UNIT 8 MASONRY WORK

Structure

8.1 INTRODUCTION

Masonry provides bulk of the structure through which the loads of the superstructure are transmitted to the foundation. Usually masonry is done with bricks, tiles, stones or concrete blocks. It makes the skeleton of the structure over which finishing items are applied. Masonry should be strong enough not only to support the dead and live load but also occasional loads like earthquake, wind etc. It is therefore, essential that masonry work is executed as per the specifications decided by the designer.

Objectives

This unit shall help you to understand how to execute masonry works as per the specifications and what aspects are to be checked during execution.

After studying this unit, you should be able to:

- supervise execution of masonry works,
- ensure that finished work conforms to the specification, and
- appreciate the points that are to be carefully looked into during execution.

8.2 MATERIALS

For masonry works we usually use bricks or stone. Stone masonry was adopted before brick making was invented. Brick tiles, concrete blocks or precast concrete blocks are also used for masonry. Bricks and tiles are made by burning clay while stone is a natural material. Concrete blocks are made of stone, cement and sand. Properly executed masonry shall have a fairly long life.

Due to increased cost of bricks we now a days construct thinner walls utilising the intrinsic strength of the brick and masonry, supervision has therefore become more important.

8.2.1 Bricks

Common Burnt Clay Bricks

They shall be free from modules of free lime, visible cracks, flaws, warpage and organic matter. They shall have a frog of size 100 mm × 40 mm × 10 to 20 mm deep in one face. Machine made bricks and brick tiles may not have frogs.

Flyash Bricks

It shall be sound, compact and uniform in shape and free from cracks etc, having a frog like common clay bricks. Flyash shall confirm to grade 1 or Grade 2 of IS: 3812-1981.

Tile Bricks

The bricks of 4 cm height are usually moulded without frogs.

Brick Bats

Brick bats shall be obtained from well burnt bricks.

Sand

Clay and silt in the sand shall prefrerably be less than 5%.

8.2.2 Lime

Lime is most commonly used material from olden days. There are different type of limes available for various uses. Lime shall confirm to class C hydrated lime of IS 712-1984.

Quick Lime: It should be received in the form of lumps and not powders. All overburnt and underburnt lump and powders should be removed from the supply of lime. It should then be converted to lime putty and used.

Hydrated Lime: It should be in the form of dry powder. It should be received in water proof bags or containers and used within 4 months of manufacture.

Storage: Lime should be stored in water proof stores.

Light weight aggregate may also be used. Coarse aggregate should not contain any deleterious material that could affect the strength or durability of concrete or affect the reinforcement. Aggregates which are chemically reactive with alkalies of cement should not be used. The percentage of deleterious material by weight should be less than 5.

8.2.3 Stone

The stone shall be of the type specified such as granite, trap, lime stone, sand stone, quartzite etc. and shall be obtained from approved quarries.

Generally the length of stones for stone masonry shall not exceed three times the height and the breadth or base shall not be greater than three fourth of the thickness of wall or not less than 15cm. The height of stone may be upto 30 cm.

Each stone shall be hammer dressed on the face, the sides and the bed. This would enable stones to be laid closely.

Hydrated lime should be stored like cement.

Testing: Physical and chemical properties of lime should be tested as per IS 6932-1973.

8.2.4 Coarse Aggregate

Aggregates most of which is retained on 4.75 mm IS Sieve is known as coarse aggregate. It can be stone, gravel or brick and should be obtained from approved sources only.

a) **Stone Aggregate**

It should consist of broken, crushed or uncrushed stones. It should be hard, strong, dense, durable and clean. It should be hard, strong, dense, durable and clean. It should be hard, strong, dense, durable and clean. It should be free from veins, adherent coatings, alkali, vegetable matter and other deleterious substances. It should be roughly cubical in shape. Flaky and elongated pieces should be avoided. It should conform to IS:383-1970.

b) **Gravel**

It should consist of naturally occurring river bed (shingle) or pit gravel-crushed, uncrushed or broken. It should be clean, sound and hard. It should be free from flat particles or shale powdered clay, silt, loam, adherent coatings and other deleterious substances. Pit gravels should be properly washed. These should conform to IS:383-1970.

c) **Brick Aggregate**

Brick aggregate should be obtained by breaking well burnt or overburnt dense bricks. They should be homogeneous in texture, roughly cubical in shape, clean and free from unburnt clay, vegetable matters and other deleterous substances. Sulphate content should be less than one per cent. They should absorb less than 10% of their own mass of water when used in cement concrete and less than 20% when used in lime concrete. It should conform to IS 306-1986.

d) **Grading**

The aggregate should conform to the specified grading. At work site different aggregate may be mixed to obtain the required grading. Nominal size of brick aggregate should be 40 mm and conform to specified grading.

8.2.5 Fine Aggregate

Aggregate most of which passes through 4.75 mm IS Sieve, known as fine aggregate, is used in mortar. It can be sand, crushed stone, stone dust, fly ash or crushed brick or cinder commonly known as surkhi. It should be clean, chemically inert, hard, durable, free from organic impurities etc. The silt content in sand should be less than 8%, otherwise it should be washed. The grading of fine aggregate should be determined and checked with the specified grading. By mixing fine aggregate of the same type but of different grading we may get the specified grading.

Bulking

Fine aggregates when fully saturated or dry has almost the same volume but presence of water increases the volume. This is known as bulkage. At the time of preparation of mortar or concrete the bulkage of most fine aggregate need be accounted for so that correct quantity is used. The moisture content of fine aggregate may be determined by any field method. For guidance the following relation can be considered:

Percentage of Moisture	Bulkage Percentage by Volume
2	15
3	20
4	25
5	30

Broken Brick Fine Aggregate

Fine aggregate from broken bricks, known as surkhi, should be made by grinding well burnt, not over or under burnt, broken bricks as specified in IS 3068-1986. It should not contain any harmful impurities like salts, coal, mica, shale etc. as to adversely affect hardening, strength, durability or appearance of the mortar.

8.2.6 Flyash

Flyash is produced during burning of pulverished coal in boilers. Flyash, used should conform to IS 3812-1981. It should be free from impurities. It is generally used as a part replacement of fine aggregate in mortar.

8.2.7 Water

It is important to ensure that water used for mixing and curing is free from harmful quantities of alkalies, acids, oils, organic materials, etc. Otherwise, the masonry may be affected in the long run. Generally potable water is considered satisfactory for mixing and curing. The ph value of water should be not less than 6. It is also important to ensure that sulphite and chloride contents are less than 500 and 2000 mg./litre respectively. It should also be checked that curing water does not produce any stain on the surface.

Sea water should not be used for mixing or curing.

Water from each source should be tested before commencement and subsequently after every three months till the completion of the work as the properties of the underground water gets changed. Test of treated water supplied by municipalities may be less frequent.

8.3 MORTAR

As you know various types of Mortar is formed by mixing, cement, lime or sand in definite proportions with water.

Grade of Masonry Mortar

The grade of masonry mortar should be defined by its compressive strength in N/mm^2 at the age of 28 days as per standard procedure detailed in IS:2250-1981.

8.3.1 Lime Mortar

Lime mortar should be prepared mixing lime putty or dry hydrated lime powder and sand in the specified proportions. Pozzolona may be added if specified. Dry volume of the ingredients should be considered. Lime putty if used should be prepared from fresh lumps of quick lime in tanks of water. Lime putty once prepared should be kept wet till it is used. It can be stored upto fifteen days if kept wet.

Mixing and Grinding

Lime putty and sand with pozzolona if any in the specified proportions should be mixed on a water tight platform or in a trough. It should then be grinded by power driven mobile roller pan mixer conforming to IS 2438-1963. For using manually driven or animal.

Driven mortar mill mortar should be grounded by not less than 180 revolutions for a

minimum of three hours to get a stiff paste of necessary working consistency.

Where the mortar is to be prepared using dry hydrated lime powder, then ingredients should first be mixed dry in a mechanical mixer. Afterwards just sufficient quantity of water should be added to get mortar of required working consistency. Mixing should be done at least for three minutes after adding water.

When mechanical mixer is not available mixing may be allowed by manually operated mixer with the approval of the engineer in charge. Mixing time should be suitable increased in that case.

Lime mortar should be used as soon as possible after mixing preferably on the same day. It should be kept wet by covering with wet jute bags or by any other suitable means and should never be allowed to dry.

8.3.2 Cement Mortar

This is prepared by mixing cement and sand, with or without pozzolona, in the specified proportions. Cement bag weighing 50 kg should be taken as 0.035 cu.m.

The mixing of mortar should be done in mechanical mixers operated by power or manually as decided by Engineer-in-Charge. Cement and sand should be mixed dry thoroughly. Water should then be added gradually and wet mixing continued for at least three minutes till workable consistency is obtained. Mortar should be used as soon as possible after mixing and before it begins to set, preferably within half an hour.

8.3.3 Cement Lime Mortar

This should be prepared by mixing cement, lime putty or dry hydrated lime powder and sand in specified proportions. Mixing should be done in a mechanical mixer.

Lime putty and sand should be mixed and ground as earlier described. Then cement should be added.

In case dry hydrate lime powder is used all ingredients may be mixed simultaneously in mechanical mixture. The mortar should be used within two hours of mixing.

In case of hand mixing cement and sand should first be mixed dry throughly. Lime putty should be mixed with water to make milk of lime, which should be added to the mixture of cement and sand. The mixture should be kneaded back and forth for about ten minutes with addition of milk of lime to obtain mortar of workable consistency.

8.3.4 Cement Flyash Sand Mortar

This should be done by mixing cement flyash and sand in specified proportions. Mixing should be done in a mechanical mixture.

Sand and flyash should be mixed dry in a mixer and then specified quantity of cement should be added and mixed dry thoroughly. Water should then be added gradually and wet mixing continued for at least one minute. Water should be just sufficient to bring the mortar to the consistency of a workable paste. Only the quantity of mortar which can be used within thirty minutes of its mixing should be prepared at a time.

In case of hand mixing the same sequence of mixing should followed.

8.4 CONCRETE

As you know concrete is prepared by thoroughly mixing aggregate, sand, cement or lime mortar and water. Concrete is designed for specified compressive strength by suitable proportioning of the constituent elements, grading of the aggregate and quantity of water. Proper compaction and curing are also very important to attain the specified strength.

8.4.1 Cement Concrete

It is prepared by mixing graded stone or brick aggregate with fine aggregate and cement in specified proportions with required quantity of water. The proportion grading and quality of materials should be such that the specified strength is attained by the concrete. One sample of six cubes 15 cm × 15cm × 15 cm should be taken for every 15 cum of concrete and tested after 7/28 days.

i) **Proportioning:** It should be done by weight or volume as specified. Boxes of suitable size should be used. A bag of 50 kg. cement should be taken as 0.035 cubic metre. For wet sand bulkage should be considered.

ii) **Preparation:** Materials of specified proportion should be mixed in a mechanical batch type concrete mixer fitted with power loader conforming to IS 1791-1985. Hand mixing may be allowed in special circumstances with addition of 10% extra cement. Before mixing brick aggregate should be well soaked with water for at least two hours. Mixing time in a mixer may be 1.5 to 2 minutes.

iii) **Workability:** The quantity of water to be used for each mix should be such that the concrete is of adequate workability for the placing conditions of the concrete and could properly be compacted with the means specified. Regular slump tests should be carried out and water quantity should be regulated accordingly. For concreting of lightly reinforced section with vibrator slump upto 25 mm should be attained. For heavily reinforced section slump of 25 mm-75 mm should be provided.

iv) **Transportation:** Concrete should be transported from the mixer to the place of laying as quickly as possible avoiding segregation or loss of any of the ingredients and maintaining the required workability.

v) **Placing:** Concrete should be deposited as nearly as practicable in its final position to avoid rehandling. It should be gently laid, not thrown. It should be thoroughly vibrated and compacted before setting commences and should not be sequently disturbed. Seggregation should be avoided.

vi) **Compaction:**Concrete should be thoroughly compacted and fully worked around embedded fixtures and into corners of form work. Compaction should be done by mechanical vibrator of appropriate type till a dense concret is obtained. The vibrator should conform to IS 2505-1980. Over vibration should be avoided to prevent seggregation. Hand compaction should be done by tapping rods only in exceptional cases. Compaction should be completed before starting to initial setting. After compaction the top surface should be finished even and smooth with wooden trowel before the concrete begins to set.

vii) **Construction Joints:** Concreting should be carried out upto construction joints as shown in the drawing or as directed by the engineer-in-charge. Number of such joints should be kept minimum. In case concreting has to be resumed on a surface that has hardened, then it should be roughened, swept clean and thoroughly wetted. For vertical joints cement slurry using 2 kg. of cement per sq. metre should be applied on the surface before concreting. For horizontal joints, the surface should be covered with a layer of kept continuously damp by ponding or by covering with a moist layer of material at least for 7 days. Curing should be extended for ten days where portland pozzolona cement is used.

Approved curing compounds may be used in lieu of moist curing with the permission of the engineer-in-charge. Such compounds should be applied to all exposed surfaces of the concert as soon as possible after the concrete has set.

Freshly laid concrete should be protected again rain by suitable covering.

Over the foundation concrete masonry work may be started after 48 hours of its compaction but curing should be continued at least for 7 days. Similarly over the base concrete floor concrete may be laid early but full curing should be done.

8.5.2 Lime Concrete

This should be prepared by mixing coarse aggregate and lime mortar in the specified proportions with required quantity of water.

i) **Proportioning:** The proportions of aggregate to lime mortar should be done by volume. Generally lime is prepared by mixing 100 parts of 40 mm nominal size graded stone aggregate, gravel or brick aggregate as specified and 40 parts of lime mortars of the specified mix.

ii) **Mixing:** Mixing of concrete should be done in a mechanical mixer. Before mixing brick aggregates should well soaked with water for at least 2 hours and mortar 10-15 mm thick composed of cement and sand in the same proportion as in the concrete mix. This should be freshly prepared and applied immediately before placing of concrete.

Where the concrete has not fully hardened, all laitenace should be removed by scrubbing with wire brushes and the surface should be thoroughly wetted without leaving any free water. It should be coated with cement slurry at the rate of 2 kg of cement per sq.m.

iii) Concreting under special conditions should be done as per the procedure set out in IS:7861 (Part I and Part II). Below 40 ^{o}C concreting should not be done. In cold weather it should be protected against frost. During hot weather the temperature of the wet concrete should be kept below 38 ^{o}C.

For under water concreting 10% additional cement should be added. Under water concreting should be done with prior approval of engineer-in-charge regarding the method equipment, materials and mix. Concrete should be deposited continuously until it is brought to required height. The concrete should be deposited under water by one of the approved methods such as tremie method, drop bottom bucket, bags, grouting etc. as per IS 456-1978. The concrete should not be disturbed after placing till it has set.

iv) **Curing:** Depending on the weather as the concrete begins to harden within two to three hours after compaction, the exposed surface should be kept damp with moist gunny bags, sand or any other material. After 24 hours after stone aggregate and gravel should be washed with water to remove dirt and dust. Measured quantity of coarse aggregate and wet ground mortar for one batch should be poured in the drum of the mixer while it is revolving. Water should then be added gradually and wet mixing should be done at least for two minutes in the drum till uniform colour and consistency is achieved. Hand mixing should be allowed only in exception cases with the prior approval of the engineer-in-charge. It should be ensured that mortar did not separate from the coarse aggregate.

v) **Placing and comapction:** Concrete should be laid not thrown in layers of about 20 cm thickness while it is quite fresh. Each layer should be thoroughly rammed with 4.5 kg to 5.5 kg iron rammer and consolidated before the succeeding layer is placed. Joints should be staggered in different layers. Ramming should be done till a skin of mortar covers the surface completely.

vi) **Curing:** After about 24 hours of compaction when the concrete had started hardening it should be kept damp with moist gunny bags, sand, or other approved methods for a minimum period of 7 days. Till then masonry over the foundation should not be started.

8.5 BRICK WORK

Bricks used should be of proper strength and specification. Mortar used should be as specified. Lime should not be used where reinforcement is provided in brick work. Bricks should be thoroughly soaked before use and should be skin dry at the time of laying.

8.5.1 Laying

Bricks should be laid generally in English bond with alternate layers of header and stretcher. For half brick wall bricks should be laid in stretcher bond. Broken bricks should not be used except where necessary to complete the bond. Bricks should be laid on a full bed of mortar. During laying each brick should be properly bedded and set in position by gently pressing with the handle of the trowel. Its inside face should be buttered with mortar before the next brick is laid and pressed against it. Joints should be fully filled and packed with mortar such that no hollow space is left inside the joints.

The walls should be taken up truly in pump of true to the required batter where specified. All courses should be laid truly horizontal and all vertical joints should be truly vertical. Vertical joints in alternate course should come directly one over the other. Quoin, Jambs and other angles should be properly plumbed as the work proceeds. The height of brick courses should be uniform.

No part of the wall should rise more than one metre above the general construction level. Parts of wall left at different levels should be raked back at an angle of 45 degrees or less with the horizontal.

All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls should be embedded as specified, in their correct position as the work proceeds.

Top courses of all plinths, parapets, steps and top of walls below floor and roof should be laid with brick on edge, unless specified otherwise.

Bricks should be laid with frong up except top course where frongs would be filled with mortar before laying.

In case of walls one brick thick and under, one face should be kept even and in proper; plane, while the other face may be slightly rough. In case of walls more than one brick thick, both faces should be kept even.

To facilitate taking service lines later without cutting the completed work, sleeves should be provided, where specified, while raising the brick work.

8.5.2 Joints

The face of brick work may be finished flush or by pointing. In flush finishing either the face joints of the mortar should be worked out while still green to give a finished surface flush with the face of the brick work or the joints should be squarely raked out to a depth of 1 cm while the mortar is still green for subsequently plastering. The faces of brick work should be cleaned with wire brush to remove any splashes of mortar. In pointing, the joints should be squarely raked out to a depth of 1.5 cm while the mortar is still green. The racked joints should be cleaned by brush and well wetted and should be later refilled with mortar to give ruled finish.

8.5.3 Curing

The brick work should be constantly keep moist on all faces for at least seven days. Dates should be boldly written over each days brick work to keep a watch on curing.

8.6 WORKMANSHIP AND QUALITY ASSURANCE

Brick masonry is usually classified as first, second and third class depending on the strength, characteristic and uniformity of shape of bricks and also the workmanship as well as the mortar used.

Stone masonry is classified into various types depending on the preparation of stone pieces and labour involved. Random rubble masonry requires least amount of preparation of stone. Ashlar masonry involves maximum preparation of stone. Stones

shall be laid on their bedding planes and dressed properly.

In stone masonry bond stones or through stones which run through thickness of the wall are very important. The stones should be laid breaking joints and should overlap each other making it a homogeneous mass.

Corner in a stone masonry like window door joints walls etc. are very important. Special type of stones called quions should be used.

In case of veneer work clamps and cramps should be used at proper intervals and shall be of the size and material specified.

The following points shall be checked while supervising masonry construction.

1) Brick shall be checked for strength, efflorescence, dimensional accuracy, water absorption and proper burning. Stones should be checked for uniformity of colour, strength texture compressive strength and water absorption.
2) Grading and silt content of sand for mortar.
3) In brick masonry thickness of joint shall not exceed 1 cm.
4) The joints shall be filled up with mortar.
5) Joints shall be staggered.
6) In brick masonry face joints shall be raked to a depth of 15mm when the mortar is still green.
7) Masonry should be plumb or in specified batter.
8) Bricks and stones should be fully soaked in water and laid skin dry.
9) Brick courses and ashlar masonry should be laid level.
10) Mortar should be properly mixed on a hard platform.
11) Strength of mortar can be checked by scratching with any sharp instrument.
12) Joints between main and cross walls should be properly bonded.
13) Curing should be proper and at least for seven days.
14) General quality of works with respect to lines, levels, thickness and trueness of the joints.
15) In brick masonry top courses in plinth, in window sill, below RCC slab and parapet shall be provided in brick on edge.
16) Holes of scaffolding should be properly filled up.
17) Specified reinforcement in half brick masonry and in corners etc. shall be provided.
18) Required number of bond stones to be provided.
19) Quality of dressing.
20) In stone masonry thickness of joints should not be excessive.
21) Cramps and dowels to be checked for materials size and number.
22) All pipe fittings and specials, spouts, hold fasts and other fixtures which are required to be built into the walls shall be embedded, as specified, in their correct positions as the masonry work proceeds.
23) To facilitate taking service lines later without excessive cutting of completed work sleeves shall be provided where specified, while raising the masonry work.
24) Outlets shall be provided wherever water is likely to accumulate.

SAQ 1

i) How brick masonry is classified into different grades?

ii) Why dry bricks or stones should not be used while laying?

iii) What is the necessity of curing masonry?

iv) What is the use of bond stones?

8.7 MEASUREMENTS

Masonry work shall be measured in cubic metres unless otherwise specified. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to 0.01 m i.e. 1 cm. Areas shall be calculated to the nearest 0.1 sq. metre and the cubic contents shall be worked out to the nearest 0.1 cubic metre.

If not otherwise specified masonry shall be measured separately in the following stages:

a) From foundation to floor one level (Plinth level)

b) Plinth level to floor two level or any other specified level.

c) Between two specified floor levels above (b).

Masonry in parapet walls, mumty, lift machine room and water tanks constructed on the roof shall be measured together with corresponding item in the wall of the storey next below.

Walls of half brick thick and less shall each be measured separately in square metres stating the thickness.

String courses, projecting pilasters, aprons, sills and other projections shall be fully described and measured separately in running metres.

Square or rectangular pillars shall be measured separately in cubic metres.

Circular pillars shall be measured separately in cubic metres as per actual dimension.

Masonry in or under water/or liquid mud and in or under foul positions shall be measured separately for payment of extra rate.

Curved masonry shall be measured and paid for separately.

8.8 TEST REQUIREMENTS

Use of specified quality of materials is the first requirement in any work.

Testing for selection of material to be used is therefore essential.

8.8.1 Bricks

Bricks should have smooth rectangular faces with sharp corner and shall be uniform in colour and gives clear ringing sound when stuck.

Bricks may be modular or non-modular but should be of uniform size.

For carrying out the tests bricks shall be taken at random according to the size of lot so that they become representative sample.

Bricks and brick tiles shall be classified on the basis of their minimum compressive strength as given below in Table 8.1.

Table 8.1

Class Designation	Not Less than kgf/cm^2	Less than kgf/cm^2
100	100	125
75	75	100
50	50	75
35	35	50

Dimensional tolerance for modular bricks shall usually be within the following limits for 20 bricks

Length	380 cm ± 4 cm
Width	180 cm ± 4 cm
Height	180 cm ± 4 cm for 90 mm high bricks
Brick tiles	80 cm ± 4 cm for 40 mm high brick tiles

The lot of bricks and brick tiles found satisfactory in respect of visual and dimensional requirements shall next be tested for other properties.

Time and quality schedule for conducting tests are given in Table 8.2. They are suggestive and can be changed at the discretion of the Engineer in Charge.

Table 8.2

Material	Test	Test Procedure	Min. Qty.	Frequency
Lime	Chemical and Physical properties	IS 6932	5 m tonne	10 mt or part thereof
Sand	(a) Silt content (b) Bulking (c) Particle size distribution	Field	20 cu m 20 cu m 40 cum	20 cu m or 20 cu m or part thereof Every 40 cm or part thereof
Bricks	(a) Dimension	Designation 100 75] 50] 35]	 1,00,000	Every 50,000 Every 1,00,000 or part thereof Test at source
	(b)Water absorption (c)Efflorescenc (d)Compressive strength		 50,000	Test at source 50,000 or part thereof Two tests for 1st lot of 100000 and one test later for every 200000 and part thereof.

Water absorption shall not be more than 20% or as specified.

Efflorescence shall not be more than moderate or as specified.

Stone shall be hard, sound, durable and free from weathering decay and defects like cavities, cracks, flaws, sand holes, injurious veins, patches of loose or soft materials and other similar defects that may adversely affect its strength and appearance.

As far as possible stones shall be of uniform colour, quality and texture. Stone with round surface shall not be used. Percentage of water absorption shall generally not exceed 5% other than specified in Table 8.3

Table 8.3

Type of Stone	Max. Water Absorption Percentage by wt.	Minimum Compressive Strength kg/sq.m.
Granite	0.5	1000
Basalt	0.5	400
Sand Stone	2.5	300
Marble	0.4	500
Quartzite	0.4	800
Laterite (Block)	12	35

Tests for compressive strength shall be carried out as laid down in IS: 1121 (Part I)-1974. Test for water absorption shall be carried out as laid down in IS 1124-1974.

8.9 LIST OF BUREAU OF INDIAN STANDARD CODE

Mortar

List of Bureau of Indian Standard Codes

1)	196-1966	Atmospheric condition of testing.
2)	269-1989	Specification for 33 grade ordinary Portland Cement
3)	383-1970	Specification for coarse and fine aggregate from natural source for concrete.
4)	455-1989	Specification for portland slag cement
5)	460-1985	Specification for test sieves :(Part I) wire cloth test sieves
6)	650-1991	Specification for standard sand for testing of cement.
7)	712-1984	Specification for building lime.
8)	1344-1981	Specification for calcined clay Pozzolana.
9)	1489-1991	Specification for portland pozzolana cement.
10)	1542-1977	Specification for sand for plaster.
11)	1727-1967	Methods of Test for Pozzolanic materials.
12)	2116-1980	Specification for sand for masonry mortar.
13)	2250-1981	Code of Practice for preparation and use of masonry mortar.
14)	2386-(Pt-I) 1963	Method of test for aggregate for concrete (Particle size and shape)
15)	2386-(Pt-II) 1963	-do-(Estimation of deleterious materials and organic impurities.
16)	2386-Pt-III-1963	-do-(Specific gravity, density, voids, absorption and bulking).

17)	2580-1982	Jute sacking bags for pacing cement.
18)	2686-1977	Specification for cinder aggregate for use in Lime concrete.
19)	3025-1986	Method of sampling and test for water.
20)	3466-1988	Specification for masonry cement.
21)	3812-1981	Specification for flyash for use as pozzolana.
22)	4031-1988	Method of Physical test for (Pt I to Pt XIII) hydraulic cement.

Concrete Work

List of Bureau of Indian Standard Codes

1)	383-1970	Specification for coarse and fine aggregate from Natural Source for Concrete.
2)	456-1978	Code of practice for plain and reinforced concrete.
3)	516-1959	Method of test for strength of concrete.
4)	1199-1959	Method of sampling and analysis of concrete.
5)	1200(Pt II)1974	Method of measurement of building and civil engineering work (concrete work).
6)	1322-1982	Specification for bitument felt for water proofing and damp proofing.
7)	1791-1985	Specification for batch type concrete mixers.
8)	2386-1963	Method of test for aggregate for concrete work. a) Pt. I Particle size and shape b) Pt. II Estimation of deleterious materials and organic impurities c) Pt.III Specific gravity, density, voids, absorption and bulking. d) Pt.IV Mechanical properties.
9)	2505-1980	General requirement for concrete vibrators immersion type.
10)	2506-1985	General requirement for screed board concrete vibrators.
11)	2645-1975	Specification for integral cement water proofing components.
12)	2686-1977	Specification for cinder as fine aggregate for use in lime concrete.
13)	3068-1986	Specification for broken burnt (clay) coarse aggregate for use in lime concrete.
14)	3812-1981	Specification for flyash for use as pozzolana and admixtures.
15)	4656-1968	Specification for form vibrators for concrete.
16)	7861-1981	Code of practice for texture weather concreting (Pt. I) recommended practice for hot weather concreting.
17)	7861-1975 (Pt. II)	For cold weather concreting.
18)	9103-1979	For admixtures for concrete.

Stone Work

List of Bureau of Indian Standard Codes

1)	737-1986	Specifications for wrought aluminium and aluminium alloy, steel and strip for general engineering purposes.
2)	1121-(Pt.I)	Methods for determination of properties 1974 and strengths of natural building stones (part I-compressive strength).
3)	1122-1974	Methods for determination of specific gravity of natural building stones.

4)	1123-1975	Methods of identification of natural building stones.
5)	1124-1974	Methods of test for determination of water absorption, apparent specific gravaity and porosity of natural building stones.
6)	1125-1974	Methods of test for determination of weathering of natural building stones.
7)	1126-1974	Methods of test for determination of durability of natural building stones.
8)	1128-1974	Specification for Lime stones (slab & tiles).
9)	1129-1972	Recommendations for dressing of natural building stones.
10)	1200(Pt. IV) 1976	Methods of measurements of building and Civil engineering works-stones masonry.
11)	1597 (Pt.I)	Code of pracatice for construction of 1967 rubble stone masonry.
12)	1597 (pt.II)	Code of practice for construction of ashlar stone masonry.
13)	1805-1973	Glossary of terms relating to stones, quarrying and dressing.
14)	2185-(Pt.I)-	Specifications for concrete masonry units, hollow and solid concrete blocks.
15)	2572-1963	Code of Practice for construction of hollow and solid concrete blocks.
16)	3620-1979	Specification for laterite stone block for masonry.
17)	3622-1977	Sand stone (slab & tiles)
18)	4101-(Pt. I)-	Code of practice for external facings and 1967 veneers (Part I-stone facing).
19)	4101-(Pt.II)	Code of practice for external facing and 1967 veneers (Part II-Cement concrete facing)
20)	12440-1988	Spacing for precast concrete stone masonry blocks.

Brick Work

List of Bureau of Indian Standards Codes

1)	712-1984	Specification for building lime
2)	1077-1986	Specification for common burnt clay building bricks.
3)	1200 (Pt.III)-1976	Method of measurements of brick work
4)	2212-1962	Code of practice for brick work.
5)	3102-1971	ClassificatioOn of burnt clay solid bricks.
6)	3495 (pts i-iv)	Method of test for clay building bricks 1976.
7)	3812-1981	Specification for fly ash for use as pozzolana and admixture.
8)	5454-1978	Methods of sampling of clay building bricks.
9)	12894-1990	Fly ash-lime bricks.

8.10 SUMMARY

In this we have told how to test the materials before use and how to supervise the masonry work. The tests to be performed has been told. The list of Bureau of Indian Standards Code has been mentioned. The important points to be checked while executing masonry work has also been told.

8.11 KEY WORDS

Bond : The arrangement of bricks in successive course to tie the brick work together both longitudinally and transversely. It ensures that vertical joints in successive course are not in one line and there is greatest possible amount of lap.

or

: In stone masonry an interlocking arrangement of structural units in a wall to ensure stability.

Coarse : A layer of bricks including bed mortar.

Bond Stone : Selected long stone used to hold a wall together transversely.

Efflorescence : A powdery incrustment of salts left by evaporation.

Jamb : The part of the wall at the side of an opening.

Joint : A junction of bricks.

Quoin : An external corner in brick work. The term may also denote the brick or stone used to form the quoin.

Scaffolding : A temporary erection of timber or steel work used in the construction or repairs of a building to support or to attend of the hoisting or lowering of workmen, their tools and materials.

Sill : A brick work forming the lower boundary of door or window opening.

Cramp : A small piece of metal or the hardest.

8.12 ANSWERS TO SAQs

SAQ 1

i) Brick masonry is classified into different grades to meet structural requirement and aesthetics on the following points:

a) Shape and uniformity of size of bricks.

b) Compressive strength of bricks.

c) Strength of mortar.

ii) If the bricks or stones are laid dry, then they absorb water from the mortar rendering it weak. The strength of the mortar is the governing factor hence dry brick or stone will weaken the masonry.

iii) The strengh of masonry depends on the strength of materials as well strength of mortar. The mortar for its hardening requires water that is supplied by curring. If masonry is not cured then it will not attain its designed strength.

iv) Bond stones or through stones makes the stone masonry one homogeneous mass.