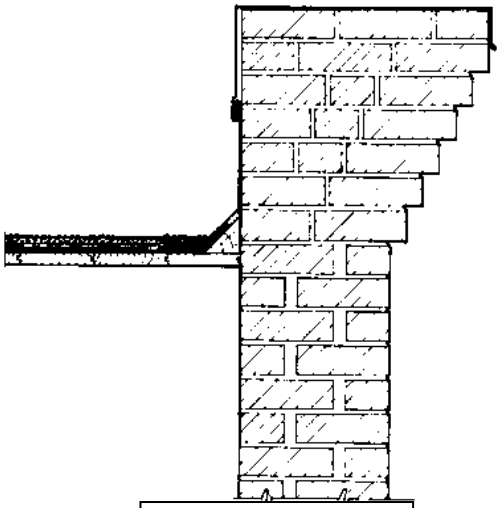


Fig.1.2: Corbel

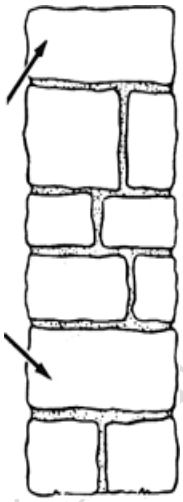


Fig.1.3: Through stone

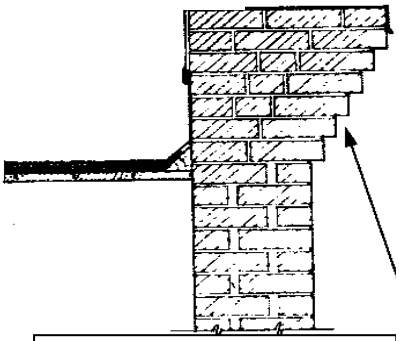
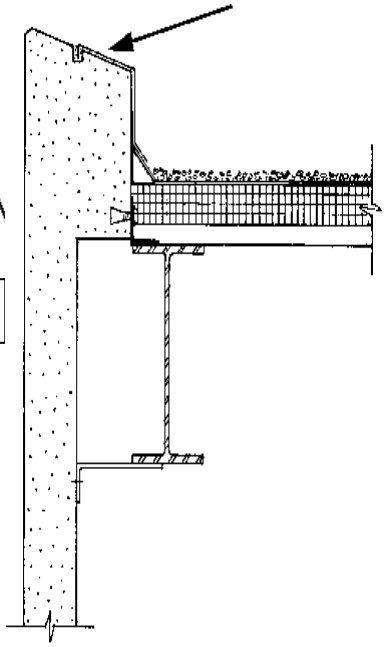


Fig.1.5: String

Fig.1.4: Coping



1.2 Classification of Stone Masonry

Based on the arrangement of the stone in the construction and degree of refinement in the surface finish the stone masonry can be classified into following two categories:

1. Rubble Masonry

2. Ashlar Masonry

1. Rubble Masonry: In construction rubble masonry stones of irregular sizes are used. The stones as obtained from quarry are taken in use in the same or they are broken and shaped to suitable size by means of hammer as the work processed. The strength of rubble masonry depends upon the following three factors:

(i) The quality of mortar.

(ii) The use of long threw stones at frequent intervals.

(iii) The proper filling of mortar in the space between stones.

The Rubble Masonry is further classified in following category.

(a) Coursed rubble.

(b) Uncoursed rubble.

(c) Random rubble.

(d) Dry rubble.

(e) Polygonal rubble.

(f) Flint rubble.

(a) Coursed rubble: This type of masonry is commonly used in the construction of low height walls of public buildings, residential buildings, abutment and piers of ordinary bridges. In this type of masonry the height of stones vary from 5 mm to 200 mm. The masonry work is carried out in this course such that the height of stones in a particular course should be the same. The course rubble masonry is further divided into three categorie

Fig.1.6: Coursed Rubble Masonry

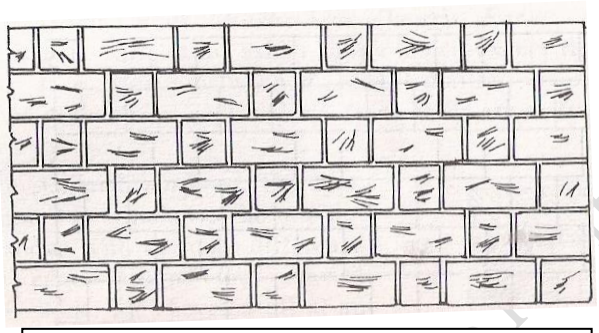


Fig.1.7: Coursed Rubble Masonry Class I

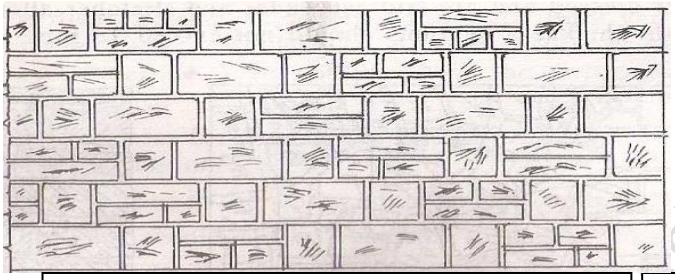


Fig.1.8: Coursed Rubble Masonry Class II

Fig.1.9: Uncoursed Rubble Masonry

(i) Coursed rubble masonry I sort: In this type stones of the same height are used and the courses are also of the same heights. (See Fig 1.7).

(ii) Coursed rubble masonry II sort: This type is similar to I sort except the following:

(a) The stones to be used are of different height.

(b) The courses need not to be of equal heights.

(c) Only two stones are to be used to make up the height of one course.

(d) The thickness of mortar joint is 12 mm.

(iii) Coursed rubble masonry III sort: This sort is similar to I sort except the following:

(a) The stones to be used are of different heights, the minimum being 50 mm.

(b) The courses are need not be of equal heights.

(c) Only three stones are to be used to make up the height of one course.

(d) The thickness of the mortar joint is 16 mm.

Fig.1.10: Dry Rubble Masonry

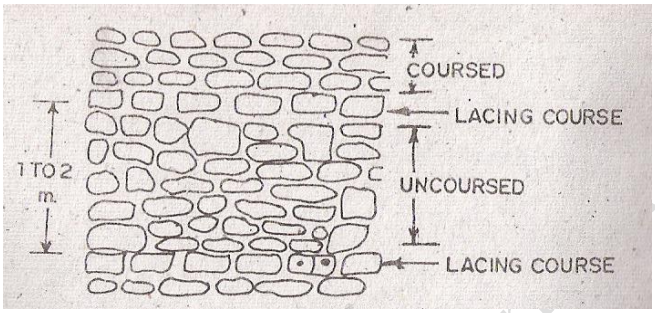


Fig.1.11: Flint Rubble Masonry

Fig.1.12: Polygonal rubble masonry

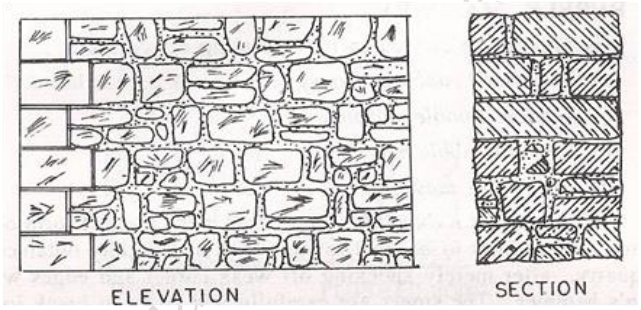


Fig.1.13: Random rubble masonry

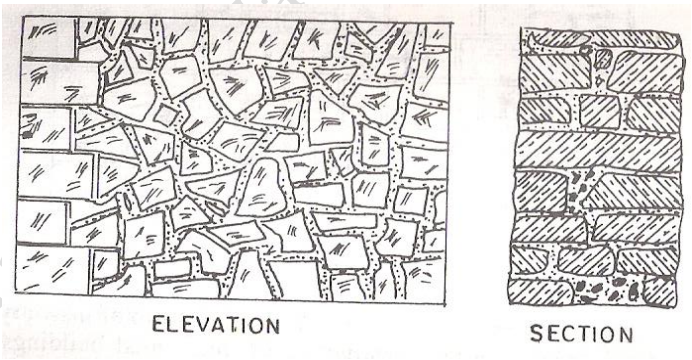


Fig.1.14: Uncoursed random rubble masonry

(b) Uncoursed rubble masonry: In this type of rubble masonry the stones are used as they are available from quarry except knocking out some coarseness. The courses are not maintained regularly. The larger stones are laid first and spaces between them are then filled up by means of spall as shown in Fig.1.8. The wall is brought to a level at every 30 cm to 50 cm. This type of rubble masonry being cheaper is used for construction of compound walls, godowns, garages etc.

(c) Random rubble masonry: The stones of irregular sizes and shapes are used in this type of rubble masonry. The stones are arranged so as to have a good appearance. It is to be noted that more skill is required to make this masonry structurally stable.

(d) Dry rubble masonry: This is just similar in construction to coursed rubble masonry except that no mortar is used in the joints. This type of construction is the cheapest but it requires more skill in construction. It is extensively used for compound walls pitching on bridge approaches retaining walls etc. In order to prevent the displacement of stones two courses at top and about 50 cm length at the ends are sometimes built in mortar.

(e) Polygonal rubble masonry: The stones are hammer dressed in this type of rubble masonry and the stones selected for face work are dressed in a selected for face work are dressed in an irregular polygonal shape. Thus, the face joints are seen running in an irregular fashion in all directions. More skill is required in the construction of this type of masonry.

(f) Flint rubble masonry: In this type of masonry stones used are flints. The flint stones varying in thickness from 8 to 15 cm and in length from 15 to 30 cm are arranged in the facing in the form of coursed or uncoursed masonry. In the case of buildings in coastal areas, the rounded flints procured from beaches are used. The joints of flint rubble masonry are slightly raked back with a pointed stick to improve the appearance.

2. Ashlar masonry: This is a superior quality of masonry. This is built from accurately dressed stones with uniform and very fine joints. The various types of ashlar masonry can be classified under the following categories.

(a) Ashlar fine.

(b) Ashlar rough tooled.

(c) Ashlar rock quarry faced.

(d) Ashlar chamfered.

(e) Ashlar facing.

(f) Ashlar block in course.

(a) Ashlar fine: At all beds joints and faces stones should be dressed perfectly so that they confirm to desired pattern (Fig. 1.12). The stones are arranged in proper bond and the thickness of the mortar joint does not exceed 3 mm. This gives perfectly smooth appearance but it is costly in construction.

(b) Ashlar rough tooled: The size of stones bond, etc. have similar specification as described in case of Ashlar fine masonry. The exposed face of this masonry should be

given a fine dressed, chisel drafting of about 25 mm in width. The thickness of mortar joints does not exceed 6 mm.

(c) Ashlar rock or quarry faced: In this type of masonry the exposed faces of the facing stones between the chisel drafting all around are left undressed. However the projections of size more than 8 cm are broken. All other specification are kept similar to that of Ashlar rough looked masonry. This type of construction gives massive appearance.

(d) Ashlar chamfered: The specifications regarding size bonds and type of joints are similar to the one as described above. The exposed edge of stones are levelled for a depth of about 2.5 cm. (See Fig.1.19).

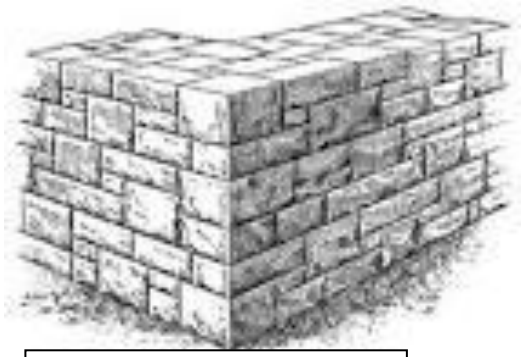


Fig.1.15: Ashlar Masonry

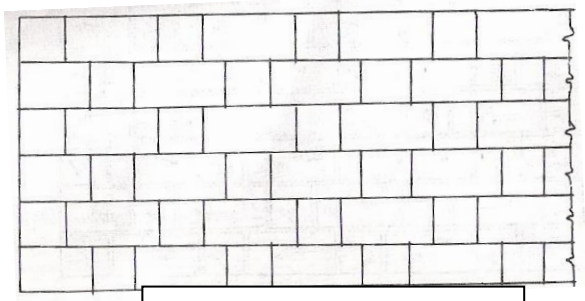


Fig.1.16: Ashlar Fine

Fig.1.17: Ashlar Masonry

Fig.1.18: Ashlar rough tooled masonry

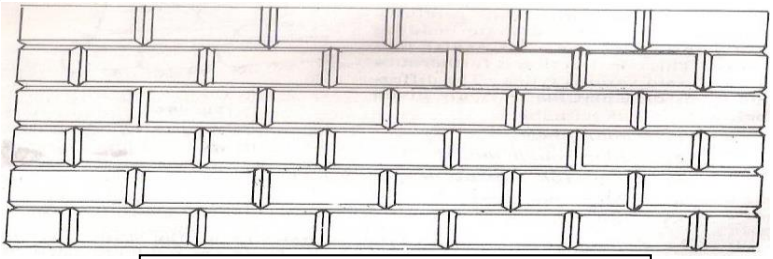


Fig.1.19: Ashlar Chamfered

(e) Ashlar facing: In this type of construction the facing is constructed in ashlar masonry and the backing may be on the brick masonry, rubble masonry or concrete masonry. This composite arrangement leads to economy. The height of course should be more than 200 mm. The facing stones are either rough tooled or chamfered.

(f) Ashlar block in course: This type of masonry occupies an intermediate position between rubble masonry and the ashlar masonry. The faces of the stones are generally hammer dressed and thickness of mortar joint does not exceed 6 mm. This type of construction is used for heavy engineering works such as retaining wall, sea wall etc.

1.3 Joints in Stone Masonry

Broadly joints in stone masonry can be categorized in the following types.

(1) Butt or squared joint.

(2) Rebated or lapped joint.

(3) Tongued and grooved joint.

(4) Tabled joint.

(5) Saddled joint.

(6) Rusticated joint.

(7) Plugged joint.

(8) Dowelled joint.

(9) Cramped joint.

(1) Butt or squared joint: This is the most common joint and is extensively used for ordinary work. In this type of joint the square surface of one stone is placed against that of another as shown in Fig.1.20

(2) Rebated or lapped joint: In this joint rebates/lapes are provided, which prevent the movement of stones. The length of rebate depends on the nature of the work but it should not less than 70 mm. This joint is used for arch work coping on gables etc.

(3) Tongued and grooved joint: In this joint a projection of one stone fit in the corresponding depression or groove in adjacent stone. This arrangement prevents the sliding of one stone over the other. This is also known as joggle joint.

(4) Tabled joint: In this type of joint a joggle is made in the bed of the stone to check the lateral movement. This joint is used in case of structures such as sea walls where lateral pressure is heavy.

(5) Saddled joint: In this type of joint the stone is rounded off to protect the joints or cornices and similar surfaces from rain water. With the help of this arrangement any water moving on the weathered surface is diverted from the joints.

(6) Rusticated joint: In this type of joint the edges of the joints are sunk below the plane of face work. The different types of rusticated joints can be: Channeled joint, Vee joint, and Vee and Channeled joint.

(7) **Plugged joint:** In this type of joint, dovetail shaped mortises are provided in the sides of adjacent stones as shown in Fig. 1.20. When stones are placed in position, molten lead is poured in the joint which when cooled connects the stones firmly cement grout is sometimes used in place of molten lead. This joint is used for coping carries etc.

(8) Dowelled joint: In this type of joint, a hole is cut into each stone and loose dowel, which are small pieces of hard stone, slate, gun-metal brass, bronze or copper are inserted and secured with cement as shown in Fig. 1.26. The dowelled joint can be easily used in place of joggled joints.

(9) Cramped joint: In this type of joint cramps are used instead of dowels. The cramps are the pieces of noncorrosive metals such as gun metal, copper, etc. and their ends are turned down to a depth of about 40 to 50 mm. The length, width and thickness of the cramps vary from 20 to 30 cm, 25 to 50 mm; and 5 to 10 mm, respectively. It prevents the tendency of the joint to be pulled apart. The cramps are placed in position, grouted and covered with cement load or asphalt. (See Fig.1.23)

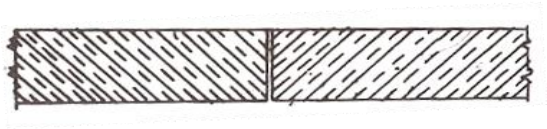


Fig.1.20: Butt Joint

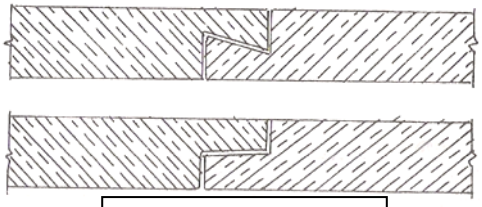


Fig.1.21:Rebated Joint

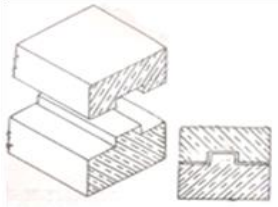


Fig.1.22: Bed joint or tabled Joint

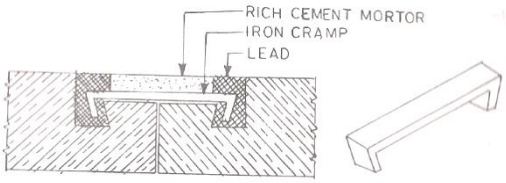


Fig.1.23:Cramp Joint

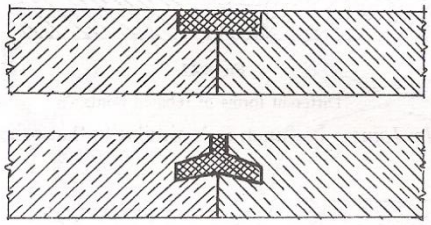


Fig.1.24: Different form of plug Joints

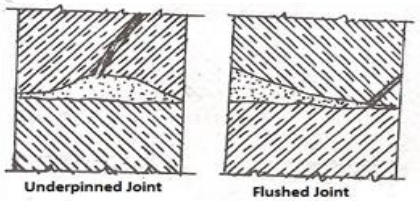


Fig.1.25:Underpinned and flushed Joint

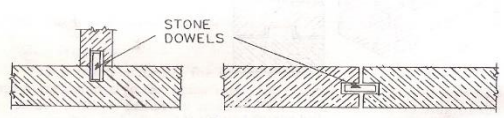


Fig.1.26: Dowel Joint

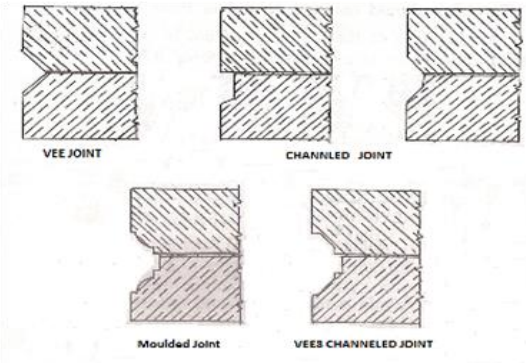


Fig.1.27: Rusticated or rebated Joint

1.4 Maintenance of Stone Masonry Construction

Stone masonry constructions should be maintained in respect of the following:

(1) Stains

(2) Efflorescence

(3) Cracks

(4) Waterproofing.

(1) Stains: The stains on stone work can be (a) iron stains (b) copper stains (c) smoke and fix stains (d) oil stains, (e) tobacco stains and (f) ink stains.

Iron stains can be removed by washing the stained area with solution of Oxalic acid mixed in water (1 kg of Oxalic acid mixed with 10 lit. of water). The stained area is rubbed with brush and water after 3 to 4 hours. In order to remove dark and deep stains a solution having one part of sodium citrate mixed with six parts of water is sprinkled. This surface is then covered with a thin layer of sodium hydro sulphide. The surface is washed after an hour.

- Copper and bronze stains are removed by application of ammonium chloride solution (1 part of Ammonium Chloride, 4 parts of powdered talc) with ammonia water.
- Smoke and fix stains are treated with powdered pumice or grit. The surface is rubbed several times and cleaned.
- Oil stains are treated with benzene or petrol. In order to remove deep oil stains a mixture of acetone and amyl acetal is used. A dilute solution of tri sodium phosphate can remove tobacco stains.
- Chlorinated lime, ammonia water or concentrated solution of sodium per borate can be used to remove ink stains.

(2) Efflorescence: The stones to be used for masonry work should be kept saturated with water so that it may not get discolored on account of the acid action. Efflorescence is common with certain type of stones and can be prevented by proper drainage of the building.

(3) Cracks: Stone masonry cracks can both be small and large. Small cracks should be cleaned with wire brush and filled with thick paste of cement mix.

Large cracks should be raked out to get a firm key for the mortar. For this an inverted groove of at least 10 mm depth is required. A cement sand mortar of 1:2 ratio with less water is applied within an hour after mixing. Aluminium may also be added in the mixture to make it a tight fit.

(4) Water Proofing: Application of water proofing material make the stone masonry free from efflorescence, dampness, frost action etc. Generally heavy petroleum distillate, fatty oil or in soluble soap are excellent waterproofing matter. These materials are applied as a washing coat they may cause some temporary discolouration.

1.5 Laying of Stone Masonry

Points to be considered during construction

- The stone should be hard, touch and durable.
- The stones should be well watered before use.
- There should not be hollow space inside the wall.
- Through stones (headers) should be used in successive layers, at 1.00 m (3' to 5') to 1.5 m apart, both ways.
- Use artificial header (R.C.C.) in case of more width.
- Care should be taken to secure a good mortar bond throughout the masonry. (Approx. 20mm i.e. ¾"). Corner stones are prepared from the mason's hammer.
- The joints should not be too smooth, to prevent stones from sliding down.
- The wall should be truly vertical i.e. in plumb.
- Minimum 12mm (½") margin should be provided in column external face and masonry, to avoid the offset of rubble in plinth masonry after plaster.
- Old work should be cleaned and watered before starting any new work on it.
- Keep expansion joint at 15m interval, in case of a compound wall.
- Lay some vertical stones in masonry for better bonding of 1st and 2nd day's work/layer of rubble masonry.
- The curing for masonry should be done for minimum 2 weeks.
- The through stone should be of a length which is at least thrice the depth.
- The joints should be pointed after proper curing and racking for at least 25mm (1") depth.

Bonding material used for masonry

- Masonry in cement mortar
- Masonry in lime mortar
- Masonry in mud mortar

Thickness of masonry

- 10 cm thick
- 20 cm thick
- 30 cm thick
- 40 cm thick
- 50 cm thick
- 60 cm thick

Proportion of mortar

- Masonry in cement/lime mortar 1:8
- Masonry in cement/lime mortar 1:6
- Masonry in cement/lime mortar 1:4
- Masonry in cement/lime mortar 1:2
- 1:8, 1:6 etc. is the volumetric proportion where 1 stands for cement/lime & 8, 6 stands for sand.

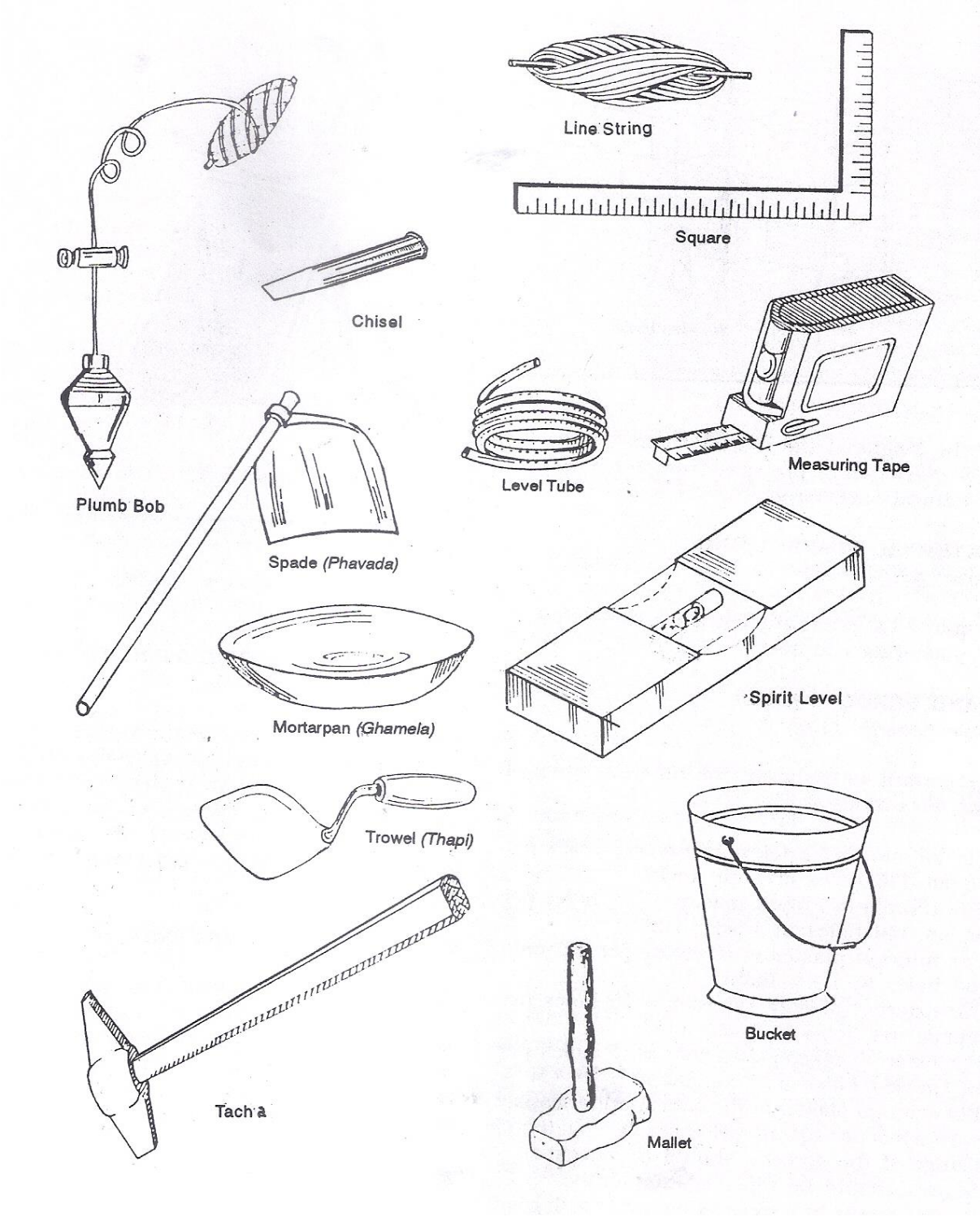
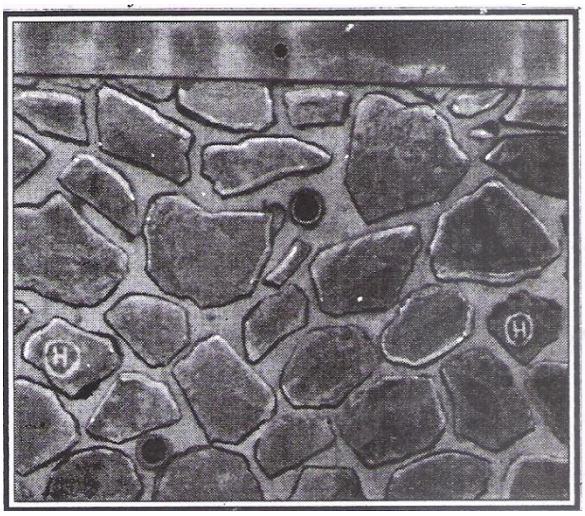
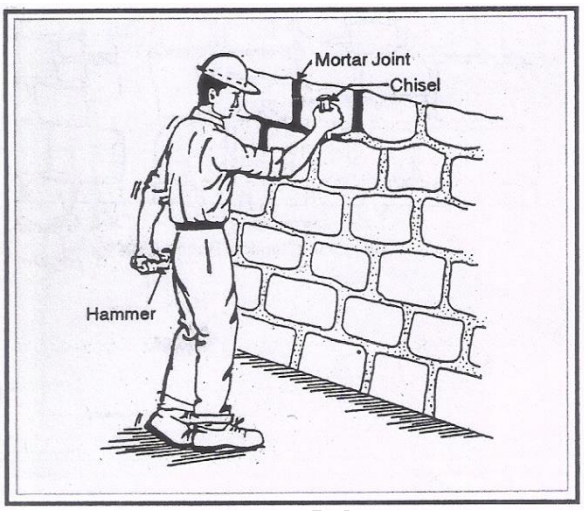


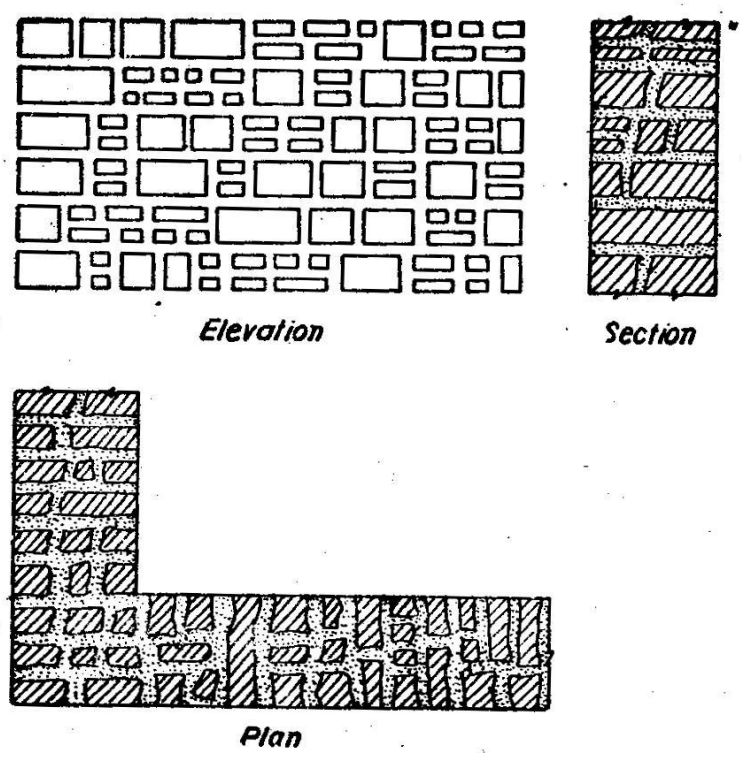
Fig.1.28: Tools Used in Stone Masonry





ACTIVITY

1. Student may do the practice of dressing the stone with appropriate tools.
2. Student are requested to construct coursed rubble masonry as per drawing given below



CHECK YOUR KNOWLEDGE

I. Answer the following:

1. Differentiate between ashlar masonry and rubble masonry.
2. What is function of the following terms?

   (a) Through stone (b) Corbel

   (c) Cornice (d) String course
3. Explain construction of a wall in coursed rubble masonry.
4. What type of stone masonry will you specify for the following.

   (a) Compound wall (b) Parapet wall

   (c) Retaining wall.
5. What is the object of preliminary dressing of stone at site?
6. Describe the tools used in Stone masonry Construction with sketch.
7. Write short note on Uncoursed rubble masonry.
8. Write the different types of ashlar masonry. Explain any one.
9. How the maintenance of stone masonry construction is carried out?
10. Enlist the types of rubble masonry. Explain any one.
11. List the tools used in masonry work.

II. Fill in the blank

1. Stone masonry is constructed with stones and ___
2. In cramped joint, cramps are used instead of _____.
3. Butt or squared joint is the most _____ joint and is extensively used for _____ work.
4. The stones of _____ sizes and shapes are used in rubble masonry.
5. Coursed rubble masonry is commonly used in the _____ of low height walls of public buildings, residential buildings, abutment and piers of ordinary bridges.
6. The curing for masonry should be done for minimum ___ weeks.

Module 2 BRICK MASONRY

Module Overview

This module offers comprehensive knowledge and practical understanding of brick masonry. It includes details about the materials and tools used, important technical terms, and the concept of bonds and their types. The module also explains the general principles to be followed during construction, the correct method for laying bricks, and how to join new masonry with old work. In addition, common defects in brick masonry and appropriate maintenance practices are discussed to ensure the longevity and quality of brick structures.

Learning Outcomes

After completing this module, you will be able to:

1. Identify the materials and tools used in brick masonry.
2. Understand common technical terms used in brick masonry work.
3. Explain the concept of bond and its various types.
4. State the general principles followed during construction of brick masonry.
5. Describe the correct method of laying bricks in a wall.
6. Explain how to properly connect new work with existing structures.
7. Identify common defects in brick masonry and how to prevent them.
8. Describe maintenance practices for brick masonry structures.

Module Structure

2.1 Material used in Brick Masonry
2.2 Tools required for Brick Masonry
2.3 Technical terms used in Brick Masonry
2.4 Bond and its type
2.5 General Principles to be observed in construction of Brick Masonry
2.6 Method of laying Bricks in the wall
2.7 Laying of Bricks in wall
2.8 Method of fixing new work with old work

2.9 Defects in brick masonry
2.10 Maintenance of Brick Masonry

In brick masonry the bricks are arranged and bedded in mortar so as to form a wall. Brick masonry is construction in which uniform units of bricks are placed with the one hand and these bricks are laid in courses with mortar joints to form walls.

2.1 Material Used in Brick Masonry

The common materials employed for brick masonry construction are:

(1) Brick

(2) Mortar

(1) Brick: A brick is building material used to make walls, pavements and other elements in masonry construction. Bricks are manufactured by moulding earth in rectangular blocks of uniform size and shape. Bricks can be manufactured of any required shape and size. The standard size of brick is kept as 19x9x9 cm. Their nominal size is considered as 20x10x10cm. Generally, first and second-class bricks are used for bricks work. Brick should be tested for hardness and durability before they are used in masonry.

(2) Mortar: *Mortar* is a material used in *masonry* construction to fill the gaps between the bricks and blocks used in construction. *Mortar* is a mixture of sand, a binder such as cement or lime, and water and is applied as a paste which then sets hard.

The commonly used mortars are:
Lime mortar, Cement mortar, Lime surkhi mortar and Mud mortar.

Fig.2.1: Mortar

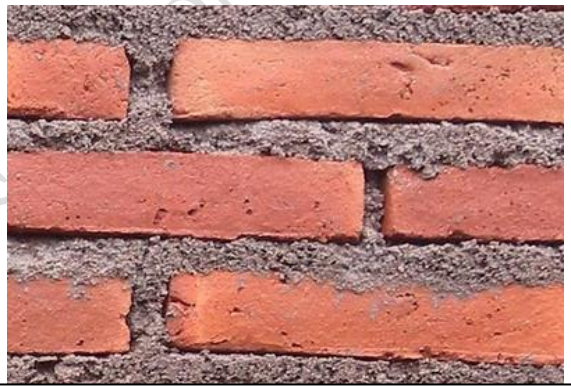


Fig.2.2: Mortar in brick joining

2.2 Tools Required for Brick masonry

The various tools commonly used by a brick layer are discussed below.

(1) Trowel: It is the most important tool used in brick masonry. It is available in sizes varying from 5 cm to 30 cm in length. Trowels are used for lifting and spreading mortar for forming joints and also for cutting bricks.

Fig.9.3: Trowel

(2) Plumb rule and bob: It is in the form of a smooth wooden piece of 2 m length, 10 cm width and 1 cm thick having its long edge parallel to each other. It is used for checking the verticality of the faces of brick work.

(3) Straight edge: This tool is used for checking the alignment of faces of brick work of a wall or pillar.

Fig.2.4: Plumb bob and

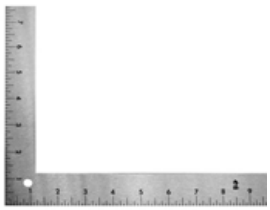


Fig.2.5: Masons square

Fig.2.6: Spirit level

Fig.2.7: Steel tape

Fig.2.8: Brick

Fig.2.9: Straight edge

(4) Mason's square: This is an exactly right-angled piece made of steel or wooden section. It is used for checking right angles.

(5) Spirit level: This tool is used along with the straight edge for checking the levels of floors, roofs etc.

(6) Steel tape: This is usually a steel tape having 2 meters length marked up to one tenth of a centimeter. It is useful for checking small measurements.

(7) Brick hammer: One end of this hammer is square and the other end is sharp edged. It is used for cutting bricks to different shapes and sizes brick paving, striking nails etc.

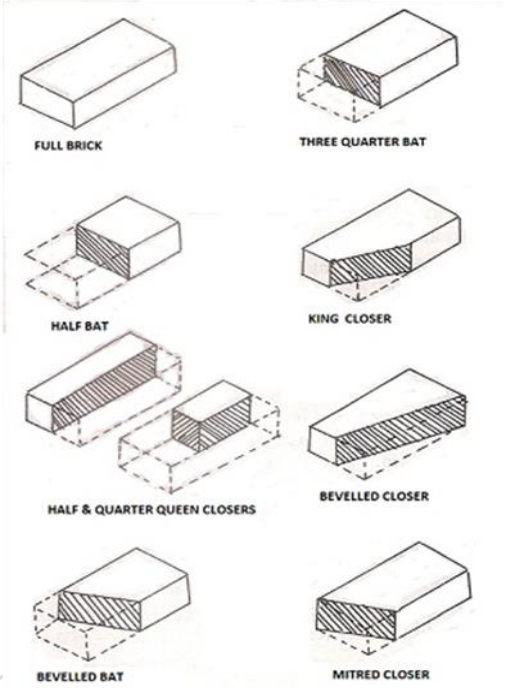


Fig.2.10: Types of Closer and Bats

2.3 Technical Terms Used in Brick Masonry (Fig.2.11):

1. **Bond:** When bricks are laid adjacent to each other forming a groove in between the bricks which is filled by cement mortar is called a bond. Bonding helps in even distribution of loads over a large area.

2. **Course:** A horizontal layer of bricks is termed as a course.

3. **Stretcher:** This is a brick laid with its length parallel to the face or front or direction of a wall.

4. **Stretcher course***:* Course of brick work in which all the bricks are laid as stretchers

5. **Header:** This is a brick laid with its breadth or width parallel to the face or front or direction of a wall

6. **Header course:** Course of brick work in which all the bricks are laid as headers

7. Arises: The edge formed by the intersection of plane surface of a brick are called the arises and they should be sharp square and free from damage.

8. Perpends: The vertical joints separating the bricks in either length or cross direction are known as perpends. For a good bond the perpends in alternate courses should be vertically one above the other

9. Bed joints: The horizontal layer of mortar upon which bricks are laid is known as a bed joint.

10. Lap: The horizontal distance between vertical joint in successive course is termed as a lap and for a good bond it should be one-fourth of the length of a brick.

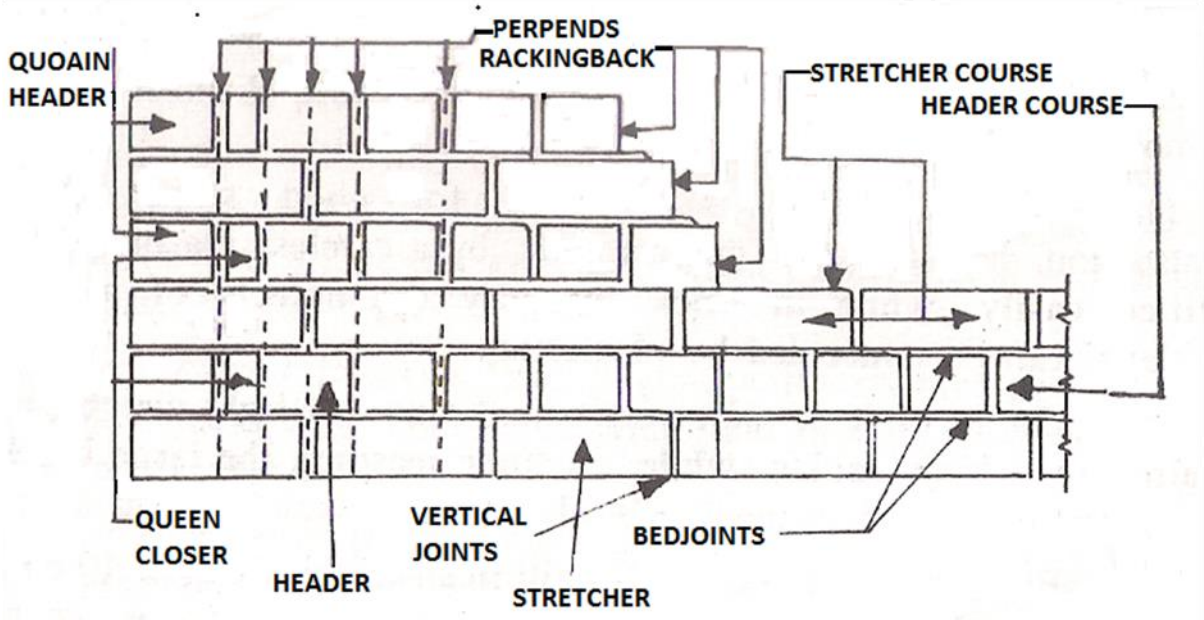


Fig.2.11: Elevation of a Masonry Wall

11. Closer: A piece of brick which is used to close upon the bend at the end of brick course is known as a closer. These are used for forming a proper bend in brick masonry. The types are:

(a) Queen closer: This is placed next to the first brick in a header course. This is a half brick cut longitudinally.

(b) King closer : This is obtained by cutting a triangular portion of brick such that half a header and half a stretcher are obtained on adjoining cut faces.

(c) Bevelled closer: The portion of a standard brick made by cutting the triangular piece between the centre of one header face and the opposite corner of the stretcher face is termed as bevelled closer.

(d) Mitred closer: The portion of a standard brick having its one end cut splayed or mitreted for the full width is called a mitreted closer (See Fig. 9.10).

12. Bull nose: These are bricks moulded with a rounded angle is termed as bull nose and it is used for constructing rounded corners of buildings.

Cow nose: A standard brick having its both the edges rounded off is called cow nose or double bull nose.

13. Plinth and plinth level: The portion of a structure between the surface of surrounding ground and the surface of the floor immediately above the ground is known as plinth and the level of the top of plinth with respect to surrounding ground is known as plinth level.

14. Jambs: The vertical sides of a door or window opening which support the door or window frame is called Jambs.

15. Soffit: The under surface of an arch or lintel provided over a door or window or verandah opening is called Soffit.

2.4 Bond and its type

As you know when bricks are laid adjacent to each other forming a groove in between the bricks which is filled by cement mortar is called a bond. Bonding helps in even distribution of loads over a large area. Bonds are classified in different types.

1. English Bond: This bond consists of alternate course of headers and stretchers (Fig.9.12). Queen closer, i.e., half of the brick cut lengthwise, shall be introduced after first header to break the vertical joint.

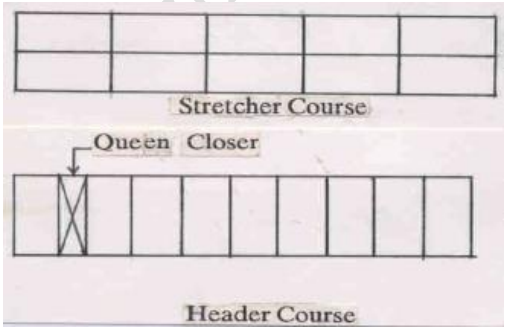


Fig.2.12: English Bond

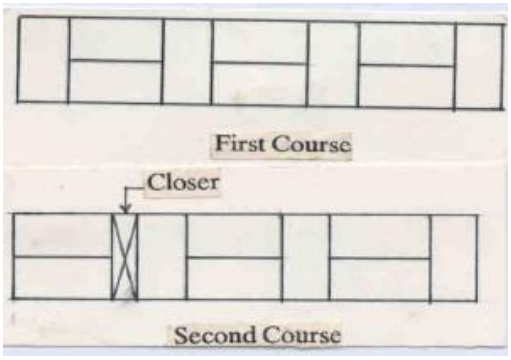


Fig.2.13: Flemish Bond

2. Flemish Bond: In this arrangement of bonding brickwork, each course consists of alternate headers and stretchers. The headers of each course are centred over the stretcher in course below. For breaking of vertical joints in successive courses closers are inserted in alternate courses next to quoin headers (Fig.2.13).

2.5 General principles to be observed in Construction of brick masonry

While supervising the construction of a brick wall the following points should be observed.

(1) Brick to be used for masonry work should be well burnt and of uniform size.

(2) All the bricks to be laid in cement or lime mortar must be properly soaked in water for at least 2 hours before they are used in construction work.

(3) All the bricks should be laid with their frog upwards so that the mortar should be properly filled in the frog and should form a key with mortar joint of the succeeding course.

(4) Specified mortar of good quality should be used.

(5) All joints of the masonry should be of uniform thickness and the thickness of each joint should not exceed 1 cm.

(6) A systematic bond must be provided throughout the masonry work.

(7) The verticality of the brick work should be frequently checked by means of a plumb rule.

(8) The upper surface of the wall should be wetted properly before a new layer is laid over it so as to form a bed for the new work.

(9) The brick work should be uniformly raised throughout the length of the wall in proper bond to avoid any unequal settlement.

(10) In one day, the height of brick masonry construction should not exceed 1.5 meters.

(11) While constructing a long wall, each successive portion should be properly raked back and the old and new brick work should be joined according to the bond.

(12) Brick bats should be used to the minimum.

(13) When timber or iron work is to be embedded in the wall the timber must be coated with coal tar and the iron work to be laid either in cement mortar or cement concrete.

(14) Freshly laid brick work should be protected against rains during construction.

(15) During frosty weather the brick work should either be suspended or carried out in cement mortar, if essential.

2.6 Method of Laying Bricks in the Wall

The following are the steps adopted in the construction of walls.

(a) Selection of bricks: Bricks are selected for different parts of the wall i.e., for facing, hearting and backing.

(b) Wetting of brick: Before the bricks are laid in the walls they should be wetted on all sides. The reasons for wetting bricks are:

(i) The bricks will tend to spread the mortar under them more evenly.

(ii) They will adhere better to the mortar.

(iii) A dry brick will quickly absorb water from mortar and water is needed for setting of cement mortar.

(iv) Wetting of bricks washes the kiln dust from them. A clean brick will produce a better joint and bed with mortar.

The mortar to be used for brick masonry is prepared properly in sufficient quantity at a time. The quantity of mortar should be such that it can be used within half an hour after its preparation.

2.7 Laying of bricks in walls

Laying of bricks in wall is done in the following two steps:

(a) Laying of bricks in foundation i.e. up to plinth level.

(b) Laying of bricks in wall above plinth level.

(a) Laying of brick in foundations:

This is done in the following steps:

(i) Spreading mortar on concrete bed About 2 cm thick layer of prepared mortar is first spread on the top of concrete bed in the area to be occupied by the corners of this step.

(ii) Constructing corners: After spreading the mortar the extreme corners are constructed in two courses after leaving the required concrete offset on each side. Surfaces of these extreme corners are made truly plumb.

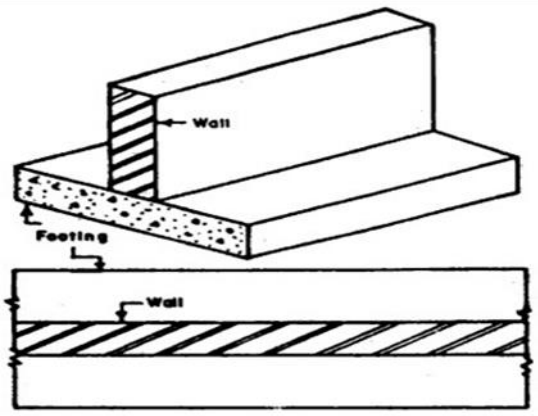


Fig.2.14: Simple footing in brickwork

iii) Laying first course: First of all, two strings are stretched at its upper level between extreme corners to mark the external and internal edges and to lay the bricks in the line and level with corner bricks of this course. Then bricks are laid on the layer of mortar in between these strings till the first course is completed.

(iv) Laying Second course: In second course two strings are stretched at its upper level between the extreme corners and bricks are again laid on the layer of mortar till this is completed. Similarly, the remaining steps of foundations of wall are completed after leaving brick offset. (See Fig 2.14)

(b) Laying of bricks in wall above plinth level

First of all a layer of 2 cm. thick mortar is spread on the top of plinth course in the area to be occupied by the corners of the wall. Then the extreme corners of the wall are constructed in the required bond up to 3 to 5 course in height. The base of each corners is extended in steps as shown in Fig. 2.15. The surface of the corners is made truly plumb. After this each course is completed in turn by stretching two threads at its upper level between the extreme corners to work the external and internal edges of the wall. In each course selected bricks for facing work are laid 1st in line and level with the external thread and then other bricks are laid in between the internal thread. When the masonry works up to the top of these extreme corner is completed again extreme corners 3 to 5 courses in height are constructed and this process

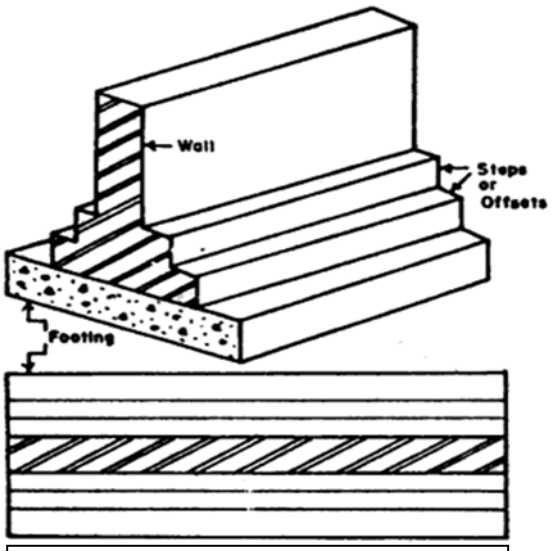


Fig.2.15: Spread footing in brickwork

repeated till the wall is constructed up to a height of 1.5 m. from ground level.

2.8 Methods of fixing new work with old work

(1) Toothing

(2) Racking back

(3) Block bonding

(1) Toothing: The process of leaving recesses in the alternate course of main wall at required place is called toothing. This method is used when a partition wall is proposed to connect with main wall or when rest of building portion is to be constructed afterwards. The length of recesses left in the wall is kept equal to the thickness of the proposed partition wall and their depth is equal to 1/4 brick or 5 cm. Toothing is done so that the new cross or partition wall or rest of the wall can be bonded to existing wall properly.

(2) Racking back: This method is useful when full length of wall cannot be built at a time. In this method the full length of wall constructed in parts and each successive portion is racked back properly. Racking back is done to reduce the possibility of any settlement in freshly laid portion of the wall.

(3) Block bonding: This method is used for joining a new course or partition wall to existing main wall. The process of creating recesses in height after every three courses in existing main wall is called block bonding.

2.9 Defects in brick masonry

Common defects occurring in brick work are:

(i) Sulphate effect on mortar.

(ii) Use of unsound material.

(iii) Frost action.

(iv) Efflorescence.

(i) Sulphate effect on mortar: Effect of sulphate causes cracking of brick work, spalling of brick edges, deterioration of mortar and falling off the plastered surface. The cause of

this failure is the chemical action between the sulphate salts present in bricks and aluminum constituent of Portland cement.

This action is rapid in presence of water. Prevention of moisture penetration will avoid this effect to a large extent.

(ii) Use of unsound material: When sub- standard material such as under burnt or over burnt bricks, poor quality of mortar etc. are used, they may result in dampness, cracking and early failure of the structure. To overcome this defect materials of good quality should be used.

(iii) Frost action: Defects due to frost action would cause cracking in the brick work. Prevention of water accumulation would go a long way in modifying this defect.

(iv) Efflorescence: The accumulation of white deposits on the exposed surfaces of bricks in brick masonry is called efflorescence.

It is due to crystallization of salts present in the bricks or absorbed by them from soil in contact with the brickwork. This provides an ugly appearance and may cause disintegration of brick work. To over-come this defect, sound bricks in good mortar should be used in brick work. The damp-proof course should be well designed and provided properly in required position to overcome dampness in brick work.

2.10 Maintenance of Brick Masonry

Maintenance is done to ensure neat appearance and stability of brick work. Following are the work generally executed for proper maintenance.

- **Cleaning brick masonry:** Cleaning of brick masonry is done to ensure neat appearance of brick work, cleaning is done either by steam or by hot water jets.
- **Removing efflorescence:** Efflorescence is removed by rubbing the surface of brick masonry with wire brush and then washing with water. If this is not effective the surface is treated with a 10percent solution of muriatic acid and then washed immediately with plain water.
- **Reconditioning of brick masonry:** To ensure neat appearance and reconditioning of brick masonry is done by repointing or replastering.

For repointing the loose mortar from the joints is removed to a depth of about 3 mm. The joints are then cleaned by means of a wire brush and washed with water. After these joints are finished with fresh mortar.

For replastering the loose plaster from surface is removed to a depth of 3 mm. The surface is then cleaned with water. After this surface is plastered.

PRACTICAL ACTIVITY

1. Stacking of bricks and counting of bricks as per laid standard procedure.
2. To construct English bond of one brick thick without mortar.
3. To construct English bond of one and half brick thick without mortar.
4. To construct double Flemish bond of one brick thick without mortar.
5. To construct single Flemish bond of one and half brick thick without mortar.
6. To prepare different types of closers.
7. To prepare different types of brick bats.
8. Construct English bond and Flemish bond as per drawing given below.

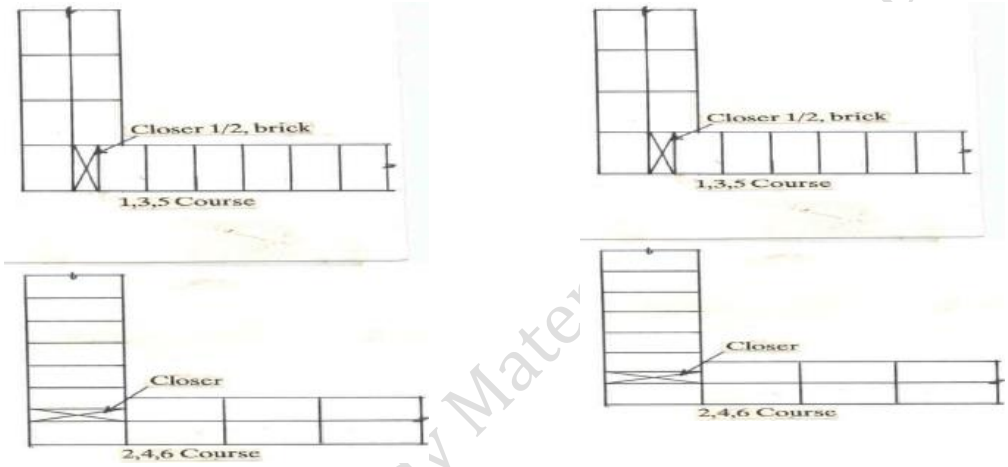


Fig.2.16: English bond for 1 brick wall

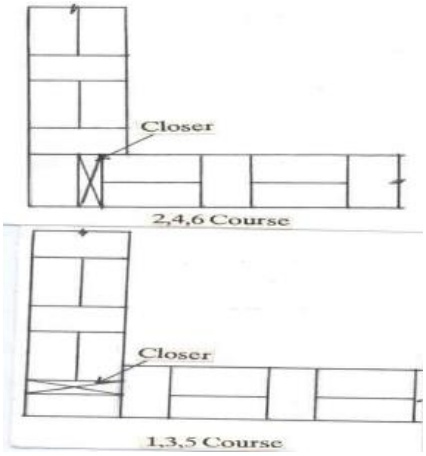


Fig.2.17: Flemish bond for brick wall

CHECK YOUR PROGRESS

I. Answer the following

1. Give the general principles to be observed and precautions to be taken during construction of brick masonry.
2. Define the following with sketches.
   (i) King closer
   (ii) Queen closer
   (iii) Standard brick
   (iv) Full nose.
3. What is bond in masonry? Why is it necessary?
4. Why are joints broken in masonry?
5. Explain the following terms:
   (i) Toothing
   (ii) Racking back
   (iii) Block bonding.
6. What are the common defects in brick masonry?
7. What are the advantages and disadvantages of English bond and Flemish bond?
8. Brick masonry is the construction of Bricks and _____.
9. Enlist different types of bonds used in brick masonry.
10. Describe the procedure of laying of bricks in a wall.
11. Differentiate between English bond and Flemish bond.
12. Explain the tools used in brick masonry.

II. Fill in the blank

1. A horizontal layer of bricks is termed as a _____
2. Course of brick work in which all the bricks are laid as headers are called as _____ course

3. Bricks are manufactured by _____ earth in rectangular blocks of uniform size and shape.
4. Trowels are used for _____ and _____ mortar for forming joints and also for cutting bricks.
5. Plumb rule and bob is used for checking the _____ of the faces of brick work.
6. Stretcher course of brick work in which all the _____are laid as stretchers
7. Straight edge is used for checking the _____ of faces of brick work of a _____or pillar.
8. Stretcher is a brick laid with its length parallel to the face or front or direction of a _____
9. _____ is a brick laid with its breadth or width parallel to the face or front or direction of a wall.

Module 3	PLASTERING WORK

Module Overview

This module introduces the concept of plastering and its role in improving the appearance and protection of walls and ceilings. It covers the tools and materials commonly used in plastering work and provides a clear explanation of the plastering process.

Learning Outcomes

After completing this module, you will be able to:

1. Explain the meaning and importance of plastering in construction.
2. Identify various tools used in plastering work.
3. List the materials required for plastering.
4. Describe the step-by-step process of plastering a surface.

Module Structure

3.1 Plastering and its importance
3.2 Tools used in plastering works
3.3 Material required for plastering
3.4 Process of Plastering

3.1 Plastering and its importance

The walls constructed with bricks or stones are generally not fine in texture. To obtain an even, smooth, regular and clean surface of walls a covering material like mortar is applied on the surface. The application of mortar is known as plaster. We can say that plaster is a layer of cement-sand-mortar, applied over the masonry work, which also acts as a damp-proof coat over the masonry work. Plastering enhances the appearance of the building. The ceiling is also made smooth with plaster.

Purpose of Plastering:

(i) To get an even, smooth and durable surface.
(ii) To safeguard the surface from effects of weathering agencies.
(iii) To provide a smooth surface for decorative surface finish.
(iv) To conceal the bad workmanship.

Requirement of an Ideal Plaster:

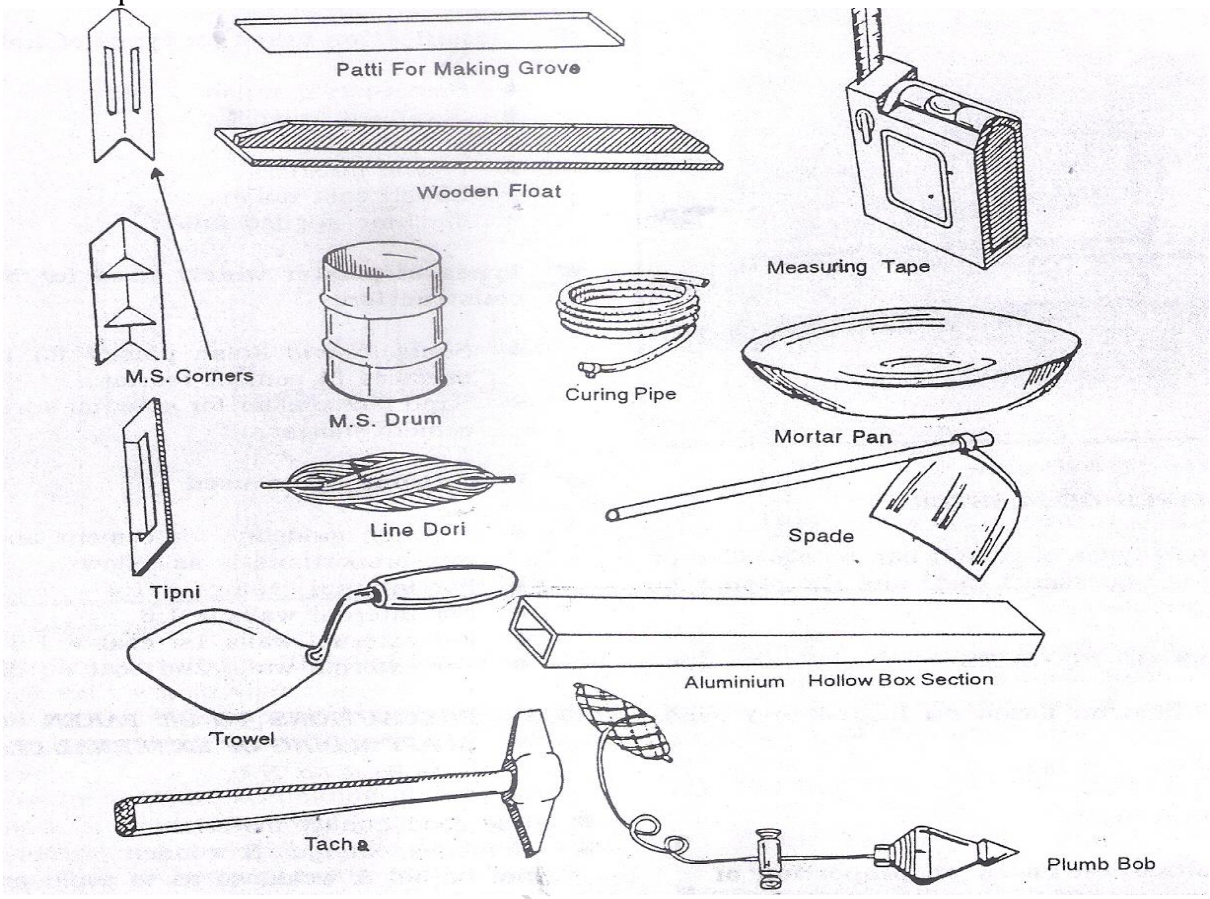
(i) It should be strong and durable against effect of weathering agencies.
(ii) It should offer good resistance against fire.
(iii) It should give a smooth and washable surface.
(iv) It should provide a smooth surface with required decorative effect.

3.2 Tools used in plastering works

Important tools used in plaster work are given below:

1. Wooden float/Metal float
2. Trowel
3. Water pipe
4. Measuring Tape
5. Aluminum Hollow box section
6. Tacha or Brick axe
7. Plumb bob
8. Patti for making Grove

9. Spade



10. Fig 3.1: Tools used in plastering work

11. Mortar pan
12. Chisel
13. Hammer
14. Right angle, small and big
15. Screen for sieving sand
16. Measuring jar
17. Wire brush
18. Measuring boxes for measuring sand

3.3 Material required for plastering

1. Cement
2. Sand
3. Water
4. Admixture (if any) e. g. water proofing compound

- **Types of plaster:**

1. Cement plaster
2. Lime plaster
3. Mud plaster

(1) Cement plaster: The plaster in which cement is used as binding material is known as cement plaster. (Cement + Sand + Water) proportion (1:3 to 1:6)

Steps to be Followed in Cement Plastering

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 15 mm or when it is required to get a very fine finish. The process of applying a double coat cement plaster on wall surface consists of the following 5 steps.

Step-1-Preparation of surface for plastering

Step-2-Ground work for plaster

Step-3-Applying first coat (or under coat or rendering coat)

Step-4-Applying second coat (or finishing coat or fine coat)

Step–5 Curing of plaster surface

3.4 Process of Plastering

Fig.3.2 Plastering with manual labour

Fig.3.3 Plastering with machine

Step by step guide for cement plastering

Step-1 (preparation of surface for plastering)

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 12 mm to give a better bonding to the plaster.
4. If the projection on the wall surface is more than 12 mm, then knock it off, so as 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.
8. For R.C.C. or Concrete surfaces racking on surface is done with racking tool.

Step-2 (ground work for plaster)

1. In order to get uniform thickness of plastering throughout the wall surface, first fix *dots* on the wall. A dot means patch of plaster of size 15 mm * 15 mm and having thickness of about 10 mm.
2. Dots are fixed on the wall first horizontally and then vertically at a distance of about 2 meters covering the entire wall surface, by using line dori and plumb bob .
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. The consequent walls are plastered with similar process & right angle to be maintained and checked with masons square.

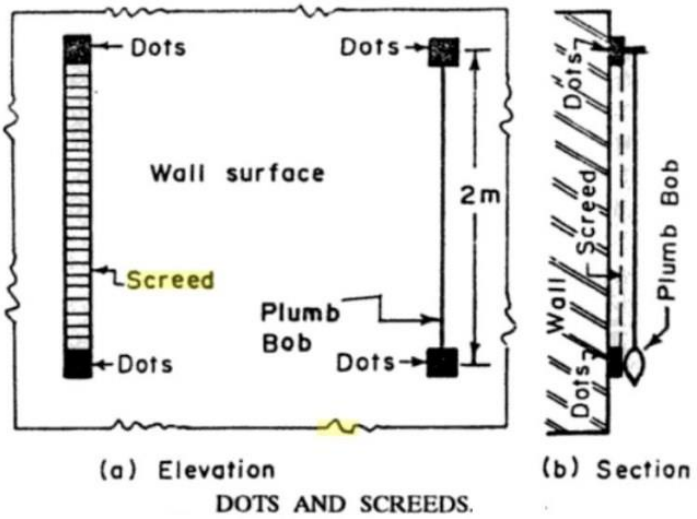


Fig 3.3 Dots and Screeds

Step-3 (applying first coat or under coat or rendering coat)

1. In case of brick masonry the thickness of first coat plaster is in general12 mm and in case of concrete masonry this thickness varies from 9 to 15 mm.
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 leveling, 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 (applying second coat or finishing coat or fine coat)

1. The thickness of second coat or finishing coat may vary between 2 to 3 mm.
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.

Step-5

After completion of the plastering work, it is kept wet by sprinkling water for at least 7 days in order to develop strength and hardness. (For Ceiling plaster work, levels are marked on wall with level tube and then dots are marked and screeds are filled on the ceiling.)

(2) Lime plaster: The proportioning of ingredients in lime mortar is different and adopted according to number of coats. If one-coat lime plaster is applied the proportion is kept 1:2 i.e. one-part lime and 2 parts sand. If two coats are applied the proportion for the first is the same but proportion for the second coat is kept 2:1 i.e. 2-part lime and 1 part of sand. In three coats of plaster the proportion for the third coat is kept 4:1 i.e. 4 parts of lime and 1 part of sand. The thickness of the lime plaster varies from 18 to 25 mm.

Lime plaster is suitable for internal rendering of building, but it is not common now a days.

Steps to be Followed in Lime Plastering

(i) **Preparing the surface:** This step of preparing the surface is the same as that in the case of cement plastering.

(ii) **Application of plaster coats:** Lime plaster is also applied in one, two or three coats. In the first coat lime plaster is applied with the help of trowel against wall surfaces between the screeds. The necessity of this coat is to fill all irregularities of the surface first coat is left to dry for 3 to 4 days before applying the second coat.

For the application of the second coat it is essential to wash the first coat and scratch over it with the edge of trowel. Lime plaster is then applied with the help of mason's trowel. The thickness of thin coat is generally kept between 8 to 10 mm.

After applying coat, finished coat is applied. This coat usually consists of fat lime. It is essential to make surface of the second coat perfectly plain, rub it first with a wooden float then with a steel float to polish the surface. It is about 3 to 6 mm in thickness. It is allowed to dry for two days and then surface is cured for at least two weeks.

(3) Mud plaster: This type of plastering is suitable on the walls of temporary sheds and low-cost countryside buildings.

In the plastering work first, the surface of the wall is prepared as in the case of cement plastering. The plaster is then evenly applied on the wall surfaces and dashed with wooden float. The surface is then damped after 24 hours. The importance of damping is to compact the layer and fill the joints deeply with mud mortar.

After damping, the surface is then polished with a steel trowel. If any small cracks develop a thin wash of cow dung is given and tamping is done again.

External Finishes:

It is essential to finish external walls of the building by using suitable material depending upon the desired appearance and degree of maintenance. There are various forms of external finishes. The common types of external finishes are:

(1) Sand faced finish.
(2) Pebble dash finish.
(3) Rough Cast finish.
(4) Smooth cast finish.

(1) Sand faced finish: This is done in two coats. In the first coat cement mortar of 1:3 to 1:4 is applied on the prepared surfaces of wall. The thickness of the first coat should not exceed 12 mm. After application of the first coat, it should be cured for at least one week. The first coat should be provided with scratches so that second coat adheres with first coat. The second coat is then applied with cement mortar of 1:1 in proportion. The thickness of coat is generally kept between 8 to 10 mm. The sand to be used in the second coat should be perfectly screened to get a uniform finished surface. After completion of the second coat the surface is kept out for at least 15 days.

(2) Pebble dash finish: In this type of finish it is essential to make 12 mm thick finishing coat. Then the clean pebbles of 10 to 12 mm size are dashed on the surface of finishing coat, so that the pebbles hold the position by mortar already applied.

(3) Rough cast finish: In this mortar the cement mixture proportion is kept 1:3 and then sand is used coarse grained. The mortar is applied on the surface of wall and is roughly finished by light movements of wooden float.

(4) Smooth cast finish: In this finish the procedure is same as that of rough cast but sand used is fine grained in place of coarse grained.

Defects of plastered surface:

(1) Sometimes small patches / conical holes (popping) swell out of the plastered surface.
(2) The development of fine hair cracks on the plastered surface.
(3) If some salt is available in the material of plaster the salt is brought out to the surface of wall and it appears in the form of whitish crystalline structure. This is called efflorescence and it seriously affects the adhesiveness of paint with wall surface.
(4) Due to bond failure between successive coats of plaster, the plaster from some portion comes off. Such formation is known as peeling.
(5) Due to thickness of finishing coat or presence of deliquescent salt certain paints on plastered surface makes the portion soft.

To minimize the defects in plastered surface following points should be kept in mind:

- Brick and other materials of superior quality should be used.
- Water free from salts should be used.
- The surface should be well watered before plastering.
- The construction should be such that the entry of moisture should be avoided.
- Fresh plastered surface should be saved from superfluous quality of water.
- Excess thrilling should be avoided.

Repairs to plastered surface: The small cracks developed in plastered surface can be repaired by grouting slurry of cement sand mortar.

For damaged plastered surface the patches are cut out in square or rectangular shape. The patch is then cleaned and wetted with water. The patch is filled with the plaster of rich ratio. The surface is then finished according to adjacent surface and cured properly.

Efflorescence is removed by rubbing the surface and cleaning it with a brush. Then a solution of water and hydrochloric acid / sulphuric acid in the ratio of 5:1 is applied on the cleaned surface. The surface is then thoroughly washed and rendered clean and dry.

CHECK YOUR PROGRESS

I. Answer the fallowing

1. Write the importance of plaster in a building.
2. List the various types of plasters and their suitability?
3. What are the requirements of an ideal plaster?
4. Describe the procedure adopted in plastering of the wall.
5. What precautions you would take for good plastering?
6. What are the purposes of plastering?
7. How defects of plaster work can be corrected?

II. Fill in the blanks with appropriate words:

a. To obtain an even, smooth, regular and clean surface of walls a covering material like mortar is applied on the surface is called as _____.
i) concrete ii) plaster iii) pointing iv) painting

b. Material required for Plastering are Cement, _____, Water and Admixture (if any).
i) aggregate ii) lime iii) sand iv) admixture

c. In case of brick masonry, the thickness of first coat plaster is in general___mm.
i) 12 ii) 8 iii) 6 iv)10

d. Due to bond failure between successive coats of plaster, the plaster from some portion comes off. Such formation is known as _____.
i)breaking ii) fading iii) dots iv) peeling

Module 4 PRECAST BLOCK MASONRY

Module Overview

This module provides essential knowledge of precast block masonry, an efficient and modern construction method. It explains why precast blocks are used and highlights both their benefits and limitations. The module also includes information about the tools and machines needed for block casting, as well as proper techniques for stacking and curing the blocks.

Learning Outcomes

After completing this module, you will be able to:

1. State the need and purpose of using precast block masonry in construction.
2. List the advantages and disadvantages of precast block masonry.
3. Identify the tools and machinery required for block casting.
4. Explain the proper method of stacking precast blocks.
5. Describe the process of curing precast blocks.
6. Understand the construction procedure using precast cement concrete blocks.

Module Structure

4.1 Why Precast block Masonry?

Since long-time bricks are being used as prime building materials. Bricks are being used in thatched houses and for multi-storey buildings. Due to growing population and sub sequent need of housing there is great demand of bricks. Supply of bricks cannot be maintained due to scarcity of raw material.

Moreover, to match the requirements for brick ultimately leads to exhausting fertile land. We should not effort damaging our resources through erosion of fertile land. As well as scarcity of skilled labour, increasing cost of kiln fuel, the demand and supply ratio for bricks require an alternative for bricks.

An alternative for bricks is none other than use of precast block masonry/ use of concrete block. Advantage of concrete blocks is that it can be manufactured on the sites.

Precast concrete is a construction product produced by casting concrete in a reusable mould or "form" which is then cured in a controlled environment, transported

to the construction site and lifted into place. In contrast, standard concrete is poured into site-specific forms and cured on site. Concrete blocks can be manufactured on the site which is great advantages. We can say Precast concrete is simply concrete that is casted somewhere other than where it will be used. Precast concrete blocks are used as brick in the construction of wall, pavement block, boundary wall, partition wall, gamla etc.

4.2 Advantage and Disadvantages of using Precast block masonry

Advantages:

1. Concrete of superior quality is produced because of better technical control on the production of concrete in factory.
2. Not necessary to provide joints in pre-cast construction.
3. The labour required in the manufacturing process of pre-cast units can easily be trained.
4. The moulds employed for preparing the pre-cast units are of steel with exact dimensions in all directions. These moulds are more durable and they can be used several times.
5. The pre-cast articles may be given the desired shape and finish with accuracy.
6. The pre-cast structures can be dismantled, when required and they can be suitably used elsewhere.
7. The transport and storage of various components of concrete for cast-in-situ work are eliminated when pre-cast members are adopted.
8. The work can be completed in a short time, when pre-cast units are adopted.
9. When pre-cast structures are to be installed, the amount of scaffolding and formwork is considerably reduced.

Disadvantages:

1. If not properly handled, the pre-cast units may be damaged during transport.
2. It becomes difficult to produce satisfactory connections between the pre-cast members.
3. It is necessary to arrange for specific equipment for lifting and moving of pre-cast units.

4. The economy achieved in pre-cast construction is partially balance by the amount to be spent in transport and handling of pre-cast members. It becomes, therefore, necessary to locate the pre-cast factory at such a place that transport and handling charges are brought down to the minimum possible extent

Note: Material for Construction: Important materials required for this block are Cement, sand and water. Mortar ratio should be 1:1 and 1:2 (cement: sand)

4.3 Tools and Machineries Required for Block Casting

- Block making machine, hand operated with and without vibrator and electrically operated with vibrator.
- Block pallets, wooden or M.S. (Mild steel)
- Phavdas (spades)
- Ghamelas (mortar pans)
- Measuring boxes
- Compacting rod
- Thani (trowel)
- Painted plates for ensuring the casting dates
- Curing pipes
- Sprinklers

(a) Block Making Machine

There are two types of block making machines.

- Hand operated machine with and without vibrator
- Electrically operated machine with vibrator attachment
- For better compacted block with more strength, electrically operated machine with vibrator attachment is preferred than hand compacting machine. But since it is expensive, smaller projects can use hand compaction machines with vibrator.

(b) Block Pallets

- Block pallets may be wooden or made of mild steel.

- Wooden pallets are generally made of sal wood and can be of different sizes. Pallets size should be about 3 mm less than the actual block size. M.S. pallets are made from 14 gauge M.S. sheet and angles welded at bottom.
- Oiling and cleaning of block pallets should be done every week and repairs should be carried out periodically.
- Cleaning, oiling and maintenance of the block casting machine should also be carried out periodically.
- Block pallets of a special size and shape are used for producing half length blocks.

Basic Materials: For manufacturing blocks, basic material required is cement, sand, shingle (coarse sand) metal, grit, dust etc.

Proportions of Material

Following proportions can be used for manufacturing non-load bearing block to get the required strength and about 35 blocks/bag of cement.

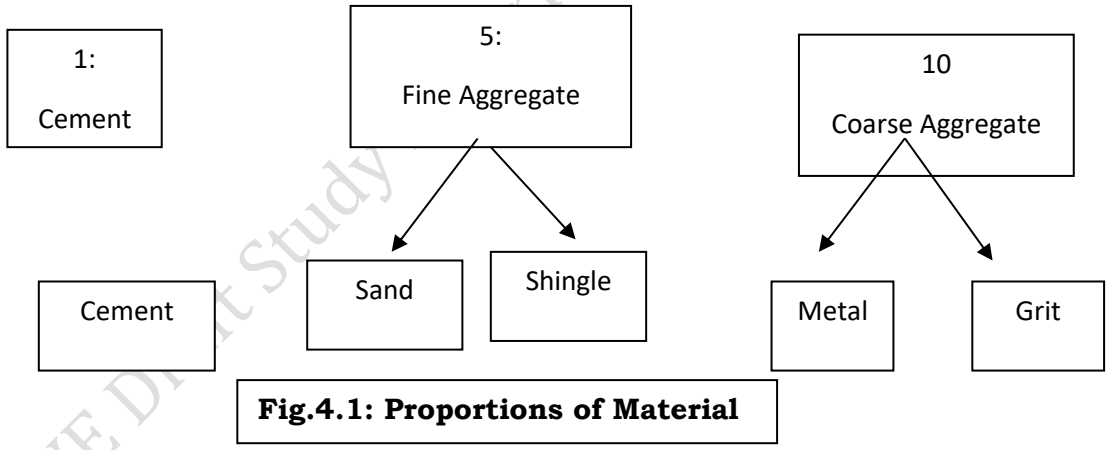


Fig.4.1: Proportions of Material

Block Manufacturing Procedure

The following procedure should be followed for manufacturing blocks.

- Concrete block should be of sizes 30cm x 150cm x 20cm or 30cm x 10cm x 20cm.
- A platform should be prepared by laying P.C.C.
- The size of the platform should be large enough to mix at least 25 depos (heaps).
- On this platform, depos of the material should be dumped for each cement bag.

- Generally, the contractor mixes one depo of 5 to 6 bags of cement at a time leading to improper mixing, ultimately affecting the strength of the block.
- Mix the cement thoroughly to get a uniform dry mix.
- Water should then be added in the depo and wet mixing should be done thoroughly.
- Water cement ratio should be kept very low, as higher w/c ratio block cannot stand for a long time.
- Now, compact the concrete.
- Compaction is important for manufacturing the blocks, since the strength of the block depends on how well the block is compacted.
- To make the block fully compacted, the moulds should be filled in layers and compaction done by tamping rod or with electrical vibrator.
- With a hand operated machine 25 strokes are required per layer, while electrical compaction needs 15 seconds to compact the block completely.
- These blocks are then carried manually to its initial stacking yard for setting.
- Similarly, hollow blocks can be prepared by making certain changes.

Half Blocks and other size blocks

- Generally, block masonry requires approx., 5% half size blocks.
- These blocks are used at corners, near windows etc.
- Making two blocks by breaking one full block is not feasible at the time of construction. Also, it can lead to an increased breakage of the blocks, resulting in wastage.
- To avoid wastage, half size block of 15cm x 15cm x 20cm or 10cm x 15cm x 20cm should be manufactured as per the requirement. Special types of pallets are used for this, as shown in Fig. No.1.4

Requirement of a Quality Block

(1) Shrinkage Period

- Blocks require a minimum of 15 days curing for the required strength.
- The blocks can be used after sufficient curing.
- A time gap of at least 90 days between the manufacturing date and the utilization date of the blocks is advisable. It is necessary to complete the shrinkage process in newly prepared blocks.
- Chances of shrinkage cracks developing in the masonry reduces considerably with a sufficient time gap.

- So, block manufacturing should commence at least 90 days in advance.
- Accordingly, the procurement of basic material should be done.

(2) Curing of the Blocks

- Curing of the blocks should be done for minimum of 28 days for the required strength.

(3) Strength and Testing of the Concrete Block

- The minimum compressive strength required for load bearing solid concrete blocks is 4N/mm^2 (40 kg/cm^2) at 28 days. However, the I.S. Coded does not specify any particular limit of non-load bearing solid concrete blocks. Practical site experience indicates that the minimum compressive strength required for these blocks should be between 2.5 to 3N/mm^2 (25 to 30 kg/cm^2) at 28 days.
- Field tests and laboratory tests are carried out to check the quality of the block (Refer Chapter No.10 for details).

4.4 Stacking of the Blocks

The following steps are involved in stacking of the blocks.

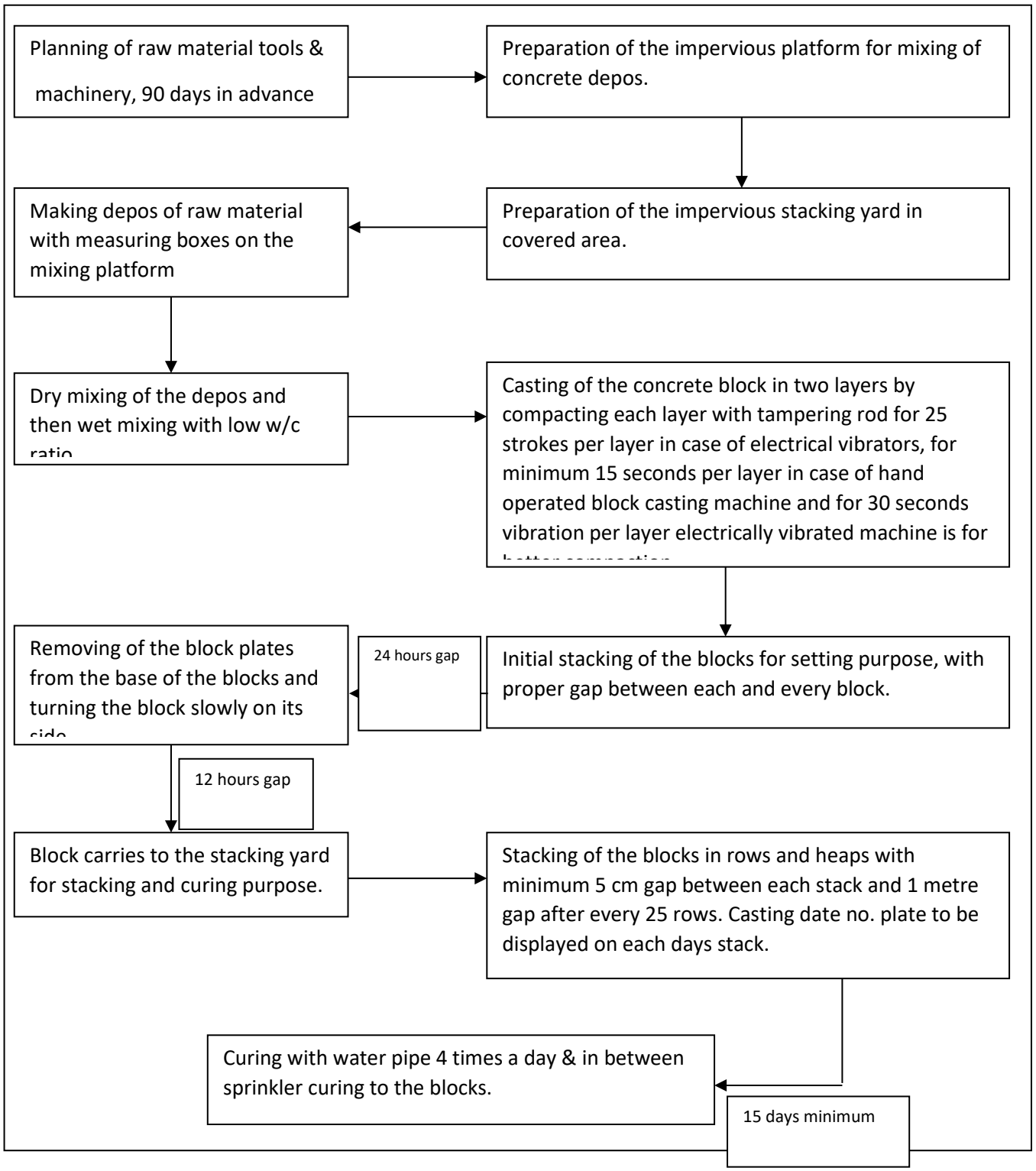
- Freshly prepared blocks should be kept in a row, with a gap of 5 cm or 7 cm gap, for at least 24 hours, without any disturbance for the initial setting of the concrete (Fig. No.1.4)
- After 24 hours, the pallets can be removed from the base of the block by turning the block slowly on its side.
- The block should be allowed to lie in the position for another 12 hours before stacking it in the stacking yard. Curing of these blocks should be done at least 4 times a day.
- The blocks should then be carried to the stacking yard for stacking and curing.

Requirements of a Good Stacking Yard

- Good stacking yard should be properly levelled with ample space with shade.
- Generally, the parking place of the building or the shaded area under a big tree makes good stacking yards.

- Water connections should be provided in the stacking yard at convenient places for easy curing.
- The blocks should be stacked in rows and heaps, with a gap of 5 cm between each stack for ventilation. (Refer Fig. No.1.2)
- There should be a gap of 1 m after every 20-25 rows for easy lifting of the blocks.
- Each stack of block should contain six numbers of blocks placed one above the other.
- Blocks should be stacked in so that the edges of every individual block remain intact.
- The casting date number plate should be kept on the stack for ensuring the curing days of the blocks.

Flow chart of Block Manufacturing



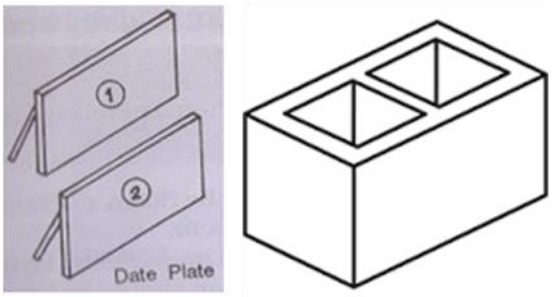


Fig.4.3: Block mould

Fig.4.4: Curing pipes

Fig.4.5: Block pallet

Fig.4.6: Block casting machine

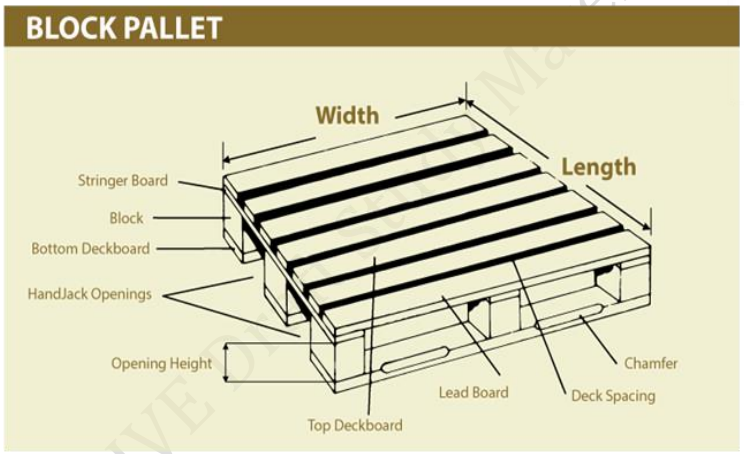


Fig.4.7: Machinery Used for Precast Concrete Block making

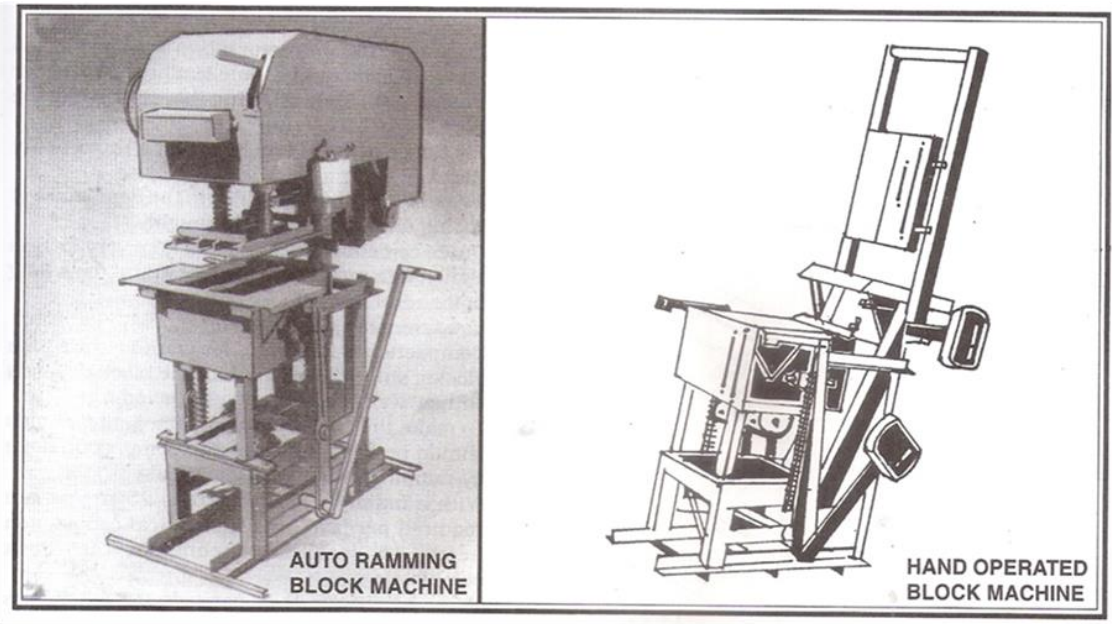


Fig.4.8: Block making machine

4.5 Curing of the Blocks

Curing is the most important activity for the production of blocks. All efforts to produce quality blocks will be useless if curing is not done properly. (Refer Fig. No.1.10)

The following steps should be observed during the curing of the blocks.

- Cure the individual stack.
- Ensure that the lowermost block in the stack has soaked water.
- Generally, to finish the work quickly, the curing man waters only the top layer of the stack and the remaining layers remain uncured.
- Curing of the blocks should start immediately after stacking and it should continue for at least fifteen days after the casting date.
- Curing with a water pipe is essential for every block at least four times a day.
- In addition to pipe curing, sprinkler curing is also advisable.
- Due to sprinkler curing the blocks remain moist all the time, resulting in an increase in the ultimate strength
- Number plates indicating casting date should be strictly displayed every day on the stack for easy supervision of curing.

Above machines are commonly used in the market. Hand operated Machine with or without vibrator and other type is electrically operated machine with vibrator attachment.

4. 6 Precast cement concrete blocks construction

Precast cement concrete block are prepared by adopting certain procedure/ steps for manufacturing of blocks.

A. Manufacturing of concrete block

1. Mould: Moulds should be fabricated using mild steel plates and mild steel angles for (Fig.1.8) stiffening the plates. The mould should be either fixed type or (box with four side walls fixed at corners and top and bottom open) or split type.

Split type may be either individual or gang mould. Where the compaction of the concrete is done manually, the mould may be either fixed type or split type. When the composition of the compaction of the blocks is done with surface vibrator, the mould shall be only split type (individual or gang mould).

Demoulding shall be done 5 to 10 minutes after compaction. In case of fixed type mould it shall be pulled up with one side handles while pressing down the blocks with the place at top with thumb. In case of split mould, the sides shall be removed first and the partition plates (gang mould) shall be pulled up subsequently.

After demoulding, the blocks shall be protected until they are sufficiently hardened to permit handling without damaging.

Fig.4.9: Different steps in moulding of Concrete block

1. **Proportion:** The normal proportion of the mix shall be as specified. To attain maximum strength, the water-cement ratio and workability of the mix should be controlled and proper compaction of concrete in the mould should be ensured. 1(Cement): 5(Fine aggregate): 10 (Coarse aggregate) should be used as ideal mixture for concrete block making.

Fig.4.10: Concrete Block Mould

3. Casting: After mixing, the concrete shall be placed in the moulds immediately, being carried in metal gamelas other suitable vessels or by a chute.

The concrete should be mixed in a concrete mixer and the water-cement ratio should be the smallest should be preferably by the use of a small immersion vibrator or table vibrator.

4. Curing: The blocks hardened shall then be cured in a curing water tank or in a curing yard and shall be kept continuously moist for at least 14 days.

5. Drying: After curing, the blocks shall be dried for a period of two to four weeks depending upon weather before being used on the work. The blocks shall be allowed to complete their initial shrinkage before they are laid in a wall.

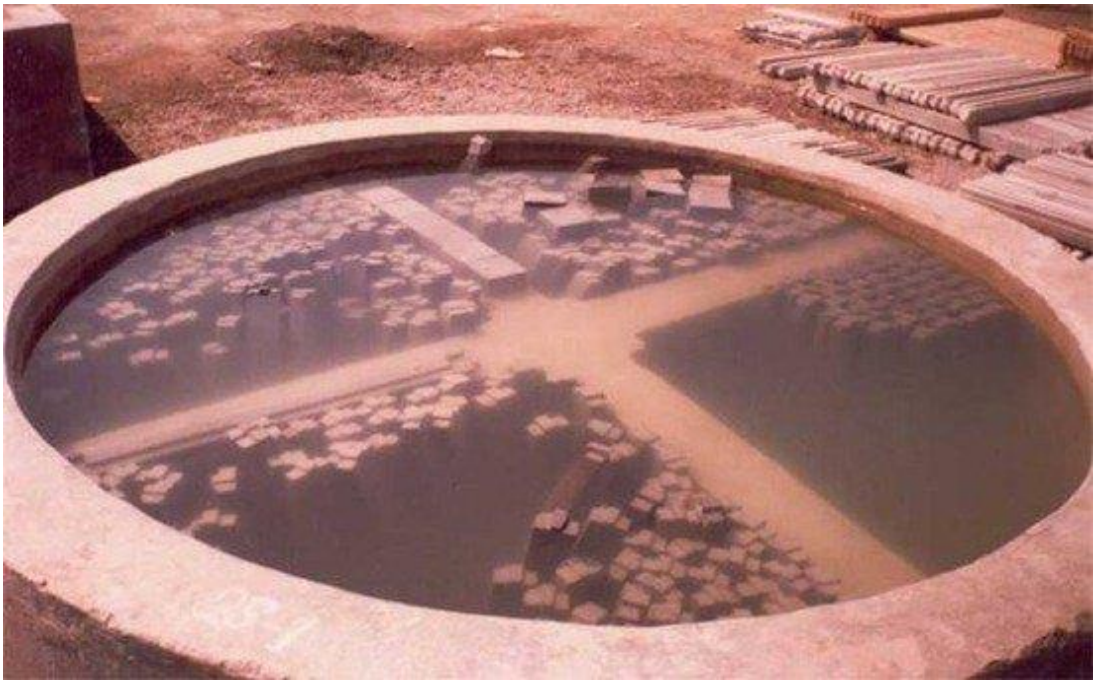


Fig.4.13: Curing Tank For Concrete Block

6. Dimensions: Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. Concrete block hollow (open or closed) or solid should be referred to by its nominal dimensions.The nominal dimensions of concrete block shall be, as follows:

Length: 400,500 or 600 mm
Height: 200 or 100mm
Width: 50, 75, 100, 200, 250 or 300mm
in addition, block shall be manufactured in half lengths of 200, 250 or 300mm to correspond to the full lengths.

7. Tolerances: The maximum variation in the length of the units shall not be more than +5mm and maximum variation in height and width of unit, not more than +3mm.

8. Density: The hollow blocks shall be provided cavities in such a way so as to ensure the maximum block density of 1600 kg/m^3. The block density is the density calculated by dividing the mass of a block by the overall volume including holes or cavities.

B. Laying of Precast Concrete Blocks to construct a Wall

Construction of masonry

For single storied buildings, the hollows of blocks in foundation and basement masonry should be filled up with sand and only the top foundation course shall be of solid blocks. But for two or more storied buildings, solid concrete blocks should be used in foundation courses, plinth, and basement walls, unless otherwise indicated. If hollow blocks are used, their hollows shall be filled up with cement concrete 1:3:6 using 12.5 mm nominal size aggregates.

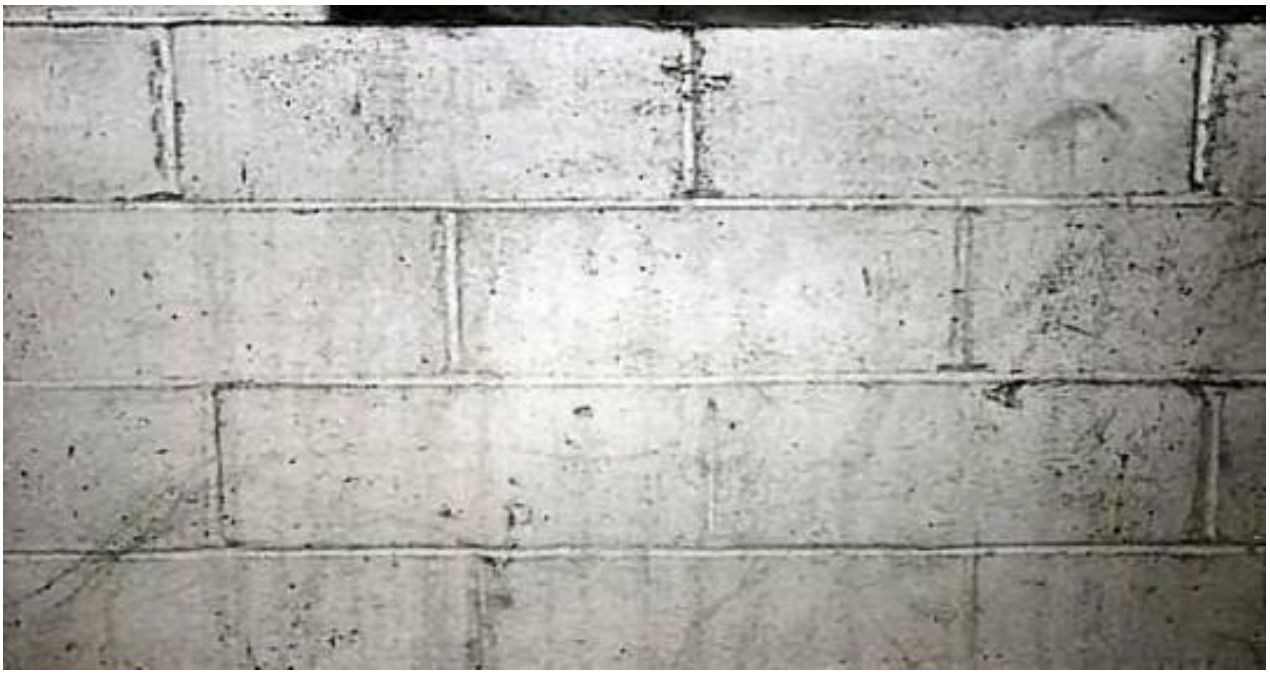


Fig.5.14: Concrete Block Wall

1. Wetting of Blocks: Blocks need not be wetted before or during laying in the walls. In case the climate conditions so require, the top and the sides of blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with mortar.

2. Laying: Blocks shall be laid in mortar, as indicated and thoroughly bedded in mortar, spread over the entire top surface of the previous course of blocks to a uniform layer of joint not less than 10 mm and not more than 12mm in thickness.

All courses should be laid truly horizontal and vertical joints made truly vertical. Blocks should break joints with those above and below for not less than quarter of their length. Precast half-length closer and not cut from full size blocks should be used. For battered face, bedding should be at right angle to the face unless otherwise directed. Care must be taken during construction to see that edges of block are not damaged.

3. Provision for Door and Window Frames: -A course of solid concrete block masonry should be provided under door and window openings (or a 10 cm thick precast concrete sill block under windows). The solid should extends for at least 20 cm beyond the opening one either side. For jambs very, large doors and windows either solid unit are used, or the hollows should be filled in with concrete of mix 1:3:6 using 12.5 mm nominal size aggregates.

4. Intersecting Walls: When two walls meet or intersect and the course are to be laid up at the same time, a true masonry bond between at least 50% of the units at the intersecting is necessary. When such intersecting walls are laid up separately, pockets with 20mm maximum vertical spacing should be left in the first wall laid. The corresponding course of the second wall should be built into these pockets.

Fig.5.15: Concrete block wall in house construction

5. Provisions for roof: The course immediately below the roof slab should be built with solid blocks. The top of the roof course should be finished smooth with a layer of cement and coarse sand mortar 1:3,10 mm thick and covered with a thick coat of white wash or crude oil, to insure free movement of slab.

6. Piers: The top course of block in the pier shall be built in solid blocks. Hollow concrete block should not be used for isolated piers, unless their hollows are specified to be filled with a cement concrete.

Fixtures, fitting etc. should be built into the masonry in cement and coarse sand mortar 1:3, while laying the blocks where possible. Holdfast should build into the joints of the masonry during laying.

Holes, chases, sleeves, openings etc. of the required size and shape should be formed in the masonry with special blocks while laying for fixing pipes, service lines, passage of water etc. After service lines, pipes etc. are fixed, voids left, if any shall be filled up with cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 stone aggregate 2 mm nominal size) and neatly finished.

7. Finishes: Rendering should not be done to the walls when walls are wet. Joints for plastering or pointing as specified will be raked to a depth of 12 mm. Joints on internal faces, unless otherwise indicated, will be raked for plastering. If the internal faces of masonry are not to be plastered, the joints should be finished flush as the work proceeds or pointed flush where so indicated.

Precautions during precast concrete construction:

DOs

1. For quality control, three blocks out of every 1000 no's may be tested for compressive strength
2. Through stones should be provided at regular intervals of 1.5-meter height.
3. Natural bed of stone should be always perpendicular to the loading.
4. Mortar should be used/consumed within 30 minutes of adding water to the mortar mix

DONTs

1. Find sand should not be used for block production.
2. Wetting of blocks is not necessary, they should be laid dry. Only in hot weather, the blocks should be wetted on the surface to reduce their suction of moisture from the mortar.
3. Rounded stone should not be used for masonry.
4. Don't make holes in the masonry for scaffolding. Only double scaffolding should be used.
5. Bonding of the wall should not be filled with small stone pieces

PRACTICAL ACTIVITY

1. Visit to the precast concrete block construction site and submit the report.
2. Construct a Precast Concrete Filler Block Masonry

Wall size – 3.05m high, 3.05 metre long (10'x12')

Wall thickness 20 cm

Size of block – 29 x 14 x 20 cm

Lean concrete mix 1:5:8 cement : sand : aggregate

Material			**Labour**		
Description	**Unit**	**Quantity**	**Description**	**Unit**	**Quantity**
Cement	Bags	5.5	Skilled mason	Man days	1
Coarse Sand	cu.m	1	Labour	Man days	6
Aggregate 20mm	cu.m	1			
Aggregate 40mm	cu.m	0.6			
Stone spalls	cu.m	0.5			

CHECK YOUR PROGRESS

I. Fill in the blank

1. ___ is a construction product produced by casting concrete in a mould or form.
2. Cement mortar used in construction of Concrete block wall construction is of ___ratio.
3. The top course of block in the pier shall be built in _____ blocks.
4. The concrete block is cured for ____ days.
5. Moulds shall be fabricated using mild steel _____ and _____ for stiffening the plates.

II. Write the answer

1. Explain the manufacturing process of precast Concrete block.
2. Derive with sketch tools used in precast concrete block construction.
3. Give the advantages and disadvantages of Precast concrete block.
4. Draw a neat sketch of concrete block mould.

5. Mention the dimensions for precast Concrete block.
6. Write down the procedure of laying concrete blocks in construction of wall.
7. Why precast concrete blocks are used nowadays in construction?

Module 5	WATERPROOFING WORKS FOR STRUCTURES USING CEMENTITIOUS MATERIALS

Module Overview

This module covers essential knowledge and practical techniques related to waterproofing in construction. It begins with an introduction to the importance of waterproofing and details the various materials, chemicals, and tools involved in the process. The module also includes step-by-step procedures for checking water leakage, carrying out brick bat coba treatment, and protecting treated surfaces according to site conditions.

Learning Outcomes

After completing this module, you will be able to:

1. Understand the importance and application of waterproofing in buildings.
2. Identify the materials, chemicals, and compounds used for waterproofing.
3. List the tools and equipment required for waterproofing works.
4. Explain different methods and types of waterproofing.
5. State the mix proportions used for waterproof cement mortar.
6. Describe the procedure for detecting water leakage in waterproofed surfaces.
7. Explain the process of brick bat coba waterproofing.
8. Discuss methods and techniques used to protect waterproofed surfaces from damage.

Module Structure

5.1 Waterproofing work in building

5.2 Materials required for water proofing
5.3 Water proofing Materials / Chemicals / Compounds:
5.4 Water proofing Compounds:
5.5 Tools and equipment used for waterproofing works
5.6 Methods of Waterproofing
5.7 Different material used for waterproofing and various ratios of mix proportion used for cement mortar mix for waterproofing works
5.8 Different type of waterproofing works
5.9 Procedure for checking water leakage in waterproofed surface
5.10 Procedure for carrying out brick bat Coba waterproofing
5.11 Various methods and techniques used to protect waterproofing of the surface from damage as per the site requirements.

5.1 Waterproofing work in building

A Building water-proofing is a process which is designed to prevent water from penetrating a building. Waterproofing maintains the appearance of the building and increases the life of the structure. For better water proofing work, the selection of quality material and workmanship is important.

Usually extensive waterproofing measures are added to a building at the time of construction to provide moisture control from the start. Waterproofing may also be done after a building is built to address problems as they emerge or as part of a building retrofit. Water-proofing maintains the appearance of the building and increases the life of the structure.

Water proofing is done in various parts of the building which includes:

1. WC
2. Bathrooms
3. Terrace
4. Roofs and Chejjas

5. Basement. swimming pools. underground ducts.
6. Under ground and overhead water tanks.

5.2 Materials required for water proofing

- Cement
- Sand
- Metal
- Brick bats
- Water proofing powder / chemical
- Geru / Red colour
- Shahabad tiles
- G. I. Sockets

1) Water Closet (W.C.) Water proofing

A. Following pre–work should be completed before starting water proofing work:

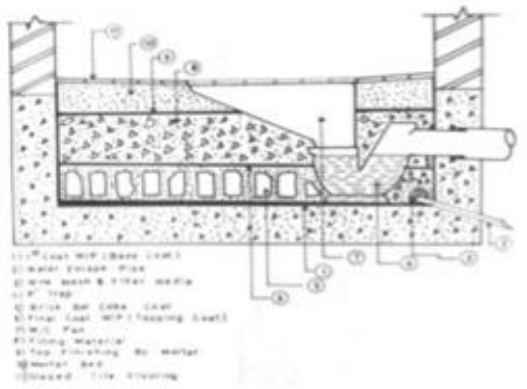
1) Completion of internal plaster of walls, leaving a margin of 18'' from the final floor level of W.C. unit.
2) Completion of grooving for concealed G. I. piping / electrical conduit piping in W.C. is done.
3) Completion of all concealed G.I. and electrical work in W.C.
4) Removing of all debris from W.C. and chiseling the extra mortar, to expose rare slab completely.
5) Completion of making holes in external walls for connecting nahani trap, P-trap, floor trap etc. to external drainage line.
6) Thorough cleaning of W.C. with sufficient quantity of water.
7) Level marking in red colour on walls, with respect to floor level to set up trap level.

B) Base Coat for W.C. Water Proofing:

1. After stopping the leakage of the base slab, provide 25 mm to 40 mm thick cement mortar base coat in proportion of (1:4) with a slope of 1 : 100 from entrance door towards the water escape pipe (drain pipe).
2. Carry out this base coat on all walls, up to a height of 45 cm above toilet finished floor level.
3. Keep this base coat full with water up to the slab drop top, for min. 4 days for curing and testing purpose.
4. After 4 days, get it checked and certified.

C) Topping Coat for W.C. water Proofing:

- After curing of the brick bat coat, complete the topping coat with 1:4 cement mortar mixed with water proofing compound, Finish this coat properly with neat cement slurry by metal float



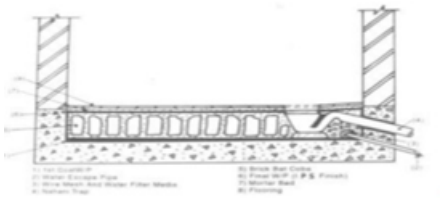
- Roughen the surface with a wire brush, for bonding of the horizon filler coat on the side walls, up to 45 cms above WC floor level. This coat should not project out beyond the plastering coat of the WC walls, so as to avoid unnecessary thickness of the glazed tile dado.
- Cure this final coat for a minimum of 7 days, With water up to minimum 7.5 cm depth.

Important components of Topping Coat for W.C. water Proofing:

1. 1st Coat W/P (tipani)
2. Water Escape Pipe
3. Wire Mesh and Filter media
4. 'P' trap
5. Brick Bat Coba Coat
6. Final coat W/P (Topping coat)
7. W/C Pan
8. Filling material
9. Top Finishing by Mortar
10. Mortar Bed
11. Glazed Tile Flooring

2) Bathroom Water Proofing:

A) Preparation of Bathroom water-proofing



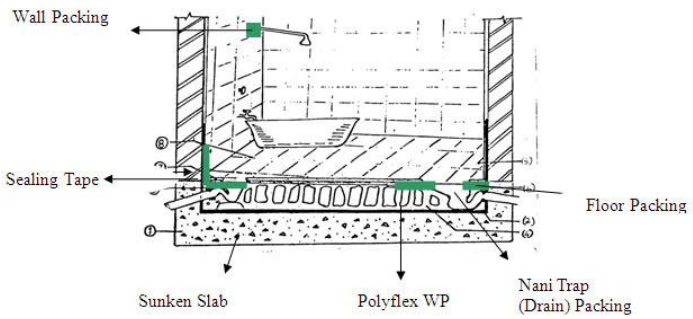
- After completion of the internal plastering of wall, keep a margin of 450 mm from the final floor level of the bathroom. Roughening of the plaster should be done with a wire brush for fixing the glazed tiles cladding dado.
- Complete grooving, chiseling for concealed G.I and electrical conduit piping in bathroom.
- Remove all debris from the bathroom after chiseling the extra mortar, if any, to expose the expose the slab completely
- Make the holes in the external walls for connecting nahini trap to external drainage line and water leakage drain pipe.

- Clean the bathroom thoroughly with water.
- Mark the level in red on the walls, with respect to the floor level, to set up the trap level.

B) Base coat for Bathroom Water Proofing:

1) After stopping any leakages in the base slab, provide 15 to 25 mm thick cement mortar base coat in proportion of (1: 4) with a slope of 25 mm. in 3 m from entrance door towards nahani trap.
2) This base coat should cover all the walls around, up to the outer face wall line at the entrance door and the bottom portion of the nahani trap connection hole made in the wall.
3) Flood this base coat with water, up to the slab drop, for min. 4 days for curing and testing.
4) Fix the nahani trap and water escape pipe / leakage drain pipe over the base coat.

Also lay all the concealed pipes such as G.I. outlet pipe for wash basin etc.



5.3 Water proofing Materials / Chemicals / Compounds

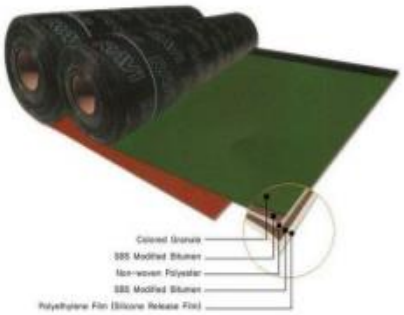
Water Proofing Chemicals

Bitumen: Mixed with a filler component such as limestone or sand. Polymers are added to the bitumen such as APP (tactic polypropylene) a plastic additive that gives rigidity and tear resistance, or SBS (styrene butadiene styrene) a rubber additive that gives more elastic benefits.

Base Products: Polyester, fibre glass, rag fiber (hessian) and paper. These products are bought in roll format and are pulled through the bitumen mixes on huge rollers. The base product becomes saturated in huge tanks by the tar like bitumen substance. creating rolls of waterproof material.

Water proofing Membranes

- Waterproofing membrane systems include both negative and positive side waterproofing.
- Positive side waterproofing systems are applied to the face of the element that is directly exposed to moisture, the exterior face.



- Negative side waterproofing systems are applied to the surface of the element opposite the surface exposed to moisture.
- Positive systems are available in numerous materials and forms. Negative systems are limited to cementitious systems.

Water Based Exterior Wall Emulsion Paint Series

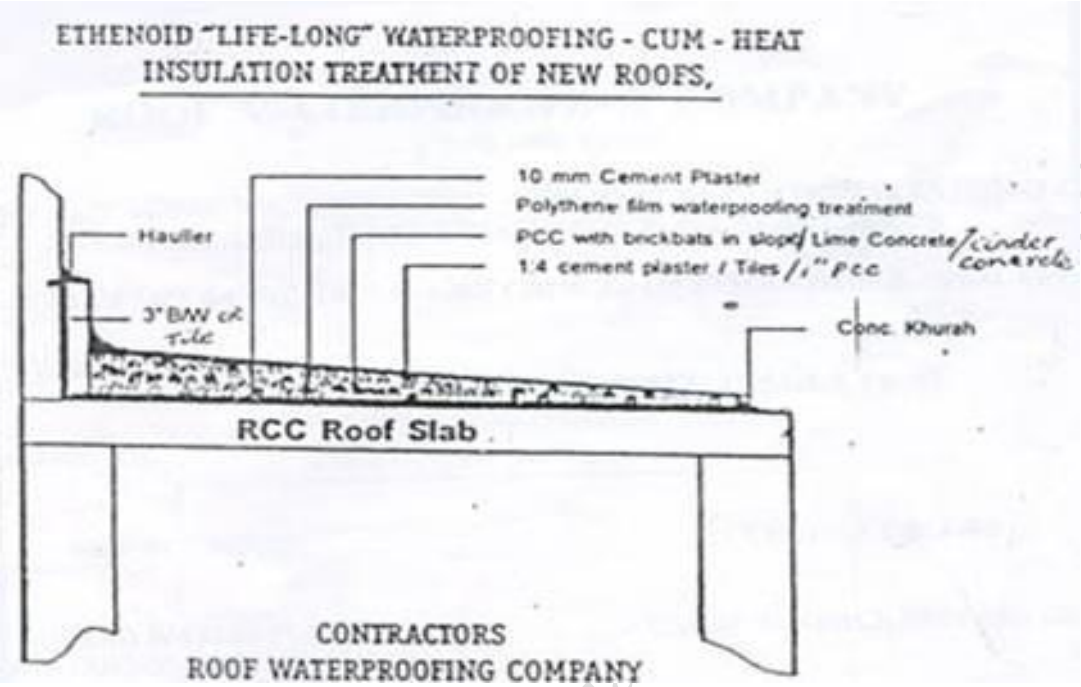
Where to use:
For new or old exterior surface of brickwork, plaster, and concrete, etc.

Features:
1. Dust Proof;
2. Alkali & fungus resistant;
3. Weathering resistant;
4. Strong adhesion;
5. Long service life.

Products Model:
VB1200 - Project Use Exterior Wall Emulsion Paint
1900 - Superfine Exterior Wall Emulsion Paint
2900 - Superfine Exterior Wall Emulsion Paint
5900 - Superfine Exterior Wall Emulsion Paint
VH1001 - High Glossy Exterior Wall Emulsion Paint
V0000A - Elastic Exterior Wall Paint

5.4 Water proofing Compounds

5) Water proofing to R.C.C. Roof Slab:



Sequence of work carried out for R.C.C. Slab Water proofing (Sloping Terrace / Chajja) :

1) Clean the surface of the sloping terrace / Chajja.
2) Apply a thick cement slurry over the surface of the slab.
3) Apply 1 : 1½ : 3 metal screen coat.
4) Cure this coat for at least seven days, by putting wet gunny bags on it.
5) Over this coat, apply a finishing coat with cement sand mortar (1:4) and water proofing compound as per the design.
6) Finally, apply the cement slurry with water proofing compound. Add colour pigments such as red, green etc.
7) Make an edge between the parapet wall and sloping slab on the second day.
8) Cure this water proofing for fifteen days, with wet gunny bags spread over it.

Standard practices for waterproofing works

Waterproofing is the process of making an object or structure waterproof or water-resistant so that it remains relatively unaffected by water or resisting the ingress of water under specified conditions.

Bitumen Mastic—This shall conform to IS: 3037-1965*

*Specification for bitumen mastic for use in waterproofing of roofs.

Bonding Material—These shall consist of blown type bitumen conforming to IS: 702-1961* or residual bitumen conforming to IS: 73-1961† or a mixture thereof, selected to withstand local conditions of prevailing temperature and gradient of roof surface. The penetration of blown type bitumen shall be limited to 45 when tested in accordance with IS: 1203-1958‡.

Reinforcement—Bitumen coated plain expanded metal lathing used for laying bitumen mastic to vertical or sloping surfaces.

Underlay or Isolating Membrane—A layer of bitumen felt conforming to IS: 1322-1965

Vapour Barrier: The vapour barrier should consist of hessian-based type 3 felt conforming to IS: 1322-1965§ with minimum overlaps of 100 and 75 mm at the end and the sides of strips of felt. This is used, where necessary, as an isolating layer between the roof deck and the insulating materials to protect the insulation against the absorption and the effects of moisture from below.

Drawings /sketches relevant to waterproofing works

5.5 Tools and equipment used for waterproofing works

- Brooms
- Brushes
- Buckets
- Caulking guns
- Chisels including cold chisels
- Cutting blades

- Dumpy, laser and water levels
- Electric drills and screwdrivers
- Electric hammers
- Extension leads
- Fusion rollers
- Gas burners and torches
- Hammers
- Hoses
- Measuring tapes and rules
- Mixers and mixing apparatus
- Moisture meters
- Nylon rollers
- Plant, including:
  - High pressure water equipment
  - Excavating equipment
  - Pumps
  - Heat welders
  - Hot air welders
  - Impact drills
  - Pressure injection equipment
  - Compressors
  - Cartridge applications
  - Vacuum pumps
- Pressure rollers
- Scissors
- Seam probes
- Solvent applicators
- Spirit levels
- Straight edges
- Trowels
- Vacuum cleaners
- Wood floats.

Basic levelling tools used in masonry works.

Next to the trowel, the level is the second most important tool to have during construction work. A good level is lightweight and absolutely straight. The better levels are called spirit levels. The purpose of the level is to keep the work you are doing plumb (even up and down, or vertically) and even straight across, or horizontally. The following are the important tools used for the leveling:

Spirit Level : A good level usually has 6 vials, two in the center, two at each end. The bubble must line up between the two red or black lines in order to be straight or level. If you lay more than one block at a time, you might want to get a level that is at least 36" long.

Fig : Spirit Level

Plumb Bob- A **plumb bob**, or **plummet**, 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**. It is essentially the vertical equivalent of a "water level".

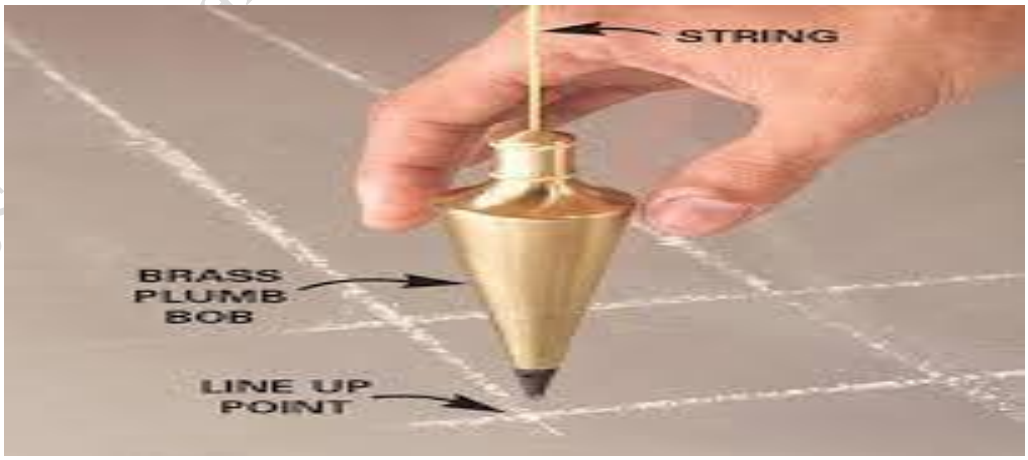


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Figure 4.2.2: Plumb Bob

Water Level-A **water level** is a device used for matching elevations of locations that are too far apart for a spirit level to span. The simplest water level is a section of clear tubing, partially filled with water.

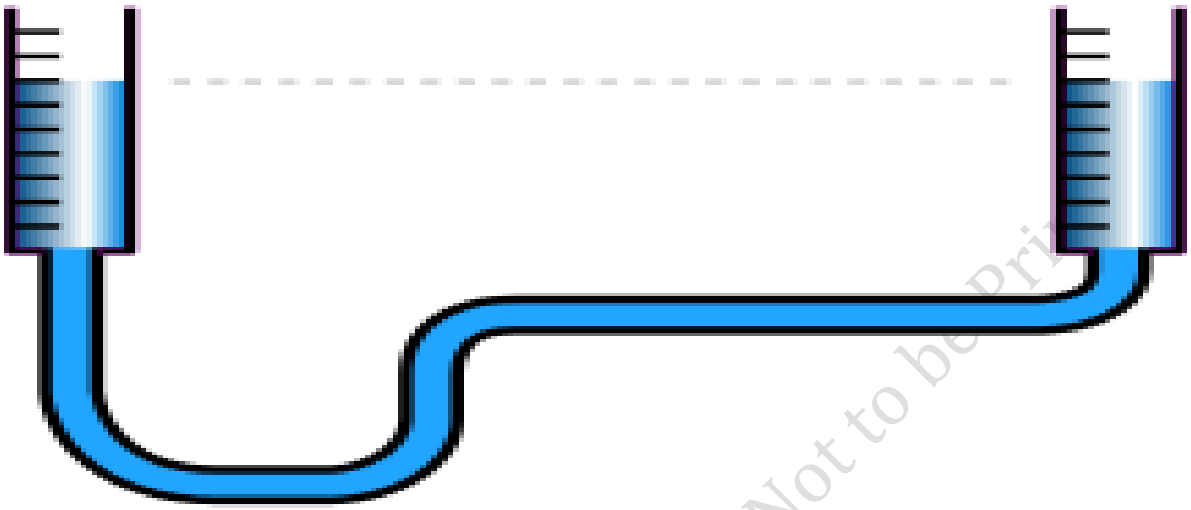

Figure 4.4.3: Water Level

Mason Line: A mason's line will let you build walls without bulges or hollows. A mason's line is placed very close to the block you are laying, but with enough room to still permit you to swipe off the excess mortar without disturbing the line.

Figure 4.4.4: Mason Line

5.6 Methods of Waterproofing

1. 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. It offers more flexibility than the cementitious types of waterproofing. The liquid cures into a rubbery coating on the wall. The elongation properties of the coating can reach as high as 280%. The durability of the waterproofing coating depends on what type of polymer the manufacturer uses for the making of the liquid waterproofing.

Liquid waterproofing membrane can be of spray-applied liquid membrane composed of polymer-modified asphalt. Polyurethane liquid membranes in separate grades for trowel, roller, or spray are also available from various manufacturers.

2. Bituminous Coating Waterproofing Method:

Bituminous coating is a type of coating used for waterproofing and flexible protective coat in accordance with its formulation and polymerization grade. Its flexibility and protection against water can be influenced by the polymer grade as well as reinforcement of fiber.

Bituminous coating is also called as asphalt coating. The most common applications of bituminous coatings include areas that are beneath screed wet. 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 expose to

Fig.5.1: Bituminous Coating

sunlight. It becomes very brittle and fragile when long exposure to the sunlight unless it is modified with more flexible material such as polyurethane or acrylic based polymers. The flexibility of the finished products always depends on the solid content of the polymer added to the bitumen.

3. Bituminous Membrane Waterproofing Method:

Bituminous membrane waterproofing is a popular method used for low-sloped roofs due to their proven performance. Bituminous waterproofing membrane have torch on membrane and self-adhesive membrane.

Self-adhesive compounds comprise asphalt, polymers and filler; additionally, certain resins and oils may be added to improve adhesion characteristics. The self-adhesive type has low shelf life as bonding properties of the membrane reduces with time.

Torch on membrane have exposed and covered types. Exposed membrane often has mineral granular aggregate to withstand the wear and tear of the weathering and the other types of membrane, contractor need to apply one protective screed to prevent the puncture of the membrane.

Fig. 5.2 Bituminous Membrane Laying

5.4 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.

Fig 5. 3 Polyurethane Liquid Membrane

Polyurethane Liquid Membrane can offer higher flexibility. Polyurethane is very sensitive to moisture content present, therefore before application, one has to be very careful evaluating the moisture content of the concrete slab, otherwise peeling or de-bonding of membranes may happen after some time.

5.7 Different material used for waterproofing and various ratios of mix proportion used for cement mortar mix for waterproofing works.

Many construction materials are not highly resistant to moisture. Therefore, a very important aspect of any construction process is to ensure the protection of materials. Modern market of construction materials is represented by a various type of waterproofing materials that are designed to effectively protect the foundation, roof, walls and floor structures from the damaging effect of groundwater moisture or precipitation.

- **Rigid waterproofing**

This type comprises waterproof dense concrete, shotcrete, metal waterproofing and sand-cement plaster waterproofing, which is made by hand or by using compressed air. Stiff sheet waterproofing is made of polymeric or metal sheets. They are fastened to the building envelope by means of anchors, screws, glue, pins or by welding.

- **Paintable waterproofing**

That is a waterproof film which is formed by coating the surface with liquid or plastic materials, such as bitumen, mastic or special paint and varnish, which have corresponding properties, i.e. resistance to moisture.
Modern waterproofing paints or varnishes have synthetic resins and plastics, which also create excellent protection against moisture.

Fig 5. 3 Paint waterproofing on roof

- **Lining waterproofing**

This type of waterproofing combines two different types: paintable protection and lining waterproofing itself, therefore it has greater efficiency and perfectly protects brick, concrete, metal and other surfaces. Lining waterproofing involves coating the surface with roll or sheet materials. The best type of such coating is roofing felt. It is also possible to use extruded polystyrene, which is glued to the bitumen mastic of hot or cold application method.

- **Waterproofing with wall putty**

This waterproofing consists of different liquid compositions of mastics and mortars (mud) to create continuous seamless waterproofing layers. This is durable waterproofing often used in construction and trimming, as it is resistant to physical, mechanical and chemical influences. It is also sufficiently elastic and does not crack under the influence of weather conditions or differential house settlement.

- **Plaster waterproofing**

Depending on the materials used plaster waterproofing can be divided into three subspecies.

1. Cement plaster, which is applied to the surface in a layer of 5 to 40 mm.
2. Asphalt plaster, which is applied in several layers, each one 4 mm thick. The coating represents protection made of hot or cold mastics.
3. Molded asphalt waterproofing. It is a solution of hot mastic which is poured into the cavity between the protective wall and the insulated surface.

Penetrating Waterproofing

This kind of waterproofing provides good water resistance of concrete structures. It can be applied at the beginning of the building process and in the final stage. Compositions deeply penetrate into the surface with a porous structure.

Also, this waterproofing has the properties of prevention corrosive processes in the reinforcing structures. Also penetrating protection compositions can withstand chemical attack and significantly increase resistance of the surface.

Fig 5. 3 Penetrating waterproofing

Process of performing various visual checks on materials and surface for waterproofing.

1) Materials used should be of standard specification and manufacturing qualities.
2) Materials to be used on various surfaces should match the properties of waterproofing materials.
3) Surface to be cleaned with water and debris stuck on surface should be cleaned properly.
4) Proper tools are used for the application of waterproofing materials on different surfaces.

Different type of defects presents on concrete surfaces such as caulking etc.
Concrete Defects:

1) Freeze-Thaw Effect

Concrete is very strong in compression but relatively weak in tension. It can and often does crack. Concrete is also fairly porous and subject to forces that absorb and release water. Absorbed water can freeze within the concrete and cause spalling and cracking.

Fig 5. 4 Freeze thaw effect

2) Chemical Attack: Chemical attack can occur because concrete is alkaline and chemically reactive. It can be attacked by acids; some alkalis; numerous salt solutions; and organics such as fermenting liquids, sugars, and animal oils, especially if they contain free acids. Seawater will attack concrete. Corrosive solutions penetrating to the steel reinforcing rods may be particularly destructive because the large displacement of the corrosion products of the steel can cause cracking and spalling of the concrete. In addition to the general physical and chemical properties of concrete

that make it subject to physical and chemical attack, several other factors influence the makeup of concrete and therefore must be considered before selecting a method of surface preparation. How the concrete will be used (e.g., as structural concrete or for floors), the method used to place the concrete, and the additives that may be present either on the concrete surface or incorporated into it all will affect the strength and the surface condition of the concrete. A discussion of structural concrete, concrete for flooring, and the surface conditions that accompany each follows.

3) Crazing

This is a network of very small surface cracks usually spreading out over large areas or the entire surface. Crazing is caused by finishing the concrete with bleed water on top. The bleed water is forced down into the surface by the finisher's trowel. This increases the ratio of water to cement, creating a weak surface layer.

Fig 5. 5 Crazing

4) Scaling

Thin flakes of concrete come loose and flake or peel off the surface. The sizes of the flakes vary, but they usually increase over time and with traffic. Conditions that cause scaling and include freeze/thaw cycles, deicing agents with calcium or sodium chloride, fertilizers containing nitrates, working in bleed water, or improper curing. Any one of the can cause scaling, but it's usually a combination of two or more that lead to severe scaling.

Fig 5. 6 Scaling

5) Blisters

These are typically about ¼ to 1-inch diameter, but it's not impossible to get 3 to 4-inch blisters. They are not easily seen until they are broken by traffic. Blisters are caused by working and finishing the surface while water or air is still working its way up through the mix to the surface.

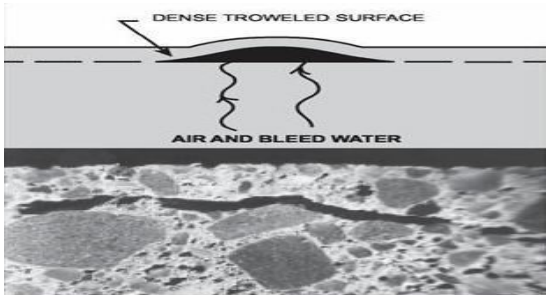

Fig 5.7 Blisters

6) Spalling

Spalling is similar to scaling except large chunks instead of just flakes break loose. This indicates a severe weakness in some parts or the entire project. It is more likely to happen during freeze thaw conditions.

Fig 5. 8 Spalling

7) Dusting

Also known as chalking, this is a fine loose powder caused by the deterioration of a weak surface. Causes of dusting include working in bleed water, improper curing, a bad sand-to-cement ratio, or exposure to carbon monoxide caused by using an unvented heat source to keep a project warm.

Fig 5.10 Dusting

8) Foreign Objects

Foreign objects can often slip into the form prior to pouring and may not become evident until after the forms are stripped. If fully embedded, the foreign object does not create a coating problem. But a piece of rope on the surface disappearing into the concrete is a problem. It must be removed, usually by chipping, and the concrete must be restored.

9) Efflorescence:

Efflorescence is more likely to be found on concrete that has been in place for a while. Concrete contains water-soluble salts. As water from the interior of the concrete migrates to the surface and evaporates, salts are deposited on the surface, usually as a white stain. Efflorescence can occur with concrete, brick, or concrete block construction. It can be removed with acid etching. The best way to prevent its recurrence is with adequate waterproofing.

Fig 5. 11 Efflorescence

Different surface preparation method prior to waterproofing such as Prime coating:

A prime coat is an application of a low viscosity asphalt to a granular base in preparation for an initial layer (or surface course layer) of asphalt. The purpose of the prime coat is; to coat and bond loose material particles on the surface of the base, to harden or toughen the base surface to provide a work platform for construction equipment, to plug capillary voids in the base course surface to prevent migration of moisture, and to provide adhesion between the base course and succeeding asphalt course. After applying the prime coat, it must cure for a minimum of 48-72 hours before asphalt is placed, with no rain in the forecast.

At one time it was thought that a prime coat was an essential element of good pavement construction. However, in recent years many engineers have eliminated the use of a prime coat in their specifications, especially when asphalt layer(s), is 4 inches or more in thickness. In many instances, prime coats are not used even when surface thickness has been as thin as 2 inches. According to studies performed by The Asphalt Institute over the last 20 years, few if any, pavement failures can be attributed to the lack of a prime coat. We at Asphalt Enterprises, Inc. concur with the outcome of these studies.

Filling holes or depressions by cementitious material:

Cementitious materials are probably the easiest waterproofing materials to fill the holes or depressions. They're readily available from suppliers of masonry products, and they're easy to mix and apply. One can get better bonding and a more solid, durable coating.

Hacking of existing RCC surface:

Hacking means removing the surface/outer layer, whether it's paint, cement, tile, etc.

Procedure:

- The person supervising the hacking must make a detailed study of the structure to be hacked and implement a hacking plan that will ensured that the sequence of hacking does not posed risks and hazards to both operator and other workers.
- Brief all workers involved on the risks and hazards involved and the safety measures taken to address any potential hazards and/or danger that may arise, and provide standing supervision.
- Work area must be barricaded prior to start of operations and warning sign be displayed.
- Ensure that no person shall enter or work near hacking area.
- Direct sufficient water at breaking point to reduce dust, when necessary.
- Beside the basic PPE, workers are to wear protective gloves, ear plug, dust mask and safety goggles

Fig 5.12: Hacking Procedure

Chipping / Scraping of Protrusion:

Disclosed is an anti-chipping film capable of preventing chips which would otherwise occur during an operation for inserting an engagement protrusion of a resin member into a mounting hole of a metal sheet, from being generated and scattered into an inner space of a frame. The anti-chipping film is adapted to be attachable to a given metal sheet to cover a (rectangular-shaped or circular shaped) mounting hole which is formed in the metal sheet to mount a given resin member. The anti-chipping film comprises a slit (linear-shaped slit, radial-shaped slit or H-shaped slit) formed in a central region thereof to allow an engagement protrusion protrudingly formed on the resin member to penetrate there through, and an adhesive layer laminated on an outer peripheral region thereof.

Cleansing free of dust

The surface should be washed with plain water to remove loose dust. A heavy-duty wet-and-dry vacuum does a good job of getting water and dust off the surface. After the floor dries, apply a concrete surface treatment containing magnesium fluosilicate, zinc fluosilicate or sodium silicate. These preparations will form a chemical bond with the cement on the surface and stop the dusting. The treatment is usually applied in two or three coats, letting the surface dry between each application.

Priming or sealing of surface

Sealing is particularly important in concrete construction where construction joints are the order of the day. They occur when a structure is built of successive concrete sections. Construction joints in new buildings are sealed with suitable hydrophilic water bars, metal water stops or joint sealing strips.

For the post-construction sealing of damaged construction joints we normally opt for the injection technique. Here, boreholes are drilled following a set pattern whereby the drilling axis should cross the joint directly in its middle. The holes are then equipped with injection lances through which the grouting material is injected under pressure into the joint.

During the injection process, the injection channel is filled first followed by the joint and later the cracks and gaps in the area closest to the joint. The grout then forces its way into large pores and cavities and later on during the injection process penetrates the capillary pores. Injection continues until counter pressure has built up in the structure and grout discharge is evident in the area of the joint or from the neighboring injection lance.

Removing sharp edges

Step1

Clean the surface of the damaged area by removing any loose material such as dirt, oil, or grease and unsound or flaking concrete.

Tip: unsound or flaking concrete can be removed by using a hammer and chisel or with a masonry grinding disk and a portable drill.

Step2

Scrub and clean the surface of the repair area with a stiff bristle brush.

Step3

Thoroughly rinse the repair area after cleaning.

Following process is applied to repair concrete edges after removing sharp edges:

Step 4

Mix the Quick-Setting Cement using a margin trowel by adding 5 parts Cement to 1-part QUIKRETE Acrylic Fortifier until a lump-free, putty consistency is achieved. It is important not to add more water or Acrylic Fortifier after the material has begun to set.

TIP: if the mix is too wet, add additional Quick-Setting Cement and mix thoroughly; if the mix is too dry, add small amounts of Acrylic Fortifier sparingly.

Step5

Dampen the repair area with enough water to saturate the surface (any standing water should be removed).

Step6

Use a masonry brush to apply a thin coating of the Quick-Setting Cement and Acrylic Fortifier mixture.

Step7

Using a margin trowel, press the cement into the repair area using firm trowel pressure.

Step8

Continue to build and sculpt the Quick-Setting Cement so that the surface of the repair is above the surrounding concrete.

Step9

In about 5 to 10 minutes once the patch has become thumbprint hard, use the edge of a margin trowel to mold and shape the repair to match the contour of the surrounding concrete.

5.8 Different type of waterproofing works

Brick Bat coba waterproofing

Brick bet waterproofing helps seal cracks and water leakages, hides the untidy marks and also provides aesthetically appealing coverage using china mosaic tiles.

Following are a few steps for brick bet waterproofing:

- Firstly, it removes the debris and cleans the whole surface.
- Secondly, apply raddo of water, chemical and cement on the surface.
- Third, put the china mosaic tiles and fix them.

Fig. 5.13 Brick bat Coba

2. Poly Acrylic chemical coating waterproofing

This is one of the superior ranges of waterproofing solutions. First, the poly acrylic chemical solution is prepared which is used to seal the breakage or leakage on the wall

and terrace which will be a strong waterproof base as well as protect and preserve the strength of any structure. This is done by a highly trained professional team. You need to make sure that high-quality products are used for the procedure.
In this type of waterproofing you need to clean the place, **then close the cracks with** poly acrylic **chemical coating**. The final step is to put two coats of poly acrylic chemical with white cement on the surface.

Fig.5.14 Poly Acrylic chemical coating waterproofing

3. Pre -Monsoon roof repairing

Pre-monsoon roof repairing is ideal for buildings and structures that are already having leakage or damage as well as for new structures to avoid leakage in future. This process helps in maintaining the life and quality of the building and ensures that there is no damage to the building because of the rains. You can try this method once in a year.

Fig 5.15 Poly Acrylic chemical coating waterproofing

China Mosaic tile waterproofing

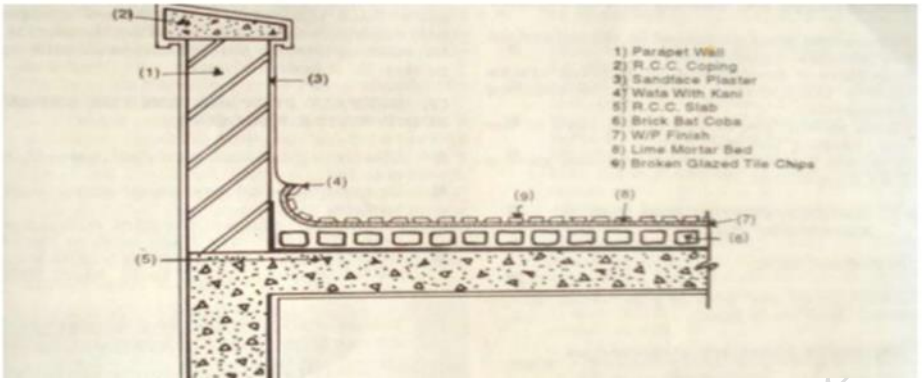

Fig. 5.16 Glazed China Mosaic Waterproofing

5.8 Different type of Waterproofing compounds used for waterproofing works

1. Wonder- Seal is an integral Waterproofing Compound for plaster and concrete. It makes the concrete dense and cohesive and can be used with all types of cement. It is free from any sulphates and chlorides. WONDER-SEAL Cement Water Proofing Compound is ideal for buildings, industrial constructions, reservoirs, sewers, swimming pools, cellars etc. These are the areas where impermeability is a must. Wonder-seal contains an active water-repellent admixture which fills the pores in cement concrete/mortar and also overcomes the capillary absorption of moisture to prevent the passage of water. Proper ramming / use of vibrator is strongly recommended for best results.

2. Crystal Sealer- A cement based waterproofing compound that chemically reacts with moist cement-based substrates. Crystal Sealer forms insoluble crystals in the capillary tracts of the substrate permanently waterproofing the surface yet still allowing the surface to breathe.

3. Dr. Fixit range of products for waterproofing and repairs for use in construction. Dr. Fixit range includes Waterproofing Compounds, Repair Products, Tile Fixing Products, Sealants & Putties, Concrete Admixtures, Flooring Products, Grouts.

Fig. 5.17 Waterproofing Compounds

Procedure for laying out Cementitious waterproofing course:

Cementitious waterproofing is the easiest method of waterproofing in construction. The materials for cementitious waterproofing are easily available from suppliers of masonry products, and they're easy to mix and apply.

This method is often used in the internal wet areas such as toilets. This method is usually a rigid or semi-flexible type waterproofing, but since it is used in internal areas such as toilets, it is not exposed to sunlight and weathering. Thus, cementitious waterproofing does not go through contract and expansion process.

Applications of Cementitious Waterproofing:

Cementitious waterproofing is used in the following type of structures:

- Water Treatment Plants
- Sewage Treatment Plants
- Bridges
- Dams
- Railway & Subway System
- Marine Cargo Ports & Docks
- River Locks/Channels & Concrete Dykes
- Parking Structures & Lots
- Tunnels

5.9 Procedure for checking water leakage in waterproofed surface

Testing of waterproofing:

- Waterproofing of slabs shall be tested by ponding the surface with water to a depth of 25 mm for 24 hours or longer.

- The waterproofing shall be considered satisfactory, if no leaks or damp patches show on the soffit.

- **IS: 2645: 2003:** Specification for Integral Waterproofing Compounds for cement mortar and concrete provides specifications for this waterproofing.

Procedure for carrying out horizontal and vertical alignment of waterproofed course

Surface Condition: The waterproofing membrane must be free of sharp projections, dirt, and dust. If water testing is desired, it should be made prior to placing protection course. Note: Protection Course should be applied at the end of each day's waterproofing to both horizontal and vertical surfaces.

Horizontal Surfaces: Protection course should be installed over the waterproofing membrane as soon as permissible by the membrane applicator or manufacturer. Protection Course sheets should be butted together and cut to fit all intersecting surfaces and protrusions.

Vertical Surfaces: For damp-proofed and/or waterproofed vertical walls to receive backfill, Protection Course should be butt jointed and, if necessary, temporarily held in place while backfilling.

Backfilling: Backfilling against vertical walls should be done immediately using care and caution to avoid damaging the waterproofing application. Backfill material should not be dropped against Protection Course in such a manner that it could drag the sheet down as the backfill drops. For horizontal applications, the waterproofing and Protection Course should be installed just prior to the installation of the wearing surface.

Precautions

Where protection course is adhered to a waterproofing membrane, use an approved adhesive. Where taped joints are desired with tape set in hot asphalt, consult membrane

manufacturer. Protection Course is shipped on pallets with the polyethylene anti-stick sheet on the top or exposed side. Protection Course should be stored on pallets and placed on a level surface.

Procedure for transferring levels on floor for maintaining desired slope.

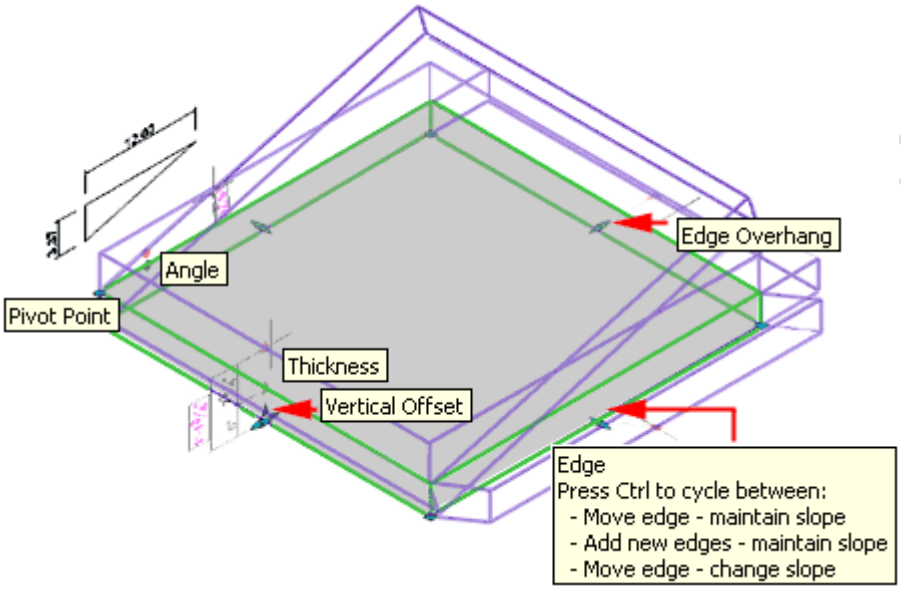

Fig. 5.18 Maintaining desired Slope

5.10 Procedure for carrying out brick bat Coba waterproofing

Waterproofing by brick bat Coba

Roof slabs constructed either by RC or RCC needs insulation for thermal comfort and waterproofing treatment to prevent leakage of water. Both these requirements are effectively full fill by brick bat coba treatment, the details of which are being below:
All existing treatment, coatings on roof slab top is to be removed and surface cleaned by hard wire brush and washed with water. The surface should be free from any oil, grease, dust etc. Remedial measured by provided to all structural cracks. Expansions joints should be treated as per standard practice.

All non-structural cracks more than 0.5 mm wide and construction joints if any, should be cut in "V" shape, cleaned with wire brush and washed, the cracks are then filled by polymer modified cement or mortar using acrylic polymer, with addition cement slurry mix is spread upon cleaned SSD roof surface. Over this 15 mm thick cement, sand mortar, 1:4 admixed, with water proofer is laid.

Brick bat laying

On the above green mortar, a layer of brick bats, soaked overnight in water, is laid, having an average thickness of about 110 mm, about 70 mm near rain water pipe and 150 mm at ridge. The gaps between the brick bats are generally kept between 15 and 20 mm. These gaps are filled with cement sand mortar, 1:4, admixed with water-proofer. In hot and dry weather, the surface should be covered with wet gunny bags immediately after finishing. Curing should start next day and continued for 7 days.

Finishing layer

The top surface is then finished smooth with 20 mm thick cement sand mortar, 1:4, admixed with a water-proofer. All liquid admixtures should be mixed with the mixing water. The surface when green is marked with 300 mm false squares. Curing is to be done by ponding.

5.11 Various methods and techniques used to protect waterproofing of the surface from damage as per the site requirements.

A) If roofs are home to building services and machinery that require periodic maintenance or cleaning, we recommend producing walkways using concrete pavers laid on supports, or a concrete screed, to give all operators a safe preferential access route to follow. Before installing walkways, a suitable separating layer must be placed between the membrane and the in-situ concrete deck.

B) When walking directly on the waterproofing membrane, special footwear must be worn, both for your own safety and to avoid damaging the membrane in question.

C) If you need to walk on the waterproofing membranes, we recommend you avoid the hottest part of the day in summer and, similarly, the coldest part of the day in winter. To avoid putting membranes under particularly high mechanical stress, we advise against using footwear with very thick soles (cleated sole footwear) and instead recommend the use of footwear with smooth soles. When using cleated sole footwear, we strongly advise you always to check that no fine gravel or other abrasive material has accidentally stuck to or become lodged in the sole before walking on the waterproofing membrane to avoid the risk of scraping or piercing the membrane in question.

D) If you are gaining access to a roof in driving rain or if the roof has pooling water or is icy, exercise extreme care to avoid the risk of slipping.

E) Never place anything heavy or sharp directly on the waterproofing membrane unless you have prepared a suitable protective surface first to set the object down on and distribute the load (such as wooden planks or other suitable devices)

CHECK YOUR KNOWLEDGE

I. Answer the following

1) What is meant by waterproofing?
2) What are the different types of waterproofing?
3) Give the cement mortar mix proportions used for waterproofing works.
4) Enlist the surface preparation methods prior to waterproofing works.
5) How cementitious waterproofing course is laid?
6) Explain the method of brick bat coba waterproofing for RCC terrace roof.
7) Name any 3 types of waterproofing compounds used in waterproofing works.

II. Fill in the blanks

1. The thickness of mortar joint spacing in brick bat coba is ___ mm.
2. ___ tool is used to apply waterproof chemicals on surface.
3. Which can be used for waterproofing _____.

III. Multiple choice questions

1. After stopping the leakage of the base slab, provide .....mm to .....mm thick cement mortar base coat in proportion of (1:4)

   a) 25 to 40 b) 25 to 50 c) 30 to 40 d) 40 to 25

2. Tools required for water proofing work are.....
   a) Trowel b) Wooden float c) Plumb bob d) All of these

3. Bituminous membrane waterproofing is a popular method used for .....roofs.
   a) low-sloped b) High-sloped c) Medium-sloped d) None of these

4. Chemical attack can occur because concrete is.....
   a) alkaline b) acidic c) Hydrant d) Less reactive

GLOSSARY

Abutment: a structure built to support the lateral pressure of an arch or span.

Ashlar: masonry made of large square-cut stones, used as a facing on walls of brick or stone rubble. Break water: refers to a wall built out into the sea to protect the shoreor harbour from the force of waves.

Brick bat: refers to the broken pieces of bricks. Brick bats: is defined as the cut portion of a brick Bridge piers: refers to structures used for supporting a bridge, embedded into the ground surface or into water under the bridge.

Ballast: is a material that is used to provide stability to a structure.

Bed: is the mortar upon which a brick is laid.

Cleated: a strip of wood or iron used to strengthen or support the surface to which itis attached.

Gneiss: is a metamorphic rock with a banded or foliated structure, typically coarse-grained and consisting mainly of feldspar, quartz, and mica.

Plinth: base course of a building Pier: is a solid support designed to sustain verticalpressure.

Ponding: refers to the act of pooling of unwanted water on a flat roof or road. **Sandstone**: is a stone that is formed of grains of sand tightly pressed together, usedin building construction.

Trowel: is a small tool with a flat blade used in building construction for spreading cement or plaster