Assistant Mason

(Job Role)

Qualification Pack: Ref. Id. CON/Q0102

Sector: Construction

Textbook for Class X

विद्यया ऽमृतमश्नुते

एन सी ई आर टी
NCERT

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Foreword

The National Curriculum Framework (NCF)–2005 recommends bringing work and education into the domain of the curricular, infusing it in all areas of learning while giving it an identity of its own at relevant stages. It explains that work transforms knowledge into experience and generates important personal and social values, such as self-reliance, creativity and cooperation. Through work, one learns to find one's place in society. It is an educational activity with an inherent potential for inclusion. Therefore, an experience of involvement in productive work in an educational setting will make one appreciate the worth of social life and what is valued and appreciated in the society. Work involves interaction with material or people (mostly both), thus, creating a deeper comprehension and increased practical knowledge of natural substances and social relationships.

Through work and education, school knowledge can be easily linked to learners' life outside the school. This also makes a departure from the legacy of bookish learning and bridges the gap between the school, home, community and workplace. The NCF–2005 also emphasises on Vocational Education and Training (VET) for all those children, who wish to acquire additional skills and seek livelihood through vocational education after either discontinuing or completing school education. VET is expected to provide a 'preferred and dignified' choice rather than a terminal or last resort option.

As a follow-up of this, NCERT has attempted to infuse work across subject areas and contributed in the development of the National Skill Qualification Framework (NSQF) for the country, which was notified on 27 December 2013. It is a quality assurance framework that organises all qualifications according to the levels of knowledge, skills and attitude. These levels, graded from one to ten, are defined in terms of learning outcomes, which the learners must possess regardless of whether they are obtained through formal, non-formal or informal learning. The NSQF sets common principles and guidelines for a nationally recognised qualification system, covering schools, vocational education and training institutions, technical education institutions, colleges, and universities.

It is under this backdrop that Pandit Sunderlal Sharma Central Institute of Vocational Education (PSSCIVE), Bhopal, a constituent of

NCERT, has developed learning outcomes based modular curricula for vocational subjects from Classes IX to XII. This has been developed under the Centrally Sponsored Scheme of Vocationalisation of Secondary and Higher Secondary Education of the Ministry of Education, erstwhile Ministry of Human Resource Development.

This textbook has been developed as per the learning outcomes based curriculum, keeping in view the National Occupational Standards (NOSs) for the job role and to promote experiential learning related to the vocation. This will enable the students to acquire necessary skills, knowledge and attitude.

I acknowledge the contribution of the development team, reviewers and all institutions and organisations, which have supported in the development of this textbook. NCERT welcomes suggestions from students, teachers and parents, which would help us to further improve the quality of the material in subsequent editions.

HRUSHIKESH SENAPATY
Director
National Council of Educational
Research and Training

New Delhi
September 2020

About the Textbook

Construction industry in India is facing a huge shortage of manpower, especially those with skill-sets to sustain the burgeoning growth in infrastructure and housing sectors. Although the construction industry employs about 31 million people, second only to the agriculture sector, the workforce requirement is about five million people per year over the next seven years to sustain the current 8% growth rate. With only 10 million workers available in the country every year, the construction industry may face a heavy manpower challenge.

An Assistant Mason manages the erecting and dismantling of temporary scaffold and assists in stone laying and concrete masonry works, brick or block fixing. The textbook for the job role of 'Assistant Mason' has been developed to impart knowledge and skills through hands on learning experience, which forms a part of experiential learning. Experiential learning focusses on the learning process for the individual. Therefore, the learning activities are student-centered rather than teacher-centered.

This textbook has been developed with the expertise of the vocational teachers, industry experts and academicians for making it a useful and inspiring teaching-learning resource material for the vocational students. Adequate care has been taken to align the content of the textbook with the National Occupational Standards (NOS) for the job role so that the student acquires the necessary knowledge and skills as per performance criteria mentioned in the respective NOS of the Qualification Pack (QP). The NOS for the job role of 'Assistant Mason' covered through this textbook are as follows:

1. CON/N0101: erect and dismantle temporary scaffold of 3.6 meter height
2. CON/N0105: handle and use hand and power tools related to masonry work
3. CON/N0106: assist in tiling, stone laying and concrete masonry works
4. CON/N0107: assist in brick or block work including fixing doors and windows and plastering works

5. CON/N8001: work effectively in a team to deliver desired results at the workplace

6. CON/N9001: work according to personal health, safety and environment protocol on construction site

Unit 1 of the textbook discusses stone masonry. Unit 2 focusses on brick masonry. Unit 3 explains the process of scaffolding. Unit 4 talks about formwork and Unit 5 discusses floor and wall tiles and its laying.

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THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1]**[SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC]** and to secure to all its citizens :

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity and to promote among them all;

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949 do **HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.**

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1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

Unit 1

Stone Masonry

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

Material Required for Stone Masonry

1. Stones
2. Mortar

Stones

The stones selected for construction should be hard, durable, tough and free from any defects. The 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 below lists the different types of stones used for different purposes.

S. No.	Purpose	Stone Used
1.	Heavy engineering work, for example, docks, break waters, lighthouses, bridge piers, etc.	Granite and gneiss
2.	Buildings in industrial towns	Granite and compact sandstones
3.	Pavements, railway ballast, door sills and steps	Granite and ballast
4.	Fire resistant works	Compact sandstone
5.	Carving and ornamental works	Marble and laterite
6.	Facade and architectural	Marble, granite and closer grained sandstone

Mortar

Mortar is required to keep the stones in position. It is prepared by mixing lime or cement with sand and water. It is placed in the joints. The type of mortar to be used depends on the strength required, load on the structure, resistance desired for climatic changes, etc. The usual varieties are— lime mortar, cement mortar, cement lime mortar and lime cement mortar.

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

Stones are categorised as per use in structural members (an object that represents a beam, brace, or column in a drawing) and location. These are:

1. Sill
2. Corbel
3. Cornice
4. Coping
5. String course
6. Through stone

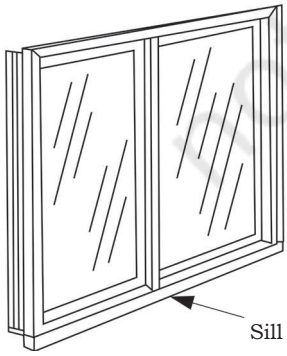


Fig. 1.1: Sill

- **Sill** is the bottom surface of a door or a window opening (Fig.1.1). The sill stones are dressed in such a way that they prevent the entry of water into the building.

- **Corbel** is a projecting stone, which is usually used to serve as a support for roof truss, beam and weather sheds, etc., as shown in Fig.1.2. Corbels are generally moulded and are given an ornamental treatment. The corbels should extend at least two-thirds of their length into wall.
- **Cornice** is a course of stone provided at the top of a wall. It is generally moulded and is given an ornamental treatment. It is weathered and threaded to dispose of rainwater. Sufficient bearing and extra weight at the top should be provided in the form of a parapet wall, to prevent overturning of the cornice.
- **Coping** is a course of stone, which is laid at the top of the wall, so as to protect the wall from rainwater. 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.1.3.

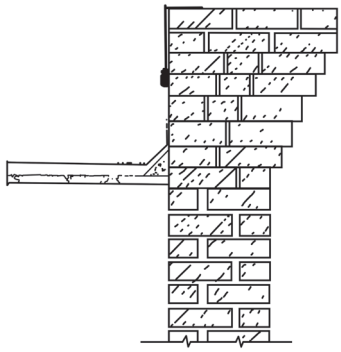


Fig. 1.2: Corbel

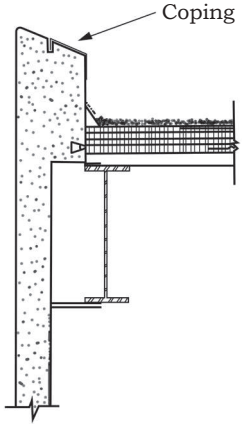


Fig. 1.3: Coping

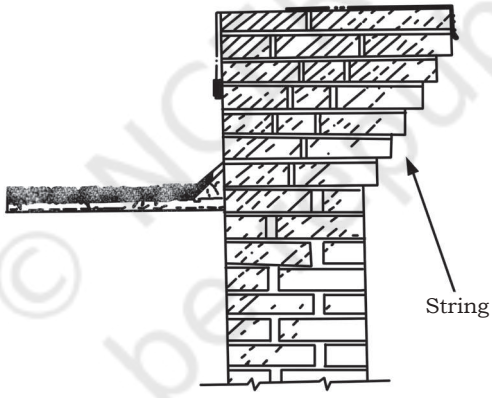


Fig. 1.4: String course

- **String course** is the horizontal course provided at suitable levels between the plinth and cornice. It breaks the monotony of a plane surface and is sometimes moulded and given architectural treatment (Fig.1.4).
- **Through stone** is set with its longest dimension perpendicular to the face of the wall and whose length is equal to the thickness of the wall (Fig.1.5). 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.

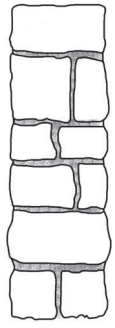


Fig. 1.5: Through Stone

Classification of Stone Masonry

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

1. Rubble Masonry
2. Ashlar Masonry

Rubble Masonry

In construction, rubble masonry stones of irregular sizes are used. The stones as obtained from the quarry are used as they are or are broken and shaped to suitable sizes by means of a hammer as the work progresses. The strength of rubble masonry depends upon the following three factors:

(i) The quality of mortar

(ii) The use of long through stones at frequent intervals

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

Rubble masonry is further classified into the following categories.

- Coursed rubble
- Uncoursed rubble
- Random rubble
- Dry rubble
- Polygonal rubble
- Flint rubble

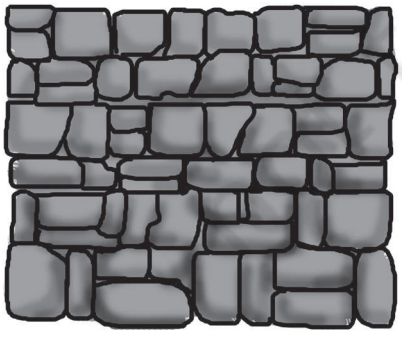


Fig1.6 Coursed rubble masonry

(a) Coursed rubble is commonly used in the construction of low height walls of public buildings, residential buildings, abutment and piers of ordinary bridges (Fig. 1.6). In this type of masonry, the height of stones varies from 5 mm to 200 mm. The masonry work is carried out in a manner that the height of the stones in a particular course remains the same. Coursed rubble masonry is further divided into three categories.

(i) Coursed rubble masonry class I: in this type, stones of the same height are used and the courses are also of the same height (see Fig 1.7).

(ii) *Coursed rubble masonry class II:* this type is similar to class I, except in the following (Fig 1.8):

- The stones to be used are of different heights.
- The courses need not be of equal height.
- Only two stones are to be used to make up the height of one course.
- The thickness of mortar joint is 12 mm.

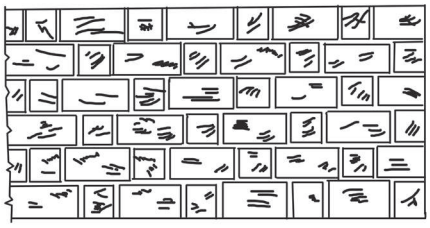


Fig. 1.7: Coursed rubble masonry Class I

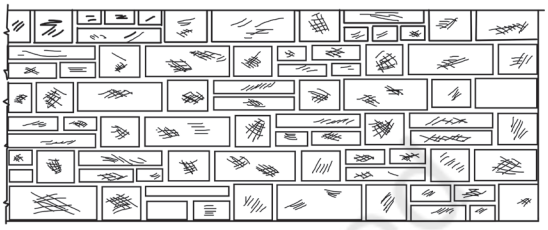


Fig. 1.8: Coursed rubble masonry Class II

(iii) *Coursed rubble masonry class III:* this sort is similar to class I except in the following:

- The stones to be used are of different height, the minimum being 50 mm.
- The courses need not be of equal height.
- Only three stones are to be used to make up the height of one course.
- The thickness of the mortar joint is 16 mm.

(b) Uncoursed rubble masonry: in this type of rubble masonry, the stones are used in the same shape as they are obtained from the 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 with spall (crushed stone) as shown in Fig. 1.9. The wall is brought to a level at every 30 cm to 50 cm. This type of rubble masonry being cheaper is used for the construction of compound walls, godowns, garages, etc.

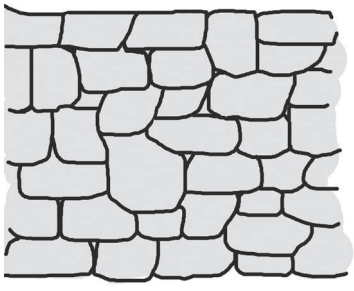


Fig. 1.9: Uncoursed rubble masonry

(c) Random rubble masonry: stones of irregular sizes and shapes are used in this type of rubble

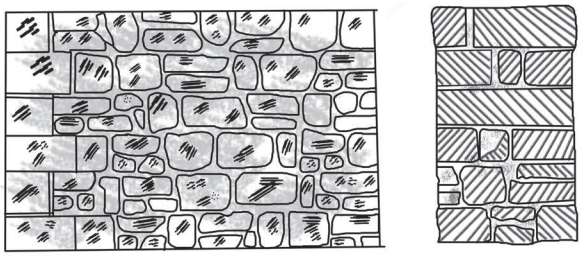


Fig. 1.10: Random rubble masonry

masonry (Fig.1.10). They are arranged in a manner to give the structure a good appearance.

Fig. 1.11: Dry rubble masonry

(d) Dry rubble masonry: this is just similar in construction to coursed rubble masonry except that no mortar is used in the joints (Fig. 1.11). Although the cheapest, it requires more skill during construction. It is extensively used for compound walls on bridge approaches, retaining walls, etc. Sometimes, to prevent the displacement of stones, two courses on the top and about 50 cm length at the ends are built in mortar.

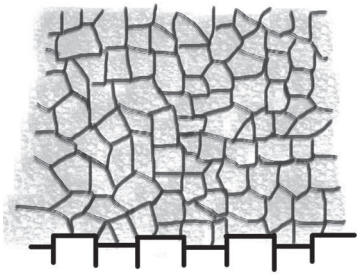


Fig. 1.12: Polygonal rubble masonry

(e) Polygonal rubble masonry: the stones are hammer-dressed in this type of rubble masonry and the stones selected for the facade are dressed in an irregular polygonal shape. Thus, the face joints run irregularly in all directions. This type of masonry requires more skill (Fig. 1.12).

(f) Flint rubble masonry: in this type of masonry, the stones used are flints. Flint stones varying in thickness from 8 to 15 cm and 15 to 30 cm in length are arranged for making a façade in the form of coursed or uncoursed masonry. In coastal areas, rounded flints procured from beaches are used. The joints of flint rubble masonry are raked back slightly with a pointed stick to improve the appearance (Fig. 1.13).

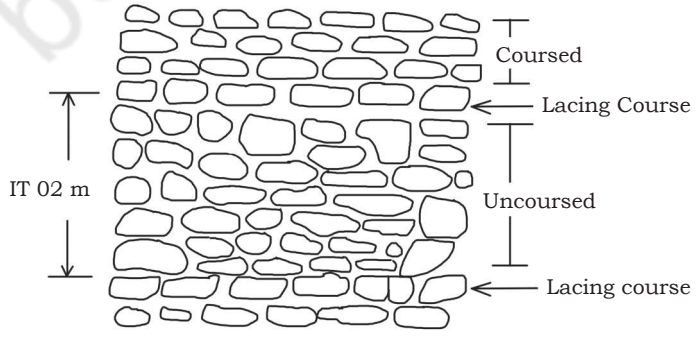


Fig. 1.13: Flint rubble masonry

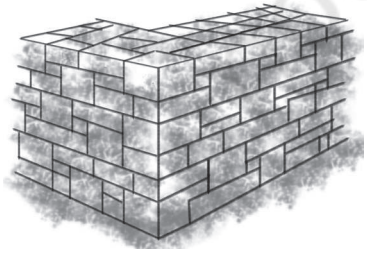


Fig. 1.14: Ashlar masonry

Ashlar Masonry

This is a superior quality of masonry and is built from accurately dressed stones with uniform and very fine

joints (Fig. 1.14). The various types of Ashlar masonry can be classified under the following categories.

- Ashlar fine
- Ashlar rough-tooled
- Ashlar rock quarry-faced
- Ashlar chamfered
- Ashlar facing
- Ashlar block in course

(a) Ashlar fine: all the bed joints and face stones should be dressed perfectly so that they conform to a desired pattern (Fig. 1.15). The stones should be arranged in a proper bond and the thickness of the mortar joint should not exceed 3 mm. This gives a perfectly smooth appearance but the cost of construction is high.

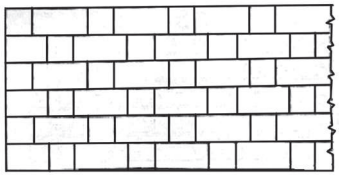


Fig. 1.15: Ashlar fine

(b) Ashlar rough-tooled: the size of the stone bonds, etc., are similar in specification as described in the case of Ashlar fine masonry. The exposed portion of this masonry should be given a fine dressed, chisel drafting of about 25 mm in width. The thickness of mortar joints should not exceed 6 mm (Fig. 1.16).

Fig. 1.16: Ashlar rough-tooled

(c) Ashlar rock or quarry-faced: in this type of masonry, the exposed portion of the facing stones, between the chisel drafting, is left undressed. However, projections that exceed 8 cm are broken. All other specifications are kept similar to that of Ashlar rough-tooled masonry. This type gives the construction a massive appearance (Fig. 1.17).

Fig. 1.17: Ashlar rock or quarry-faced

(d) Ashlar chamfered: the specifications regarding size bonds and type of joints are similar to the ones described above. The exposed edges of stones are levelled for a depth of about 2.5 cm. (Fig.1.18).

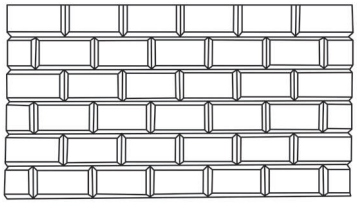


Fig. 1.18: Ashlar chamfered

(e) Ashlar facing: in this type of construction the façade is constructed in Ashlar masonry and the rear side may be constructed in brick masonry, rubble masonry or concrete masonry. This composite arrangement is economical. The height should be more than 200 mm. The façade stones are either rough-tooled or chamfered.

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

Joints in Stone Masonry

Broadly, joints in stone masonry can be categorised in the following types.

- Butt or squared joint
- Rebated or lapped joint
- Tongued and grooved joint
- Tabled joint
- Saddled joint
- Rusticated joint
- Plugged joint
- Dowelled joint
- Cramped joint

(a) 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. 1.19.

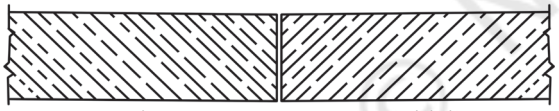


Fig. 1.19: Butt or squared joint

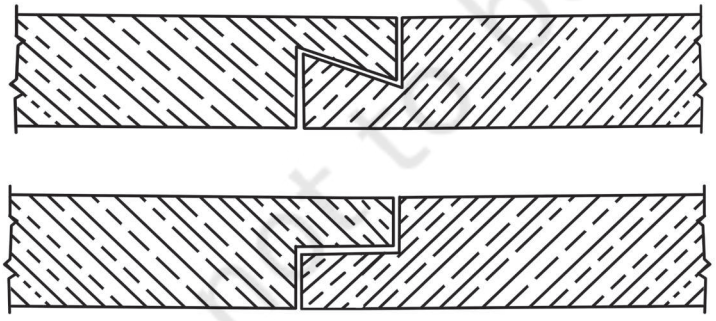


Fig. 1.20: Rebated or lapped joint

(b) Rebated or lapped joint: in this joint rebates or laps are provided. They prevent the movement of stones. The length of a rebate depends on the nature of the work but it should not be less than 70 mm (Fig.1.20).

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

(b) Tabled joint: is made in the bed of the stone to check the lateral movement. This joint is used for sea walls where lateral pressure is heavy (Fig. 1.21).

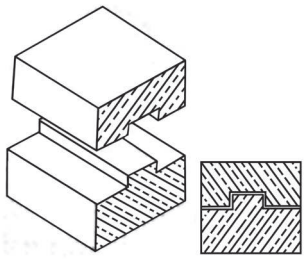


Fig. 1.21: Tabled joint

(c) Saddled joint: is rounded off to protect the joints or cornices and similar surfaces from rainwater. With the help of this arrangement, water moving on the weathered surface is diverted from the joints.

(d) Rusticated joint: in this type of joint, the edges of the joints are sunk below the plane of the facade. The different types of rusticated joints are— channelled joint, vee joint, and vee and channelled joint (Fig.1.22).

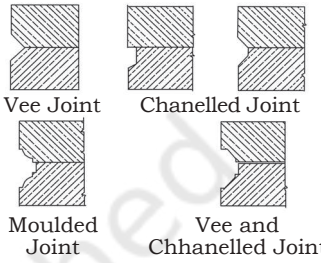


Fig. 1.22: Rusticated joint

(e) 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. (Fig.1.23).

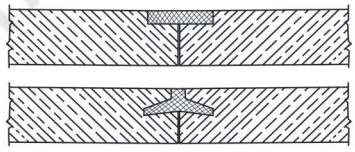


Fig. 1.23: Plugged joint

(f) Dowelled joint: in this type of joint, a hole is cut into each stone and loose dowels, which are small pieces of hard stone, slate, gun-metal brass, bronze or copper. They are inserted and secured with cement as shown in Fig.1.24. A dowelled joint can easily be used in place of joggled joints.

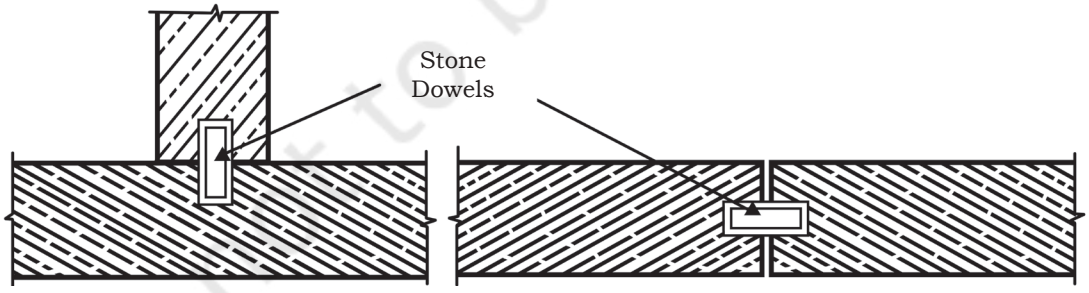


Fig. 1.24: Dowelled joint

(g) Cramped joint: in this type of joint, cramps are used instead of dowels. Cramps are pieces of non-corrosive metals, such as gun metal, copper, etc., and their ends are turned down

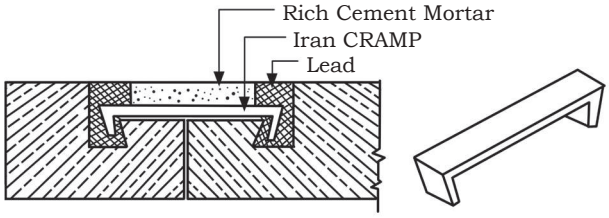


Fig. 1.25: Cramped joint

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 (Fig.1.25).

Maintenance of Stone Masonry Construction

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

- Stains
- Efflorescence
- Cracks
- Waterproofing

(a) 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 a solution of Oxalic acid mixed in water (1kg of Oxalic acid mixed with 10 litres of water). The stained area is rubbed with a brush and water after 3 to 4 hours. 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 hydrosulphide. The surface is washed after an hour.

Copper and bronze stains are removed by applying 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. To remove deep oil stains a mixture of acetone and amyl acetal is used. A diluted solution of washing soda and water can also remove tobacco stains.

Chlorinated lime, or ammonia water can be used to remove ink stains.

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

(c) **Cracks:** can be both small and large. Small cracks should be cleaned with a wire brush and filled with a thick paste of cement mix. Large cracks should be raked out to get space 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.

(d) **Waterproofing:** application of waterproofing material makes stone masonry free from efflorescence, dampness, frost action, etc. Generally, heavy petroleum distillate, fatty oil or insoluble soap are excellent waterproofing material. These materials are applied as a washing coat. They may cause some temporary discolouration.

Laying of Stone Masonry

The following points should be considered during construction.

- The stone should be hard, tough and durable.
- The stone should be well watered before use.
- There should be no hollow space inside the wall.
- Through stones (headers) should be used in successive layers, at 1 m (3' to 5') to 1.5 m apart, both ways.
- Use artificial header (RCC) in case of more width.
- Care should be taken to secure a mortar bond throughout the masonry. (Approximately 20 mm, that is, ¾"). Corner stones are prepared from the mason's hammer.

- To prevent stones from sliding down, the joints should not be too smooth.
- The wall should be vertical, that is, in plumb.
- Minimum 12 mm (½") margin should be provided in the external face of the column 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.
- In case of a compound wall, keep expansion joint at a 15 m interval.
- Lay some vertical stones in masonry for better bonding of first and second day's work or layer of rubble masonry.
- The curing for masonry should be done for a minimum of two weeks.
- The through stone should be of a length, which is at least thrice the depth.
- After proper curing and racking for at least 25 mm (1") depth, the joints should be pointed.

The bonding material used for masonry are:

(i) Cement mortar
(ii) Lime mortar
(iii) Mud mortar

The thickness of masonry should be:

(i) 10 cm
(ii) 20 cm
(iii) 30 cm
(iv) 40 cm
(v) 50 cm
(vi) 60 cm

The proportion of mortar should be:

(i) Masonry in cement/lime mortar 1:8
(ii) Masonry in cement/lime mortar 1:6
(iii) Masonry in cement/lime mortar 1:4
(iv) Masonry in cement/lime mortar 1:2
(v) 1:8, 1:6, etc., is the volumetric proportion where 1 stands for cement/lime and 8, 6 stands for sand.

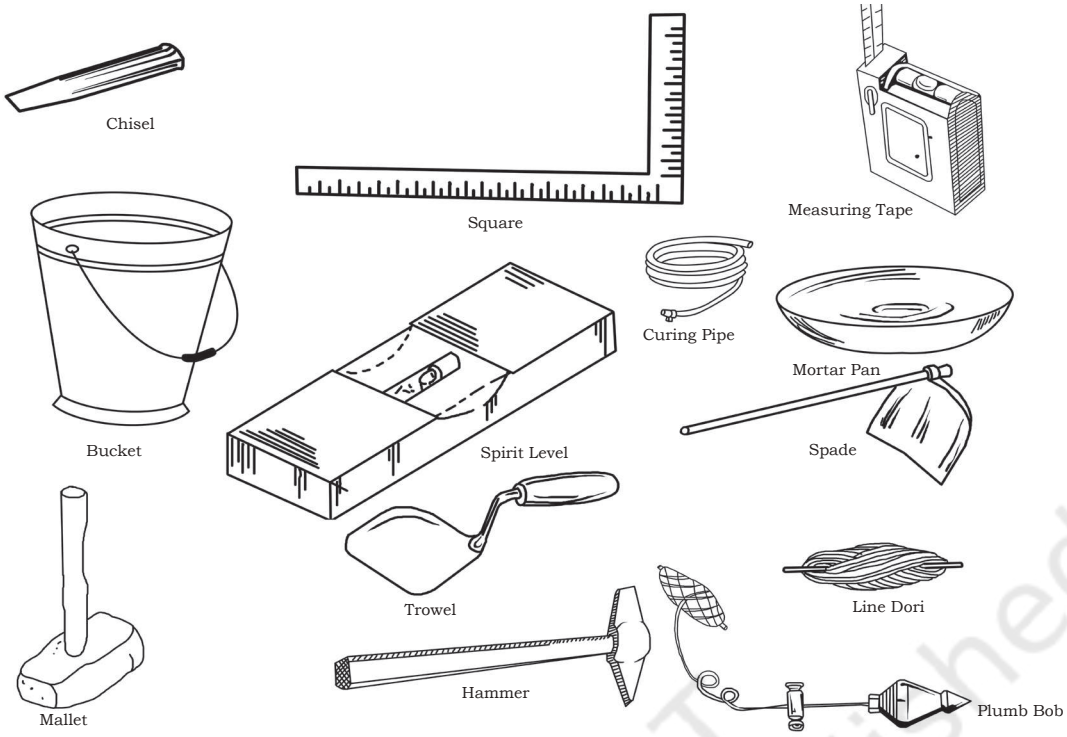
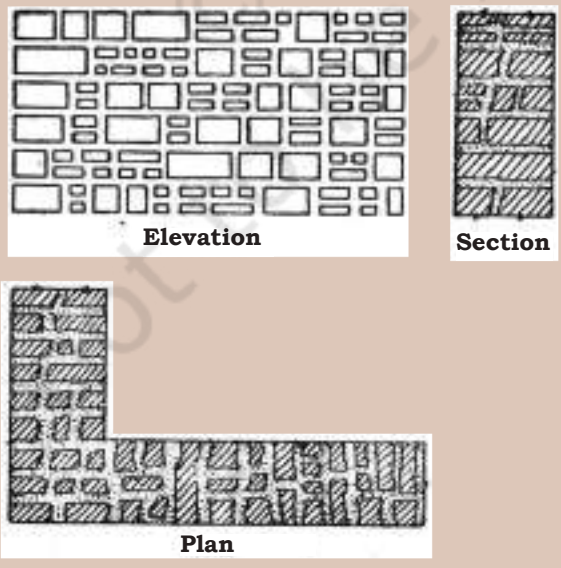


Fig. 1.26: Tools used in stone masonry

Practical Exercise

1. Students may practice how to dress the stone with appropriate tools.
2. Students are requested to construct Coursed rubble masonry as per the drawing given below.



Check Your Progress

A. Fill in the blanks

1. Stone masonry is constructed with stones and _____.
2. In cramped joint, cramps are used instead of _____.
3. A 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.

B. Multiple choice questions

1. Stone used in work should be _____.
   a) hard
   b) durable
   c) soft
   d) tough
2. Mortar is prepared by mixing _____.
   a) cement
   b) sand
   c) water
   d) All of the above
3. Bottom surface of a door or a window opening is known as _____.
   a) sill
   b) corbel
   c) cornic
   d) coping
4. Small cracks should be cleaned with _____.
   a) paper
   b) cloth
   c) wire brush
   d) None of the above
5. Butt joint is most common joint and is extensively used for _____.
   a) heavy work
   b) small work
   c) ordinary work
   d) None of the above

C. Short answer questions

1. Differentiate between Ashlar masonry and rubble masonry.
2. Explain the construction of a wall in coursed rubble masonry.
3. Describe the tools used in stone masonry construction with a sketch.
4. Write a short note on uncoursed rubble masonry.
5. What are the different types of Ashlar masonry? Explain any one.
6. How is the maintenance of stone masonry construction carried out?
7. Enlist the types of rubble masonry. Explain any one.

ASSISTANT MASON CLASS 10

Unit 1: Stone Masonry

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Unit 2

Brick Masonry

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

Material Used in Brick Masonry

The common material employed for brick masonry construction are

1. Brick
2. Mortar

Brick

Fig. 2.1: Brick

A brick is a building material used to make walls, pavements and other elements in masonry construction (Fig. 2.1). Bricks are manufactured by moulding earth in rectangular blocks of uniform size and shape. The standard size of a brick is 19×9×9 cm. Their nominal size is 20×10×10 cm. Generally, first and second class bricks are used for brick work. Bricks should be tested for hardness and durability before they are used in masonry.

Mortar

Mortar is a material used in masonry construction to fill 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 (Fig. 2.2).

The commonly used mortars are— Lime mortar, cement mortar, lime surkhi mortar and mud mortar.

Fig. 2.2: Mortar

Fig. 2.3: Mortar in brick joining

Tools Required for Brick masonry

The various tools commonly used by a bricklayer are discussed below.

Trowel

It is an 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. 2.4).

Fig. 2.4: Trowel

Plumb Rule and Bob

It is a smooth wooden piece of 2 m length, 10 cm width and 1 cm thickness, having its long edge parallel to each other (Fig. 2.5). It is used for checking the verticality of the brick work.

Straight Edge

This tool is used for checking the brick work alignment of a wall or pillar (Fig. 2.6).

Fig. 2.5: Plumb Rule and Bob

Fig. 2.6: Straight edge

Mason's Square

This is a right-angled piece made of steel or wood. It is used for checking right angles (Fig. 2.7).

Fig. 2.7: Mason's square

Fig. 2.8: Spirit level

Fig. 2.9: Steel tape

Fig. 2.10: Brick hammer

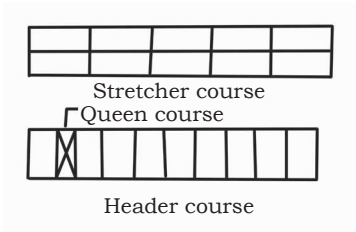

Fig. 2.11: English bond

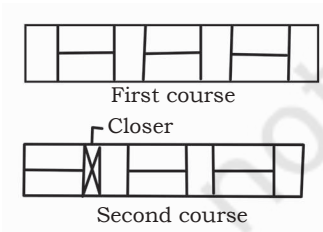

Fig. 2.12: Flemish bond

Spirit Level

This tool is used along with the straight edge for checking the levels of floors, roofs, etc. (Fig. 2.8).

Steel Tape

This is usually of 2 m length marked up to 1/10th of a cm. It is useful for checking small measurements (Fig. 2.9).

Brick Hammer

One end of this hammer is square and the other is sharp-edged. It is used for cutting bricks to different shapes and sizes, brick paving, striking nails, etc. (Fig. 2.10).

Technical Terms Used in Brick Masonry

Bond

A bond is when bricks are laid adjacent to each other, forming a groove between the bricks, which is filled by cement mortar. Bonding helps in even distribution of load over a large area. Bonds are classified into different types.

- **English Bond** consists of an alternate course of headers and stretchers (Fig.2.11). Queen closer, that is, half of the brick cut lengthwise, shall be introduced after the first header to break the vertical joint.
- **Flemish Bond** is an arrangement of bonding brickwork. Each course consists of alternate headers and stretchers. The headers of each course are centred over the stretcher in the course below. For breaking of vertical joints in successive courses, closers are inserted in alternate courses next to quoin (a cornerstone) headers (Fig.2.12).

Course

A horizontal layer of bricks is a course.

Stretcher

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

Stretcher Course

Course of brick work in which all the bricks are laid as stretchers.

Header

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

Header Course

Course of brick work in which all the bricks are laid as headers.

Arises

The edges formed by the intersection of a plane surface of a brick are called arises. They should be sharp, square and free from damage.

Perpends

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

Bed Joints

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

Lap

The horizontal distance between a vertical joint in successive course is called a lap. For a good bond, it should be one-fourth of the length of a brick.

Closer

A piece of brick, which is used to close the bend at the end of a brick course, is known as a closer. In brick masonry, these are used to form a proper bend (Fig. 2.13). The types of closer are:

- **Queen closer** is placed next to the first brick in a header course. This is a half brick cut longitudinally.
- **King closer** is obtained by cutting a triangular portion of a brick in such a way that half a header and half a stretcher are obtained on adjoining cut faces.

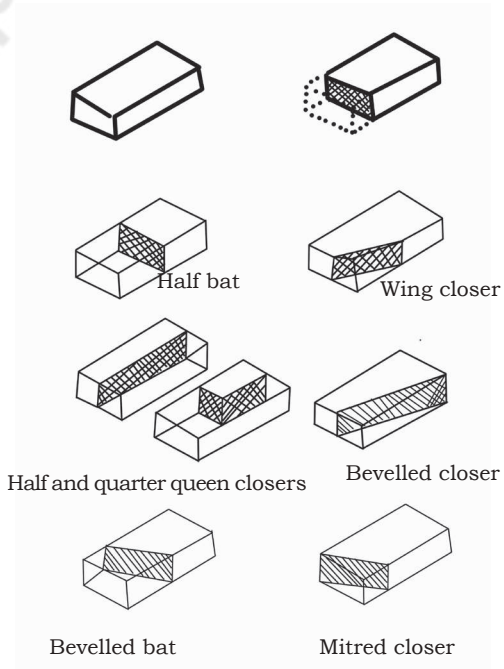

Fig. 2.13: Types of closer

- **Bevelled closer** is 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.
- **Mitred closer** is the portion of a standard brick having its one end cut, splayed or mitred for the full width.

Bull Nose

These are bricks moulded with a rounded angle. They are used for constructing rounded corners of buildings.

Cow Nose

It is a standard brick with both its edges rounded off. It is also called a double bull nose.

Plinth and Plinth Level

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

Jambs

The vertical sides of a door or a window opening, which support the door or a window frame, are called jambs.

Soffit

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

General Principles in the Construction of Brick Masonry

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

1. Bricks 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 two hours before they are used in construction work.

3. All the bricks should be laid with their frog (a raised or swollen area on a surface) upwards so that the mortar can be properly filled in the frog. It should form a key with the mortar joint of the succeeding course.
4. Specified mortar of good quality should be used.
5. All joints of the masonry work should be of uniform thickness. 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 m.
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 should be laid either in cement mortar or cement concrete.
14. Freshly laid brick work should be protected against rains during construction.
15. During winter, the brick work should either be suspended or carried out in cement mortar, if essential.

Method of Laying Bricks in the Wall

The following steps are adopted in the construction of walls.

Selection of Bricks

Bricks are selected for different parts of the wall that is, for the face, the heart and the back.

Soaking of Bricks

Before the bricks are laid in the walls they should be wetted. Bricks are soaked to:

(i) pread the mortar under them more evenly.

(ii) adhere better to the mortar.

(iii) set the cement mortar.

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

Preparation of 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.

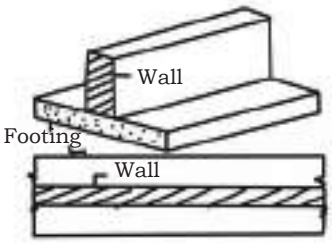

Fig. 2.14: Simple footing in brick work

Laying of Bricks in Walls

Laying of bricks in a wall (Fig. 2.14) is done in the following two steps:

(a) Laying of bricks in the foundation that is up to the plinth level.

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

Laying of Bricks in the Foundation upto the Plinth Level

The steps to lay bricks is as follows:

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

(ii) Constructing corners: after spreading the mortar, the extreme corners are constructed in two courses after leaving the required concrete offset on each side. The surfaces of these extreme corners are made in vertical direction.

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

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

Laying of the Bricks in the Wall Above the Plinth Level

First, a 2-cm thick layer of mortar is spread on top of the 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 corner is extended in steps as shown in Fig. 2.15. The surfaces of the corners are made on vertical line. After this, each course is completed in turn by stretching two threads at the upper level between the extreme corners to work the external and internal edges of the wall. In each course, selected bricks for façade work are laid first, in line and level with the external thread, and then other bricks are laid between the internal thread. When the masonry work is completed up to the top of these extreme corners, the extreme corners 3 to 5 courses in height are constructed again. This process repeated till the wall is constructed up to a height of 1.5 m from ground level.

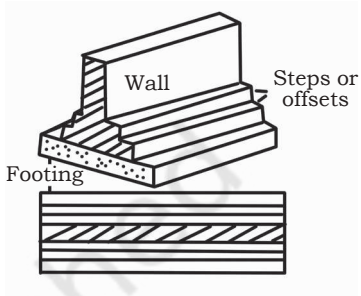

Fig. 2.15: Spread footing in brick work

Methods of Fixing New Work with Old Work

1. Toothing
2. Racking back
3. Block bonding

Toothing

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

new cross or partition wall or the rest of the wall can be bonded to the existing wall properly.

Racking Back

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

Block Bonding

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

Defects in Brick Masonry

Common defects occurring in brick work are:

(i) effect of sulphate on mortar
(ii) use of unsound material
(iii) frost action
(iv) efflorescence

Effect of Sulphate on Mortar

The effect of sulphate causes cracking of brick work, spalling of brick edges, deterioration of mortar and falling off of the plastered surface. The cause of this failure is the chemical action between the sulphate salts present in bricks and aluminium constituent of Portland cement.

This action is rapid in the presence of water. This can be avoided to a large extent by preventing the penetration of moisture.

Use of Unsound Material

When sub-standard material, such as underburnt or overburnt bricks, poor quality of mortar, etc., are used, they may result in dampness, cracking and early failure of the structure. To overcome this defect, good quality material should be used.

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.

Efflorescence

The accumulation of white deposits on the exposed surfaces of the bricks in brick masonry is called efflorescence.

Efflorescence occurs due to crystallisation of salts present in the bricks or absorbed by them from the soil in contact with the brickwork. This provides an ugly appearance and may cause disintegration of brick work. To overcome 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 the required position to overcome dampness in brick work.

MAINTENANCE OF BRICK MASONRY

Maintenance is done to ensure a neat appearance and stability of brick work. The following are generally executed for proper maintenance.

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

For repointing, 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 this the joints are finished with fresh mortar.

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

Practical Exercise

1. Stack bricks and count them as per the laid standard procedure.
2. Construct a one-brick thick English bond without mortar.
3. Construct a one-and-a-half-brick thick English bond without mortar.
4. Construct a one brick-thick double Flemish bond without mortar.
5. Constructing a one-and-a-half brick-thick single Flemish bond without mortar.
6. Prepare different types of closers.
7. Prepare different types of brick bats.

Check Your Progress

A. Fill in the blanks

1. A horizontal layer of bricks is termed as a _____.
2. The course of brick work in which all the bricks are laid as headers is called _____ 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 is in which all the _____are laid as stretchers.
7. Straight edge is used for checking the _____ of facades 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.

B. Multiple choice questions

1. Trowel is important tool used for _____.
   a) brick masonry
   b) measurement of item
   c) breaking the stone
   d) measuring the distance

2. Brick hammer shape at one end is square and other end is _____.
   a) oval
   b) sharp edged
   c) flat
   d) round
3. Jambs is term used to denote the side of window or door frame _____.
   a) horizontal side of door
   b) vertical side of door
   c) lateral side of door
   d) None of the above
4. Defects due to frost action causes _____.
   a) cracking in the brick work
   b) tightening of the brick work
   c) hardening of the brickwork
   d) None of the above
5. Brickbat is known as _____.
   a) full brick
   b) half brick
   c) powder brick
   d) None of the above

C. Short answer questions

1. Give the general principles to be observed and precautions to be taken during the construction of brick masonry.
2. Define the following
   (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. Enlist different types of bonds used in brick masonry.
9. Describe the procedure of laying bricks in a wall.
10. Differentiate between English bond and Flemish bond.
11. Explain the tools used in brick masonry.

ASSISTANT MASON CLASS 10

Unit 2: Brick Masonry

Check Your Progress

A. Fill in the blanks

1. A horizontal layer of bricks is termed as a _____.
2. The course of brick work in which all the bricks are laid as headers is called _____ 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 is in which all the _____are laid as stretchers.
7. Straight edge is used for checking the _____ of facades 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.

B. Multiple choice questions

1. Trowel is important tool used for _____.
   a) brick masonry
   b) measurement of item
   c) breaking the stone
   d) measuring the distance
2. Brick hammer shape at one end is square and other end is _____.
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Unit 3

Scaffolding

Scaffolding and Its Use

Scaffolding is a temporary structure on the outside of a building, made of wooden planks and metal poles, used by workmen while building construction, repairing, or cleaning the building (Fig. 3.1). The material used for scaffolding is tubes, bamboos, couplers and boards.

Fig. 3.1: A view of Scaffolding

Following are the important components (Fig. 3.2) used in a scaffolding.

- Putlog is a horizontal transverse scaffold member supported by ledgers. The scaffold platform rests on the bearer. The bearer joins the scaffold uprights, posts, poles, and similar members.
- Guard rail is a rail at the edge of something that prevents people from falling off.
- Toe board is a long piece of 2"×4" wood nailed horizontally along a roof in various places.
- Ledger is a horizontal brace.
- Standard is the upright component with connector joints.
- Walk boards are wooden or metal boards, which provide space for movement.
- Brace is a rigid connection that holds one scaffold member in a fixed position with respect to another member, to a building or structure (Fig. 3.3).
- Coupler is a device for locking together the tubes and a coupler scaffold (Fig. 3.4).

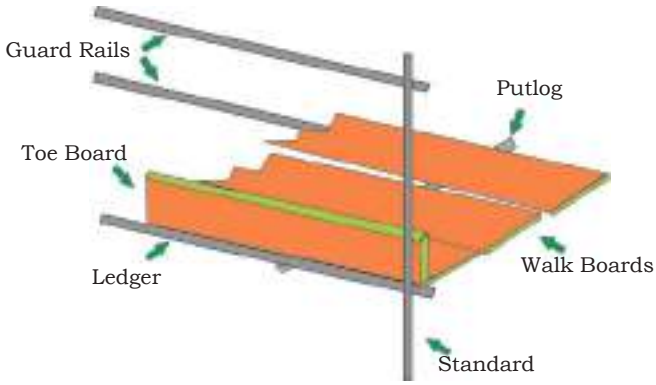


Fig. 3.2: Components of scaffolding

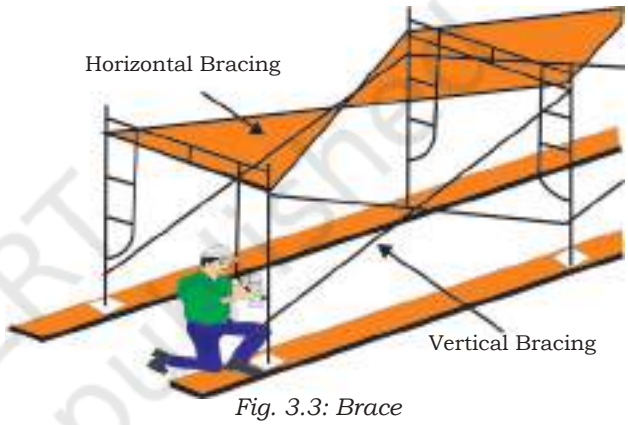


Fig. 3.3: Brace


Fig. 3.4: Coupler

Types of Scaffolding

Following are the important types of scaffoldings used.

Single Scaffolding

Single scaffolding is generally used for brick masonry. It is also called bricklayer's scaffolding (Fig. 3.5). Single scaffolding consists of standards, ledgers, putlogs, etc. It is parallel to the wall at a distance of about 1.2 m.

- The distance between the standards is about 2 to 2.5 m. Ledgers connect the standards at a vertical interval of 1.2 to 1.5 m.


Fig. 3.5: Single Scaffolding

- Putlogs are taken out from the hole left in the wall to one end of the ledger. Putlogs are placed at an interval of 1.2 to 1.5 m.

Double Scaffolding

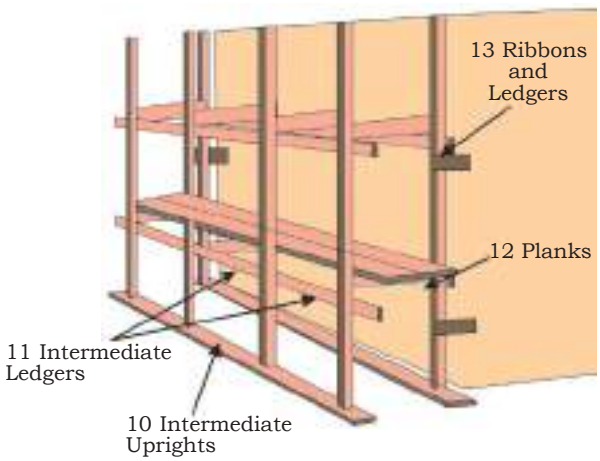


Fig. 3.6: Double Scaffolding

- Double scaffolding is generally used for stone masonry. Therefore, it is also called mason's scaffolding (Fig. 3.6).
- In stone walls, it is hard to make holes in the wall to support putlogs. Therefore, two rows of scaffolding are constructed to make it strong.
- The first row is 20–30 cm away from the wall and the other is 1 m away from the first row.
- Then, putlogs supported by both the frames are placed. To make it stronger, rakers and cross braces are provided. It is also called independent scaffolding.

Cantilever Scaffolding

Fig. 3.7: Cantilever Scaffolding

This is a type of scaffolding in which the standards are supported on a series of needles (Fig. 3.7). These needles are taken out through holes in the wall. This is called single frame type scaffolding.

Cantilever scaffoldings are used under conditions, such as

- when the ground does not have the capacity to support standards,
- when the ground near the wall has to be free from traffic, or
- when the upper part of the wall is under construction.

Steel Scaffolding

Steel scaffolding is constructed by steel tubes, which are fixed together by steel couplers or fittings (Fig. 3.8).

- It is very easy to construct or dismantle.
- It has great strength, durability and high fire resistance.

- It is not economical but is safer for workers. It is used extensively.

Fig. 3.8: Steel Scaffolding

Bamboo Scaffolding

This type of scaffolding is made from bamboo, and has been used widely in construction work for centuries (Fig. 3.9). Many famous landmarks, notably The Great Wall of China, were built using bamboo scaffolding.

H-frame Scaffolding

It consists of rigid welded frames of two verticals and two horizontals (Fig. 3.10). The frames are interconnected by scissor cross braces in all the bays or alternate bays (for top 20 m) of scaffolding through pins welded on frames and locked in position by spring clips.

Fig. 3.9: Bamboo Scaffolding

Fig. 3.10: H-Frame Scaffolding

Scaffolding Base Preparation

- For erecting scaffolding, the foundation should be smooth.
- Scaffold frameworks should have simple base plates to safely carry and spread the load.
- Although base plates are always recommended, scaffolding can be used without base plates on concrete or similar hard surfaces.
- For softer surfaces sole boards must be used. Beneath a single standard, a sole board should be at least 1,000 sq. cm (160 in^2) with no dimension less than 220 mm (8.7”) and the thickness must be at least 35 mm (1.4”).

- For heavy duty scaffold much more substantial baulks set in concrete are required. On uneven ground, steps must be cut for the base plates. A minimum step size of around 450 mm (18") is recommended.
- A working platform requires certain other elements to be safe. They must be close-boarded, have double guard rails and toe and stop boards. Safe and secure access must also be provided.

Visual checks should be carried out on the scaffolding components to ascertain their usability

Visual inspection teams must be thoroughly trained to recognise the following possible defects or unsafe conditions present in the system scaffold components, regardless of age or source:

- Posts (legs, uprights, and standards).
- Cracked or broken welds at connection points (nodes), welds
- Split or cracked tube
- Holes in posts due to cutting or cutting torch activity
- Evidence of extreme heat
- Extra or deformed holes
- Missing or inoperable connection points
- Legs out of round or deviations from normal cross section
- Dents or dimples in legs
- Straightness of posts
- Excessive corrosion, such as pitting and/or flaking. Corrosion can affect the overall strength of the product due to loss of cross-sectional area
- Bent or deformed connection points
- Discoloration due to possible exposure to caustic chemicals.
- Evidence of field welding or modification.

Various jigs and fixtures can be assembled to inspect and check the posts and accessories.

The spacing or height to be provided among different components of temporary scaffolding is as follows.

1. Distance between the standards is about 2 to 2.5 m. Ledgers connect the standards at a vertical interval of 1.2 to 1.5 m.

2. Putlogs are taken out from the hole left in the wall to one end of the ledgers. Putlogs are placed at an interval of 1.2 to 1.5 m.

The safety measures to be followed while tightening, fixing or assembling different parts of the scaffold together are as follows.

- Examine the scaffolding prior to and after use.
- Observe the workplace to identify areas where scaffolds are used.
- Checks should be performed to see if there is any interaction with vehicles, pedestrians and fixed structures.
- Examine the environment in which the scaffold is to be used, including checking ground conditions.
- Identify the major functional requirements of the scaffold, like the maximum live and dead loads and access requirements.
- Ask the workers about any problems they encounter or anticipate at the workplace when constructing or interacting with scaffolds.
- Use engineering controls, such as toe boards, perimeter containment sheeting or overhead protective structures, to prevent objects falling and hitting workers or other people below the work area.
- Use personal protective equipment (PPE) for example, hard hats, protective hand and footwear and high visibility vests.

The different hand tools used for erecting or dismantling scaffolds are as follows.

- **Hammer:** delivers a blow (a sudden impact) to an object. Most hammers are hand tools used to drive nails, fit parts, forge metal, and break apart objects (Fig. 3.11).
- **Spanner:** is used to provide grip and mechanical advantage in applying torque to turn objects – usually rotary fasteners, such as nuts and bolts – or to keep them from turning (Fig. 3.12).
- **Pulley:** is a wheel with a grooved rim around which a cord passes that helps to change the direction of force applied to the cord. A pulley is used to raise heavy weights (Fig. 3.13).

Fig. 3.11: Hammer

Fig. 3.12: Spanner

- **Hook:** is a tool with a portion that is curved or indented. This curve can be used to hold another object (Fig. 3.14).

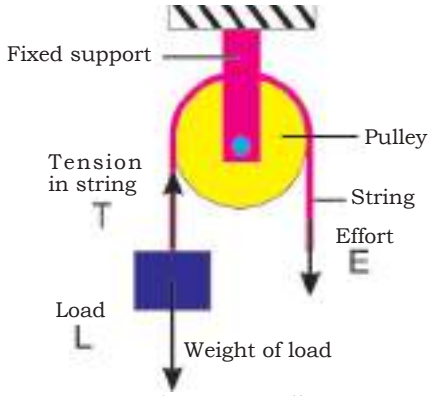


Fig. 3.13: Pulley


Fig. 3.14: Hook


Fig. 3.15: Rope

- **Rope:** is a group of yarn, or strands that are twisted or braided together into a larger and stronger form (Fig. 3.15).

The different accessories used for scaffolding are as follows.

- **Clamp:** is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure (Fig. 3.16).


Fig. 3.16: Clamps


Fig. 3.17: Washer

- **Washer:** is a thin round plate with a hole in the middle that is normally used to distribute the load of a threaded fastener, such as a screw or nut (Fig. 3.17).
- **Props:** are the compression members used as temporary supports for building and civil engineering works incorporating a means for adjusting and fixing their length (Fig. 3.18).
- **Brace:** is a tie that holds one scaffold member in a fixed position with respect to another member.


Fig. 3.18: Props

Standard Method of Erecting and Dismantling of Scaffolds

Notes

Erecting Scaffolding

- Erection of the scaffolding should be under the supervision of a person with proper experience and aptitude for securing safe installation. The person should also be familiar with the Scaffolding Safety Rules.
- It is the responsibility of the person supervising the erection of the scaffold to see that all components and locking devices are in working order, and that no damaged or deteriorated equipment is used in the set-up.
- Workmen should not be allowed on the scaffolding if it becomes damaged after the equipment has been erected, till the damaged items have been repaired or replaced.
- The work of erecting the scaffolding progresses smoothly if it is planned in advance. The equipment should be unloaded as close to the area of use as possible and should be arranged in the order for it is to be used.
- Before setting up the scaffolding, adjustment screws should be set to their approximate final adjustment. At this time, a person should check to see that all panels that require coupling pins have them.
- After erecting the first tier of scaffold frames, plumb and level (using instruments) all frames, so that no matter how high the final scaffolding is set-up, the additional frames will also be in correct alignment.
- As work proceeds, tie all scaffolding securely to the structure at the ends and at least every 30 feet horizontally, and at height intervals not to exceed four times the minimum base dimension.
- Free standing scaffold towers must be restrained from tipping by guying or other means. Scaffold frames must be fastened together with coupling pins where there is a possibility of uplift.
- When scaffolds are to be partially or fully enclosed, specific precautions must be taken to attach the scaffolding to the building to be able to handle

increased load conditions resulting from effects of wind and weather.

- The scaffolding components to which the ties are attached must also be checked for additional loads. When erecting additional lifts, always work from planking placed within the scaffold structure. Move planking as the work progresses.

Dismantling Scaffolding

Scaffolding should be dismantled under the supervision of a person with proper experience and aptitude. The following should be observed while dismantling.

1. Check to see if scaffolding has been structurally altered in any way to make it unsafe. If so, reconstruct where necessary, before commencing with the dismantling procedures.
2. Dismantle scaffold from top to bottom. Begin by removing all accessories from the lift being dismantled.
3. Always work from a minimum of two planks placed on the tier of frames below those being removed. Move the planking down as the dismantling progresses.
4. Do not remove ties until dismantling has reached the tier they are attached to.
5. Always stay inside the scaffold. Do not climb on the outside for any reason when dismantling. Do not climb on ties, braces or unbraced frames.
6. Only remove fastening devices from the bottom of the frames being removed.
7. Lower scaffolding components safely as they are dismantled. Avoid dropping or throwing the components as this could result in damage to the equipment, or injury to personnel below.

Following are the material handling and shifting methods while the scaffolding is being erected or dismantled.

- All scaffolding material should be stored at a designated location to protect them from adverse environment conditions such as corrosion, weather, etc. Storage racks, locations or areas should be clearly identified.
- The storage facility should be properly constructed ensuring stability and load bearing capability.

- Steel pipes, scaffolding platform, grating should be stacked horizontally according to length. Fittings, couplers should be stored in separate bins.
- Defective material should be removed from the site.
- Contractor owned scaffolding material, such as tubular, planks, clamps, etc. should be inspected annually by the contractor. The visual inspection should cover 100% scaffold material. The inspected material should be colour coded, which will be in rotation.

Standard Safety Procedure (while working at a height)

Scaffolds must follow safe systems of work to prevent people from falling. In particular,

- when lifting or lowering materials, the scaffolders must be tightened on or should be working within a handing platform that is fully boarded, with double guard-rails and toe boards.
- a minimum three-board working platform with a single guard-rail is provided as erecting or dismantling work progresses.
- scaffolders should wear safety harnesses at all times. They should be fitted with a 1.75 m length lanyard and a 55m opening scaffold hook or something similar for a one handed operation. Harnesses clipped on to a secure anchorage point requires the following minimum conditions:

1. The scaffold must be tied to a sound structure as the work progresses.
2. The attachment can be made to a ledger, transom or guard-rail supported with load bearing couplers. It can also be a transom supported by ledgers in a lift above that is fixed at both ends by single couplers.

- At least one bay of a scaffold should remain boarded out as the work progresses. This should be used for ladder access for scaffolders for the full height of the scaffold.
- Early into the process of erecting the scaffolding, safe ladder access for scaffolders should be incorporated.

- Scaffolders should not be clambering up and down scaffolds without proper ladder access. Safe working platforms should also be provided on each lift being worked on.

Dos and Don'ts of Working at a Height

Dos

- Work from the ground as much as possible.
- When the workers are working at a height, ensure that they can get safely to and from the spot of work.
- Ensure that the equipment is suitable, stable and strong enough for the job, and is maintained and checked regularly.
- Take precautions when working on or near fragile surfaces.
- Provide protection from falling objects.
- Consider emergency evacuation and rescue procedures.

Don'ts

- Do not overload ladders. Carefully consider the equipment or material that the workers are carrying before working at a height. Check the pictogram or label on the ladder for information.
- Do not overreach on ladders or stepladders.
- Do not rest a ladder against weak upper surfaces, for example, glazing or plastic gutters.
- Do not use ladders or stepladders for strenuous or heavy tasks. Only use them for light work of short duration (a maximum of 30 minutes at a time).
- Do not let an incompetent person to work at a height.

Checks to be Conducted after Erecting Scaffolds

There are a number of scaffold collapses each year. The following will help you ensure that your scaffold does not collapse

- Make sure that the anchors specified to tie a scaffold to a structure are suitable for the base material and they are installed correctly.

- Ensure that the scaffold anchors or ties are installed as the erecting work progresses. Conversely, they should not be removed too early during dismantling operations also.
- More ties will be needed on a sheeted or netted scaffold to ensure its stability so ensure their availability.
- Ensure that the scaffolds are not overloaded with equipment, especially tube and fittings, during erecting or dismantling operations.

Check Your Progress

A. Fill in the blanks

1. Ledger is a _____ brace.
2. The uplift component with a connector joint is called _____.
3. A horizontal transverse scaffolding member supported by a leader is called_____.
4. Props are the _____ used as temporary support for building.
5. A washer is a _____ plate.

B. Multiple choice questions

1. Which of the following types of structure is scaffolding?
   a) Permanent
   b) Temporary
   c) Fixed
   d) None of the above
2. Double scaffolding is used for _____.
   a) brick masonry
   b) stone masonry
   c) sand masonry
   d) None of the above
3. Brace is used in scaffolding for _____.
   a) holding scaffolding member
   b) folding the scaffolding member
   c) erecting the pipe
   d) None of the above
4. Erection of scaffolding should be done under the supervision of _____.
   a) mason
   b) plumber
   c) contractor
   d) experienced personnel

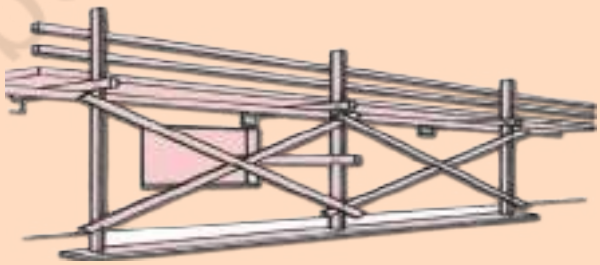
NOTES

5. Props are the _____ members used as temporary supports for building and civil engineering works.
   a) tension
   b) compression
   c) both of above
   d) None of the above

C. Short answer questions

1. What is scaffolding? Write its uses.
2. Write the steps to install single scaffolding.
3. Write the process of erecting and dismantling scaffolding of 3.6 m height.
4. Write the steps of fitting of steel scaffolding.
5. What are the different equipment used in scaffolding?
6. List the standard safety procedures while working at a height of 3.6 m.
7. Explain the various types of scaffolding.
8. Define the following.
   (a) Hammer
   (b) Spanner
   (c) Hook
   (d) Rope
9. Explain the following.
   (a) Clamps
   (b) Washer
   (c) Proper
   (d) Bracing

D. Identify and name the scaffolding given below.



ASSISTANT MASON CLASS 10

Unit 3: Scaffolding

Check Your Progress

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4. Props are the _____ used as temporary support for building.
5. A washer is a _____ plate.

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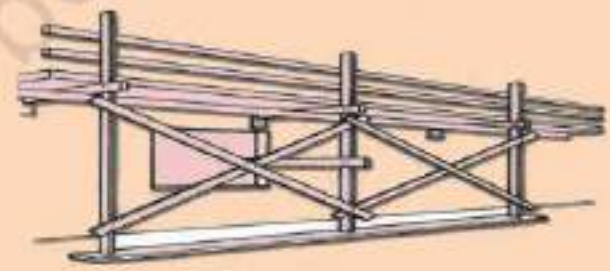

Unit 4

Formwork

Concrete in the plastic stage is placed in a column footing, wall, roof, lintel, staircase, etc. Concrete, in this state, requires some temporary support till it gains strength to remain in place. This temporary support is called 'formwork' or 'shuttering'. The term 'mould' is used in place of formwork for small items like lintel, tiles, blocks, etc. The term 'centring' is used in place of formwork for arches, domes, etc.

In concrete construction, the false work supports the shuttering moulds.

Temporary Timber, plywood, metal or other material is used to provide support to wet concrete mix till it gets strength for self support in formwork. The formwork also produces the desired finish on concrete surface.

Shuttering or formwork should be strong enough to support the weight of wet concrete mix and also the pressure of concrete inside or on top of the formwork or shuttering. It should be firm to prevent any deflection in the surface after laying cement concrete. It should also be sufficiently tight to prevent loss of water and mortar from cement concrete. Shuttering should be easy to handle, erect at site and easy to remove when the

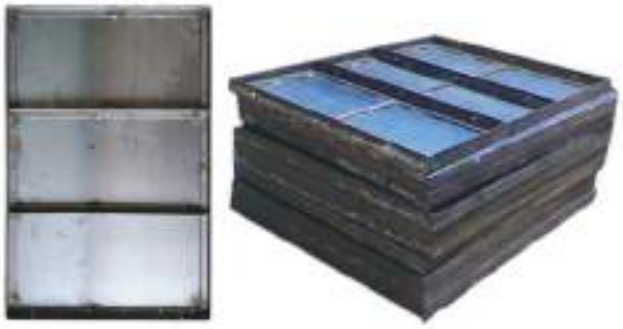

Fig. 4.1: Steel plates for shuttering or centring

cement concrete is sufficiently hard.

The construction of a formwork requires a lot of time. The removal of a formwork is called 'stripping'. The removed component of a formwork is reused for another construction. When the required strength of concrete is achieved, the formwork is removed. The cost of a formwork is 20-25% of the cost of building material.

Classification of Formwork or Shuttering

1. Wooden or Timber
2. Plywood
3. Steel
4. Combined (wood and steel)

Wooden or Timber Formwork

Wooden or timber is the most common type of formwork. This type is preferred, when.

(a) a formwork is required for small works with fewer repetitions.
(b) cheaper formwork is needed.
(c) complicated shapes of concrete are to be provided for a formwork on a limited time schedule.
(d) a formwork has to be erected quickly.
(e) a formwork is to be erected with less skilled people.

The timber used for the formwork should have moisture content of around 20%. As dry timber absorbs moisture from the concrete, honeycomb and distortion can be seen in the concrete. With impermeable coating, shuttering can be removed easily. Water impermeable coating is applied on wood formwork to reduce warping, swelling and shrinking.

Steel Formwork

Steel formwork or shuttering is used for major works. Mild steel sheets, angles, pipes and flats are used to make steel formwork with the welding and bolting system. The advantages of steel formwork are as given below.

(a) It is strong and durable and can be reused a number of times.
(b) It is easy to install and dismantle. Hence, it requires less labour cost.
(c) It does not absorb water from concrete. Hence, there is no honey formation in concrete.
(d) The surface obtained on the concrete surface is smooth and even.
(e) It does not distort or shrink. Hence, greater accuracy of the concrete dimension can be achieved.
(f) It provides ease of stripping.
(g) It gives a smooth and even concrete surface.
(h) It is costly.

Requirements of Formwork

A good formwork should satisfy the following requirements.

(a) The material for formwork should be cheap and can be reused many times.
(b) It should be waterproof and should not absorb water from the concrete. There should be minimum shrinkage and swelling.
(c) It should be strong enough to bear all loads – dead load of concrete, live load of labour during pouring, compaction and curing.
(d) It should be hard so that there is minimum deflection.
(e) It should be light as much as possible.
(f) The surface of the formwork should be smooth for easy stripping.
(g) All the joints of the formwork should be stiff so that there is minimum lateral deformation under load. The joints should be leakproof.

Fig. 4.2: Formwork for circular columns

Formwork for Columns

Formwork for columns consists of a box made of timber or steel plates. The four sides are held together in the required position by wooden

Fig. 4.3: Formwork for square or rectangle columns

blades or yokes and steel bolts. The important features of this formwork are that

(a) it is strong to resist the load of concrete.
(b) the spacing of the yokes is about one metre.
(c) a hole is provided at the bottom of the formwork, so that the bottom can be cleared of any debris.
(d) it is washed with water before laying concrete.
(e) the size of the box can be varied by wooden blocks.

NORMS AS PER INDIAN STANDARD OF FORMWORK (IS: 456-1964)

- **General:** the formwork should conform to the shape, lines and dimensions as shown on the plans. It should be rigid during placing and compacting of concrete. It should be water tight to prevent loss of water from concrete.
- **Cleaning treatment of forms:** all rubbish, chippings and sawdust should be removed from the interior of the formwork before placing concrete and should be wetted.
- **Stripping time:** the formwork should not be removed till it becomes strong. See table below.

Type of formwork	Time
Vertical wall, columns	16-24 hrs
Soffit of slab (Prop should be refixed immediately)	3 days
Soffit of beam (Prop should be refixed immediately)	7 days
Props to slab span < 4.5 m	7 days
Props to slab span > 4.5 m	14 days
Props of beam (span < 6 m)	14 days
Props of beam (span > 6 m)	21 days

Procedure for Removing Formwork

(a) All formworks should be removed without shock or vibration to avoid damaging the concrete.
(b) Before the soffit (bottom surface) and struts (pole) are removed, the concrete should be exposed, to check that it has sufficiently hardened.
(c) Proper precautions should be taken to allow for decrease in the rate of hardening in cold water.

Camber

(a) To ensure that beams do not slump when they have taken up their deflection a formwork should be given an upward camber (slope).
(b) This should be done only when it is allowed in the design calculation of the beam.

Tolerances

A formwork should be constructed such that the internal dimensions are within the permissible tolerance specified by the designer.

LOADS ON FORMWORK

The formwork has to take the following loads:
(a) Live load due to labour.
(b) Weight of wet concrete.
(c) Hydrostatic pressure of the fluid concrete acting against the vertical or inclined faces of form.
(d) The impact due to pouring of concrete.
(e) The live loads of labour and equipment, including impact, may be taken as 370 kg/m^2.

SHUTTERING FOR VARIOUS MEMBERS OF RCC WORKS

The salient features of the various RCC works are explained here. It should be observed during shuttering, erecting and dismantling.

Column

It consists of
(a) sheeting around the column periphery.
(b) side and end yokes.
(c) wedges.
(d) bolts with washers.

Shuttering for the column

(a) The side yokes are two each.
(b) They are suitably spaced along the height of the column.
(c) The two side yokes are comparatively heavier and are connected together by two long bolts.

(d) The four wedges, one in each corner, are inserted between the bolts and end yokes.
(e) The sheathing is nailed to the end yokes.

Beam and Slab Floor

Slabs and beams are usually constructed together by laying concrete in the formwork. The formwork consists of rows of vertical posts, which carry wooden beams on top. Wooden or steel planks are placed on top of the horizontal beams. At different heights, the vertical posts are suitably supported by lateral posts from the sides. The bottom of the vertical posts rests on tapered wooden wedges and flat steel plates. For constructing a formwork for a beam, the formwork is supported by tapering blocks from the sides, bad beam from the bottom and the beam is supported by wooden blocks and struts on the vertical posts. Some important points are given below.

(a) The slab is continuous over a number of beams.
(b) The slab is supported on a 2.5 cm thick sheathing laid parallel to the main beam.
(c) The sheathing is supported on wooden battens, which are laid between the beams, at suitable intervals.
(d) In order to reduce deflection, the battens may be propped at the middle of the span through joists.
(e) The side forms of the beam, consists of a 3 mm thick sheathing.
(f) The bottom sheathing of the beam form may be 5 to 7 cm thick.

Shuttering for Beam and Slab Floor

(a) The ends of the battens are supported on the ledger, which is fixed to the cleats throughout the length (Fig. 4.4).

Fig. 4.4 (a): Shuttering for beam and RCC Floor

(b) Cleats, measuring 10 cm × 2 cm × 3 cm are fixed to the forms at the same intervals as that of the battens, so that the battens may be fixed to them. The beam form is supported on a head tree.

(c) The shore or post is connected to a head tree through cleats.

(d) At the bottom of the shore, two wedges of hard wood are provided over a sole piece.

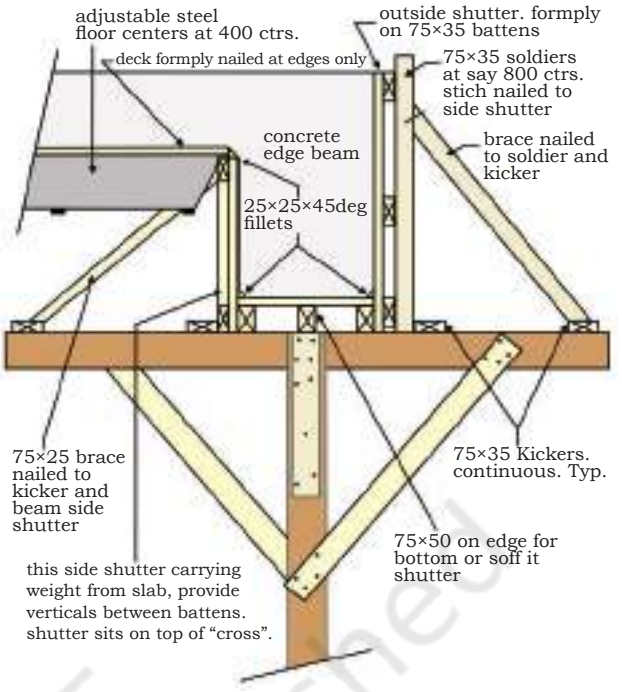

Fig. 4.4 (b): Diagram explaining shuttering for beams and RCC Floor

Stairs

The sheathing or decking for a deck slab is carried on cross joists.

(a) Cross joists are supported on raking ledgers.

(b) A ledger is 7.5 cm × 10 cm in size.

(c) Cross joists are 5 cm × 10 cm in size.

(d) Riser planks are 4–5 cm thick.

Planks are levelled at the bottom to allow the entire tread face to be trowelled.

Shuttering for Stairs

(a) The riser planks are fixed after reinforcement has been fixed in position (Fig. 4.5).

(b) A cut string made of a 5 cm plank carries the outer end of the risers.

(c) The cut string is strutted to the cross joists by 5 cm × 10 cm struts.

(d) The wall ends of the riser planks are carried by 5 cm × 10 cm hangers secured to a 5cm thick board are fixed to the wall.

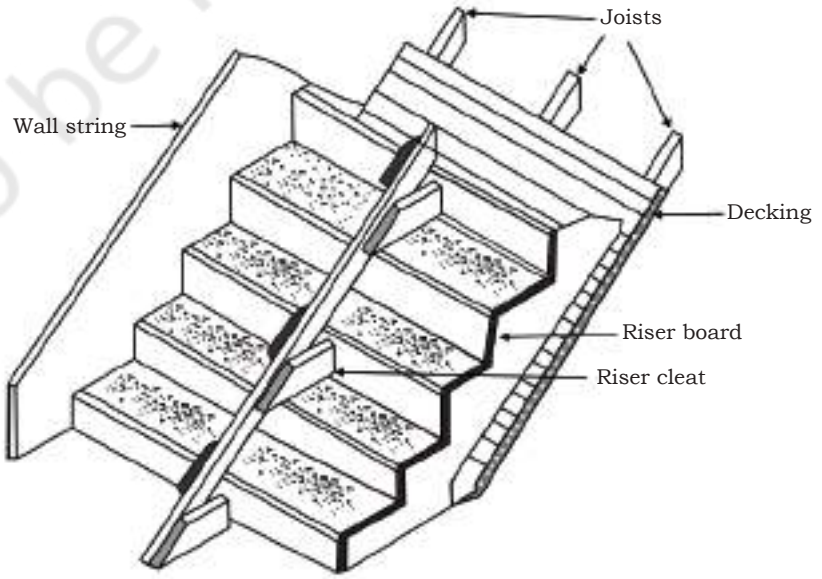

Fig. 4.5: Shuttering for stairs

(e) The treads are left open for concreting and vibration.
(f) A 5 cm × 10 cm stiffener joist is placed along the middle of the riser planks.
(g) The stiffener is wired to the cross joists through decking.

FORMWORK FOR WALLS

(a) The boarding is 4 to 5 cm thick for walls of 3 to 4m height.
(b) Boards, known as studs or soldiers, are fixed to 5cm × 10cm posts.
(c) Studs are placed at intervals of 0.8 m.
(d) A horizontal wall, 7.5cm × 10cm in size, is fixed at suitable intervals.

Moving Wall Form

(a) In moving wall forms, panels are made of 0.6 × 1.8 m so that handling and stripping is easy.
(b) A 15 mm ply board is used, instead of boarding.
(c) The panels are installed in such a way that the lower panel can be removed when the concrete is hard and used on a wall higher up.
(d) A 5 cm × 10 cm framing is used to ply the shutter.
(e) The panels are fixed to a central and two end studs.
(f) Each stud consists of two pieces of timber, 5 cm × 15 cm apart.

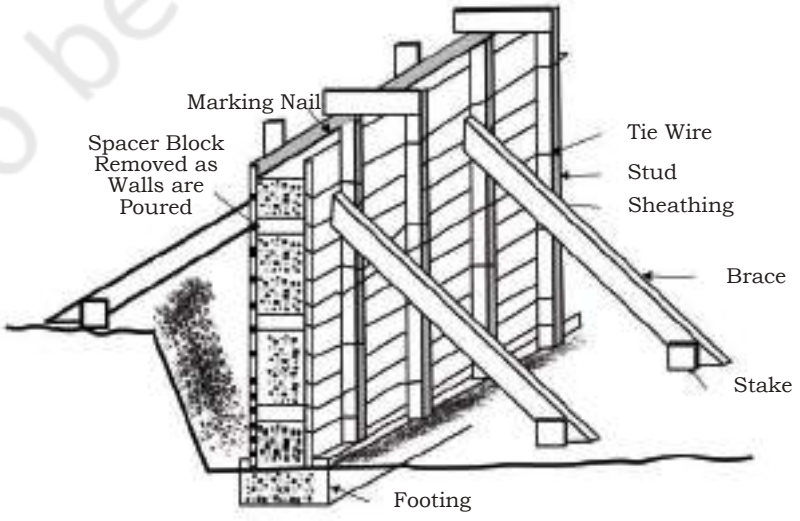

Fig. 4.6: Shuttering for wall

(g) The end strut of each panel secures an adjacent panel.

(h) The boards are reversed for the first lift. For succeeding lifts, bolts pass through holes formed on the previous lift.

(i) For rapid construction of a constant thickness wall, a continuously rising form, commonly known as the sliding shutter is used.

Practical Exercise

1. Prepare and list the different material used for formwork and shuttering.
2. Visit a construction site and prepare a report on formwork for the following RCC components.
   - Column footing
   - Column
   - Beam and slab
   - Stairs
   - Wall

Check Your Progress

A. Fill in the blanks

1. Formwork is the term given to either _____ or permanent moulds into which concrete or similar material are _____.
2. The most common formwork used is _____.
3. In moving wall forms, panels are made of _____size so that handling and stripping is easy.
4. A stiffener joist of 5cm × 10cm is placed along the middle of the riser _____ in stairs.

B. Multiple choice questions

1. The _____ for a deck slab is carried on cross joists.
   a) ledger
   b) sheathing or decking
   c) riser planks
   d) None of the above
2. Slabs and _____ are usually constructed together by laying concrete in the formwork.
   a) yokes
   b) beams
   c) steel plates
   d) None of the above

3. A formwork should be constructed such that the internal dimensions are within the permissible _____specifed by the designer.
   a) tolerance
   b) limit
   c) length
   d) depth

4. All formworks should be removed without _____ to avoid damaging the concrete.
   a) shock or vibration
   b) dismantling
   c) pulling
   d) None of the above

5. The timber used for the formwork should have moisture content of around _____.
   a) 20%
   b) 60%
   c) 30%
   d) 50%

C. Short answer questions

1. What is the use of shuttering in the construction of a building?
2. Describe the various kinds of shuttering.
3. Why is formwork necessary?
4. What are the different kinds of formwork?
5. What is the purpose of a formwork in concrete work?
6. Differentiate between timber and steel formwork?
7. Explain the formwork designed for beam and slabs.
8. Give the merits and demerits of timber formwork and steel formwork.
9. What are the requirements of a good formwork?

ASSISTANT MASON CLASS 10

Unit 4: Formwork

Check Your Progress

A. Fill in the blanks

1. Formwork is the term given to either _____ or permanent moulds into which concrete or similar material are _____.
2. The most common formwork used is _____.
3. In moving wall forms, panels are made of _____size so that handling and stripping is easy.
4. A stiffener joist of 5cm × 10cm is placed along the middle of the riser _____ in stairs.

B. Multiple choice questions

1. The _____ for a deck slab is carried on cross joists.
   a) ledger
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8. Give the merits and demerits of timber formwork and steel formwork.
9. What are the requirements of a good formwork?

Unit 5

Flooring Work

Floor

The lower surface of a room is known as a floor. As per location requirements, various types of material are used for flooring work (Fig. 5.1). Flooring is done manually or with the help of machines. Some of the commonly used machinery for flooring work is given below.

Tile cutting machine

Vitrified tile cutting machine

Tile polishing machine

Floor polishing machine (Heavy duty)

Stone cutting machine

Fig.5.1: Various types of machines used in flooring

Floor and Types of Flooring

Floors are made of various material as per need and quality. Given below are the commonly used types of floorings.

- Brick flooring
- Flagstone flooring
- Cement concrete flooring
- Granolithic flooring
- Precast terrazzo tile flooring or Mosaic flooring

Brick Flooring

Fig. 5.2: Brick flooring

- When a floor surface is constructed with individual bricks and it is fixed or laid like tiles, either with or without mortar or grouting. It is called as brick flooring (Fig. 5.2). Flooring bricks are also called pavers and are thinner than construction grade material. They are generally used because they do not raise the level of the floor, and they place a significantly lower weight load on the subfloor.

Material or Tools required for Brick Flooring

(a) First class bricks
(b) Cement or lime
(c) Sand, water
(d) Brick ballast
(e) Tools for brick work
(f) Spirit level
(g) Wooden straight edge
(h) Iron rammer (*dhurmut*)
(i) Wooden float

Procedure

(a) Properly consolidate the floor by manually compacting the base to the required level and slope.
(b) A 10 to 15 cm thick layer of lean cement concrete in the ratio of 1:6:12 or lime concrete should be laid over the entire area of the floor to be constructed.
(c) A proper slope of 1:80 should be provided in the sub-grade.

(d) The slope should be checked with a straight edge at five to six places and any differences should be corrected.
(e) Lime concrete should be properly cured for seven days.
(f) The bricks should be properly soaked in water for six hours.
(g) Cement sand mortar or lime mortar of the required proportion should be prepared.
(h) The bricks should be laid on the edge on a 12 mm thick mortar bed.
(i) All the joints should be filled with mortar. The thickness of the joints should not exceed 1.0 cm.
(j) The flooring should be cured for a minimum of seven days.

Flagstone Flooring

Flagstone (flag) is a general type of flat stone, shape of flagstone may be regular rectangular or square and it is generally used for paving slabs or walkways, patios, flooring, fences and roofing (Fig. 5.3). Thickness of flagstone flooring may be between 20 to 40 mm.

Fig. 5.3: Flagstone flooring

Materials or Tools required for flagstone flooring

(a) Laminated sandstone not less than 38 cm in width and a thickness between 20 to 40 mm.
(b) Cement or lime
(c) Brick ballast
(d) Sand
(e) Water
(f) Tools for stonework
(g) Spirit level
(h) Wooden straight edge
(i) Iron rammer (dhurmut)
(j) Wooden float

Procedure

(a) The same steps, as given in the brick floor laying procedure, should be followed up to the preparation of lime concrete sub-grade.
(b) Flagstones should be properly soaked in water.

(c) Flagstones should be laid on a 20 to 25 mm thick layer of bed mortar.

(d) It is necessary to give a slope of 1 to 40 in flagstone flooring for proper drainage.

(e) When the stone slabs are properly set, mortar in the joints is raked out to a depth of about 20 mm.

(f) These joints should then be flush pointed with 1:3 cement mortar.

(g) Curing should be done for seven days.

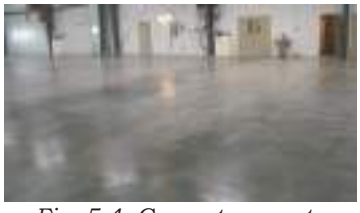

Fig. 5.4: Cement concrete flooring

Cement Concrete Flooring

This is the most commonly used type of flooring and is best suited for all types of rooms. This flooring is generally non-absorbant, durable, smooth, pleasing in appearance, possess good wear resisting properties and is economical (Fig. 5.4).

Materials or Tools required for Cement Concrete flooring

(a) Portland cement or lime
(b) Stone aggregate
(c) Coarse sand
(d) Brick ballast
(e) Water
(f) Glass or aluminium strip
(g) Tools required for preparation of concrete mix
(h) Spirit level
(i) Straight edge
(j) Wooden float
(k) Rammer (*dhurmut*)
(l) Steel wire brush
(m) Carborundum stone of no. 120

Proportion

The proportion of cement concrete should be 1:2:4.

Procedure

Sub-grade preparation

(a) Properly consolidate the earthen base by ramming the surface hard with the iron rammer (*dhurmut*) to the required level and slope.

(b) A 7.5 cm thick base of lean cement concrete of 1:6:12 proportion, or lime concrete should be laid over the entire area of the floor to be constructed.

(c) In the case of lime concrete, curing should be done for seven days before starting the construction of the top layer.

(d) A slope of 1:100 should be given in the sub-grade.

(e) The surface of the sub-grade should be roughened with a steel wire brush.

(f) Before laying the flooring, the area should be filled with water and a coat of cement slurry at 2 kg/sqm should be applied to get a good bond between the sub-grade and the concrete floor.

(g) The floor should be levelled and divided into panels, the size of which should not exceed 1 m in its smallest dimension and 2 m in the large dimension.

(h) A 3 mm thick glass or aluminium strip with a depth equal to the thickness of the floor should be fixed on the base with cement mortar.

(i) Camber 1:100 should be given for draining the wash water.

(j) Concrete should be mixed in the desired proportion.

(k) The floor should be laid in two layers of 22 mm thickness. A 3 mm thick top layer should be laid for a 25 mm thick flooring.

(l) Cement concrete should be placed in position in the panels.

(m) It should then be levelled with the help of straight edge and trowel and beaten with a wooden handle or mason's trowel.

(n) Blows should be fairly heavy in the beginning but as consolidation takes place they should be light and rapid.

(o) Finally, the surface should be finished with a wooden float by applying thick slurry of mortar.

(p) The entire laying operation should be completed within 30 minutes.

(q) After laying, the surface should be left undisturbed for two hours and covered with wet bags. After 24

hours, the floor should be cured by flooding with water for seven days.

(r) After four days of laying, the finished concrete floor is filled with water and fine sand spread. The polishing of the floor should be done with 15cm × 8cm × 8cm carborundum stone.

Precautions

(a) The flooring in lavatories and bathrooms should be laid after fixing the water closet and floor traps.

(b) Proper curing should be done before opening the floor for use.

Repair of Damaged Concrete Flooring

(a) The entire panel of the damaged portion should be removed up to the top of the base of the concrete surface.

(b) The base concrete should be brushed off and a coat of cement grout applied to the surface of the base concrete.

(c) Cement concrete, 1:2:4, should be prepared and laid inside the panel.

(d) Concrete should be rammed and finished to a uniform level conforming to the adjacent floor level.

(e) The topping should be cured for 14 days.

Granolithic or Mosaic Floor

Fig. 5.5: Mosaic flooring

Granolithic, or Mosaic Terrazzo flooring is popular for residential as well as public buildings. A terrazzo floor is usually not slippery, when wet, because of its many grout lines. Terrazzo is a composite material, poured in place or precast, which is used for floor and wall treatments. This floor consists of two layers, the bottom layer should be 20 mm thick and the thickness of the top layer should be based on the size of the chips (Fig. 5.5).

Table 5.1: Thickness of the top layer

Grade no.	Size of the chips	Maximum thickness of the top layer
00	1-2	6 mm
0	2-4	9 mm
1	4-7	9 mm
2	7-10	12 mm
3	10-15	1.5 times the maximum size

4	15-20	Same as above
5	20-25	Same as above

For every part of the marble cement powder mix, the proportion of aggregate (marble chips), should be as follows.

Table 5.2: Proportion of aggregate

Size of aggregate	Proportion of aggregate to binder mix
For grades 00, 0 and 1	1.75 parts
For grades 2 and 3	1.50 parts
For grades 4 and 5	1.25 parts
Mixed sizes	1.50 parts aggregate

Materials or Tools required for Terrazzo Flooring

Portland Cement

(a) Stone aggregate
(b) Coarse sand
(c) Brick ballast
(d) Water
(e) Marble chips
(f) Marble powder
(g) Oxalic acid
(h) Cement or lime
(i) Brick ballast
(j) Sand
(k) Water
(l) Tools for stone work
(m) Spirit level
(n) Wooden straight edge
(o) Iron rammer (*dhurmut*)
(p) Wooden float

Procedure

(a) The same steps, as given in the brick floor laying procedure, should be followed up to the preparation of lime concrete sub-grade.
(b) Flagstones should be properly soaked in water.
(c) Flagstones should be laid on a 20 to 25 mm thick layer of bed mortar.

(d) It is necessary to give a slope of 1 to 40 in flagstone flooring for proper drainage.

(e) When the stone slabs are properly set, mortar in the joints should be raked out to a depth of about 20 mm.

(f) These joints should be flush pointed with 1:3 cement mortars.

(g) Curing should be done for seven days.

Precast Terrazzo Flooring

Fig. 5.6: Terrazzo tile flooring

Terrazzo is a composite material which is poured in place or precast Precast Terrazzo consists of chips of marble, quartz, granite, glass, or other suitable material, poured with a cementitious binder (for chemical binding), polymeric (for physical binding), or a combination of both (Fig. 5.6). Terrazzo is used for floor and wall treatments. Terrazzo tiles are available in nominal sizes of 20cm×20cm (actual size is 19.85cm × 19.85cm) of 20mm thickness, and 30cm × 30cm (actual size is 29.85cm × 29.85cm) of 25mm thickness.

The proportion of cement to aggregate in the backing of the tiles should not be leaner than 1:3 by weight.

Materials/Tool required for Precast Terrazzo flooring

(a) Precast terrazzo tiles
(b) Lime
(c) Sand
(d) Water
(e) Wooden mallet
(f) Cutting hammer
(g) Chisel, etc. (same as for cement concrete flooring)
(h) Grinding stones no. 60, 120 and 320.

Procedure

(a) Sub-grade concrete, on which the tiles are to be laid, should be cleaned, wetted and mopped.

(b) Lime mortar should be prepared in the specified proportion.

(c) Lime mortar bedding should be spread damped and corrected to the proper level and allowed to harden for a day before the tiles are set.

(d) The average thickness of the bedding mortar should be 30 mm and the thickness should not be less than 10 mm at any place.

(e) Over the bedding, neat grey cement slurry of honey-like consistency should be spread at the rate of 4.4 kg of cement per sq.m.

(f) Tiles should be washed, and fixed in this grout one after another. Each tile should be gently tapped with a wooden mallet till it is properly bedded and is in level with the adjoining tile.

(g) The joints should be kept as thin as possible, not exceeding 1.5 mm.

(h) The surface of the flooring should be frequently checked with straight edge during laying of the tiles, so as to obtain a true surface with the required slopes.

(i) One day later, the joints should be cleaned of the grey cement grout to a depth of 5 mm and all the dust and loose mortar should also be cleaned.

(j) The joints are grouted with cement paste with pigment to match the shade of the top layer of the tile.

(k) The floor is kept wet for seven days.

(l) Grounding is done similar to that in mosaic flooring, either mechanically or by hand grinding.

Glazed Tile Flooring

Ceramic tile is made from clay and sand. But the glazed ceramic tiles have a liquid glass coating on the surface (Fig. 5.7). The liquid glass coating creates the texture, design, and colour of a glazed tile and protects the body of the tile from staining. Due to their vibrant allure, there are mostly used as floor tiles for kitchen and bathroom walls.

Fig.5.7: Glazed tile flooring

Tiles are of nominal sizes of 150x150 mm and 100 × 100 mm. The thickness of a tile is 5 mm or 6 mm.

The top surface of the tile is glazed. The glaze is either glossy or matt. The underside of the tile is completely free from glaze. The edges of the tiles should be not less than 38 cm wide and the thickness should vary between 20 to 40 mm.

Materials and Tools required for Glazed Tile Flooring

(a) Cement or lime
(b) Brick ballast
(c) Sand
(d) Water
(e) Tools for stone work
(f) Spirit level
(g) Wooden straight edge
(h) Iron rammer (*dhurmut*)
(i) Wooden float

Procedure

(a) The same steps, as given in the brick floor laying procedure, should be followed up to the preparation of lime concrete sub-grade.
(b) Flagstones should be properly soaked in water.
(c) Flagstones should be laid on a 20 to 25 mm thick layer of bed mortar.
(d) It is necessary to give a slope of 1 to 40 in flagstone flooring for proper drainage.
(e) When the stone slabs are properly set, mortar in the joints should be raked out to a depth of about 20 mm.
(f) These joints should be flush pointed with 1:3 cement mortars.
(g) Curing should be done for seven days.

Fig. 5.8: Linoleum flooring

Linoleum Flooring

Linoleum is laid on any base that is finished, even and smooth, such as concrete, timber, boarding or mastic asphalt. Linoleum should be plain, moiré, jaspe or marble (Fig. 5.8).

The thickness of linoleum should be adequate for the condition of the surface. Generally, the following thickness should be used.

Sl. no.	Situation	Thickness
1.	For public buildings, cinemas, restaurants, and shops	6 to 6.7 mm
2.	For offices, shops depending upon the intensity of traffic	3.2 to 4.5 mm
3.	For houses	3.2 mm

The adhesive used to paste the linoleum should be of heavy consistency and have a reasonably short drying time.

Materials and Tools required for Linoleum flooring

(a) Linoleum

(b) Adhesive

(c) Sharp straight edge, gauge, adhesive spreading brush, 70 kg cast iron roller

Procedure

(a) The base is dried completely and made damp-proof because moisture slowly rots the base and damages the adhesive.

(b) Damp-proofing is done with a layer of mastic asphalt, 12.5 mm minimum thickness, spread and finished evenly and smoothly on the concrete or other base.

(c) Linoleum should be kept at a temperature of not less than 20° C, for at least 48 hours, before it is unrolled.

(d) Linoleum should be cut to the required size and shape with straight edge and gauge, and laid dry to the pattern.

(e) First, the length for the border should be cut and adjusted.

(f) Linoleum should then be adjusted in the central portion with their edges overlapping by 12 mm.

(g) Edges should then be cut with the help of a special instrument called 'gauge'.

(h) The adhesive should be brushed over the base. The sheet should then be firmly pressed down and rolled with a light cast-iron 70 kg roller to ensure that they stick evenly to the base.

(i) The sheet should be laid with butt joints throughout. The joints should be very fine.

(j) Sand bags should be placed over the edges and joints to keep the sheet pressed down and to prevent it from curling.

(k) After laying the sheet, any adhesive contaminating the face of the sheet should be removed immediately with kerosene oil or spirit.

(l) After cleaning, the flooring should be wax polished to give it a smooth, shining surface.

Marble flooring

Wooden flooring

Glass flooring

Granite flooring

Fig. 5.9: Various types of flooring

Precautions

There should not be any crease in the linoleum, as it will crack.

Other Types of Floors

(a) Marble stone flooring
(b) Kota stone flooring
(c) Wooden flooring
(d) Wood block flooring
(e) PVC sheet or Tile flooring

Step 1: Dimension and marking

Step 2: Pasting of mortar

Step 3: Positioning

Final fixation

Fig. 5.10: Tile laying

Tile Laying

It is a thin slab or fixed piece of baked clay, sometimes painted or glazed. It is used for various purposes, such as using it to form a roof covering, floor, or revetment. Standard practices are involved in tiling, stone laying, concreting works, brick soling and PCC flooring (Fig.5.10).

Procedure of tile laying

Following is the procedure to lay tiles on the floor.

1. Establish a datum level for the finished floor.
2. Tiles must be correctly positioned when they are placed and laid with joints.
3. Control the overall level of the finished floor by means of a spot check of levels.
4. Check whether the width of the joints is specified before setting out or use a tile spacer for uniform width spacing.
5. Provide 1% slope going to the floor drain.
6. Set out the tiling width joints of consistent width, ensuring they are horizontal and parallel.
7. Grouting of the joints should be carried out within four hours of the completion of the laying of the tiles so that the grout attaches itself firmly to the bedding. Avoid disturbing the tiles during grouting.
8. Ensure that the joints are continuous from one surface to the next where adjoining tile surfaces are in different planes.

Check Your Progress

A. Fill in the blanks

1. The lower surface of a room is known as a _____.
2. Flagstone is a general type of flat _____.
3. _____ is most commonly used type of flooring.
4. _____ flooring is popular for residential as well as public buildings.
5. Terrazzo is a _____ material which is poured in place or precast.

B. Multiple choice questions

1. Thickness of flag stone flooring is kept as _____.
   a) 10 to 15 mm
   b) 15 to 20 mm
   c) 20 to 30 mm
   d) 20 to 40 mm
2. Proportion of cement and concrete in cement concrete flooring _____.
   a) 1:1:2
   b) 1:2:3
   c) 1:2:4
   d) None of the above
3. Terrazzo is a material _____.
   a) simple
   b) composite
   c) hard
   d) None of the above
4. Ceramic tile is made of _____.
   a) clay and sand
   b) clay and cement
   c) cement and sand
   d) None of the above
5. Linoleum is laid on any base _____.
   a) as finished material
   b) as shining material
   c) as coating material
   d) None of the above

C. Short answer questions

1. Mention the slopes required to be provided in flagstone, cement concrete, mosaic and tile flooring.
2. In mosaic flooring, describe the thickness of the top layer for different grades of chips used.

3. Give the sizes of carborundum stones used for the first, second and third stage grinding.
4. Why is it important to provide slopes in tile flooring?
5. List the steps to be followed during tile fixing.
6. Give the procedure of cement concrete flooring.
7. List the steps used for brick flooring.
8. Explain the construction of terrazzo flooring.

ASSISTANT MASON CLASS 10

Unit 5: Flooring Work

Check Your Progress

A. Fill in the blanks

1. The lower surface of a room is known as a _____.
2. Flagstone is a general type of flat _____.
3. _____ is most commonly used type of flooring.
4. _____ flooring is popular for residential as well as public buildings.
5. Terrazzo is a _____ material which is poured in place or precast.

B. Multiple choice questions

1. Thickness of flag stone flooring is kept as _____.
   a) 10 to 15 mm
   b) 15 to 20 mm
   c) 20 to 30 mm
   d) 20 to 40 mm
2. Proportion of cement and concrete in cement concrete flooring _____.
   a) 1:1:2
   b) 1:2:3
   c) 1:2:4
   d) None of the above
3. Terrazzo is a material _____.
   a) simple
   b) composite
   c) hard
   d) None of the above
4. Ceramic tile is made of _____.
   a) clay and sand
   b) clay and cement
   c) cement and sand
   d) None of the above
5. Linoleum is laid on any base _____.
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   b) as shining material
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C. Short answer questions

1. Mention the slopes required to be provided in flagstone, cement concrete, mosaic and tile flooring.
2. In mosaic flooring, describe the thickness of the top layer for different grades of chips used.
3. Give the sizes of carborundum stones used for the first, second and third stage grinding.
4. Why is it important to provide slopes in tile flooring?
5. List the steps to be followed during tile fixing.
6. Give the procedure of cement concrete flooring.
7. List the steps used for brick flooring.
8. Explain the construction of terrazzo flooring.

ANSWER KEY

Unit 1: Stone Masonry

A. Fill in the blanks

1.mortar 2.dowels 3.common, ordinary
4.irregular 5.construction

B. Multiple choice questions

1.a 2.d 3.a 4.c 5.c

Unit 2: Brick Masonry

A. Fill in the blanks

1.course 2.stretcher 3.soaking 4.Lifting, spreading
5.verticality 6.bricks 7.brick work, wall 8.wall
9.Header

B. Multiple choice questions

1.a 2.b 3.b 4.a 5.b

Unit 3: Scaffolding

A. Fill in the blanks

1.horizontal 2.standard 3.putlog
4.compression member 5.thin

B. Multiple choice questions

1.b 2.b 3.a 4.a 5.c

Unit 4: Formwork

A. Fill in the blanks

1.temporary, poured 2.timber
3. 0.6 × 1.8 4.planks

B. Multiple choice questions

1.b 2.b 3.a 4.a 5.a

Unit 5: Flooring Work

A. Fill in the blanks

1.Flore 2.stone 3.Cement Concrete Flooring
4.Granolithic 5.composite

B. Multiple choice questions

1.d 2.c 3.b 4.a 5.a

GLOSSARY

Ceramic: *is any product made of natural clay, mixed in different proportions with water and sometimes organic material, shaped, decorated, usually glazed, and hardened by heat.*

Concrete: *is the mixture of sand, cement, water, aggregates, in suitable proportion.*

Corrosion: *is a phenomenon in which atmospheric oxygen in the air or water reacts with the metal to form oxides.*

Corrugation: *material shaped into a series of parallel ridges and grooves or like crest and trough of wave so as to give added rigidity and strength.*

Emulsion: *is defined as the stable suspension of a hydrophobic substance in a hydrophilic solvent with the aid of soap.*

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

Foundation: *a sub-structure of building that transfers load of super-structure to the soil beneath.*

Hard Strata: *it refers to a soil layer, which has a good bearing strength.*

Lining: *is the support for remaining load of plaster which the wall cannot support by itself.*

Lintels: *is a horizontal building component that lies across an opening and holds the weight of the structure above it. It is generally placed between two vertical supports.*

Mortar: *is a workable paste used to bind building blocks together. (Stones, bricks, and concrete masonry units). Mortar is a mixture of sand, a binder, such as cement or lime, and water.*

Plinth: *it is normally the finished floor level of the ground floor. It is the level where you actually start seeing columns rising, from the floor, though columns penetrate up to footing. Usually kept at 450 mm from existing ground level.*

Porcelain: *ceramic products that have been baked at high temperatures to achieve vitreous, or glassy, qualities, such as translucence and low porosity.*

Quarry: *is a kind of open-pit mine from which rock or minerals are extracted.*

Reinforcement: *steel is used as reinforcement in concrete.*

Sound insulation: *is any material that impedes the transmission of sound waves.*

Structure: *is a series of connected, interrelated elements that togetherform a system that can resist a series of external load effects applied to it, which includes its own self weight, and provide adequate rigidity.*

Sub-structure: *a structure constructed below ground level is termed as sub-structure.*

Super-structure: *a structure constructed above plinth level is termed as super structure.*