

AXIS CONSULTANTS

<u>STANDARD CIVIL ENGINEERING SPECIFICATION</u>		
ISSUED: 15-09-2012	MASONRY SPECIFICATION	REV. - 0

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1.0 SCOPE

This specification covers the requirement for material, laying, jointing, curing, testing etc for brick masonry, stone masonry work, laterite block work, concrete block work and pitching.

2.0 APPLICABLE CODES

Note: - Wherever reference is made to IS Codes, on any page of this Technical Specification (including annexures), applicable year of publication of IS Code is as stated below.

The Indian standard codes applicable to this section shall include but not limited to the following:

IS 1077-1992	: Common burnt clay building bricks
IS 1121 (Part 1) - 1974	: Methods of test for determination of strength properties of natural building stones – Part 1 Compressive Strength.
IS 1123-1975	: Method of identification of natural building stones.
IS 1124-1974	: Method of test for determination of water absorption apparent Specific gravity and porosity of natural buildings stones.
IS 1127-1970	: Recommendations for dimensions and workmanship of Natural building stones for masonry work.
IS 1129-1972	: Recommendations for dressing of natural building stones.
IS 1542-1992	: Sand for Plaster.
IS 1597-1992	: Code of practice for construction of stone masonry. Part-1 – Rubble Stone Masonry Part-2 – Ashlar Masonry
IS 1905-1987	: Code of practice for structural use of un-reinforced masonry.
IS 2116-1980	: Sand for masonry mortars.
IS 2180-1988	: Heavy duty Burnt clay building bricks
IS 2212-1991	: Code of practice for brickwork.
IS 2250-1981	: Code of practice for preparation and use of masonry mortars.
IS 2386 (Part 1) To (Part 8)-1963	: Methods of test for aggregates for concrete.
IS 2430–1986	: Methods of sampling of aggregates for concrete.
IS 3495-1992	: Method of test for burnt clay building bricks
IS 3620-1979	: Specification for Laterite Stone Block for Masonry

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IS 4082-1996 : Stacking and storage of construction materials and components at site – Recommendations.

IS 5454-1978 : Methods of sampling of clay building bricks

3.0 PRIORITY OF REQUIREMENTS

In case of any variation and discrepancy in condition between the special conditions, this specification and codes, order of priority shall be as under :-

- (1) Special conditions
- (2) This specification
- (3) Codes

4.0 MATERIALS

4.1 Cement

Cement shall conform to “General Concrete Specification” unless otherwise specified.

4.2 Sand

4.2.1 The sand shall consist of natural sand, crushed stone sand, crushed gravel sand or combination of any of these. The sand shall be hard, durable, clean, free from adherent coatings and organic matter and shall not contain the amount of clay, silt and fine dust more than specified in IS 2116.

4.2.2 The sand shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal or other organic impurities, mica, shale or similar laminated materials, soft, fragmens, sea shells in such form or in such quantities as to affect adversely the hardening, strength or durability of the mortar.

4.2.3 The maximum quantities of clay, fine silt, fine dust and organic impurities in the sand, when tested in accordance with IS 2386, shall not be more than 5% by mass in natural sand, crushed gravel sand or crushed stone sand, unless specified otherwise. For organic impurities, when determined in accordance with IS 2386, colour of the liquid shall be lighter than that indicated by the standard solution specified in IS 2386.

4.2.4 Grading of Sand

The particle size grading of sand for use in mortars shall be within the limits as specified below.

GRADING OF SAND FOR USE IN MASONRY MORTARS

IS SIEVE DESIGNATION IS 460 (PART 1)	PERCENTAGE PASSING BY MASS	REF. TO METHOD OF
4.75 mm	100	IS : 2386 (Part 1)
2.36 mm	90 to 100	
1.18 mm	70 to 100	
600 micron	40 to 100	
300 micron	5 to 70	
150 micron	0 to 15	

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In case of a sand whose grading falls outside the specified limits, due to excess or deficiency of coarse or fine particles, this shall be processed to comply with the standard by screening through a suitably sized sieve and/or blending with required quantities of suitable sizes of natural sand particles or crushed stone screenings which are by themselves unsuitable. Based on test results and practical experience with the use of local materials, deviation in grading of sand may be allowed by the Engineer-in-Charge. The various sizes of particles of which the sand is composed shall be uniformly distributed throughout the mass.

4.2.5 Sampling and Testing

The method of sampling shall be in accordance with IS:2430. The amount of material required for each test shall be as specified in relevant parts of IS:2386. Any test which the Engineer-in-Charge may require in connection with this, shall be carried out in accordance with the relevant parts of IS:2386.

If further confirmation as to the satisfactory nature of the material is required, compressive test on cement mortar cubes (1:6) shall be made in accordance with IS:2250 as instructed by the Engineer-in-Charge. These tests shall be performed, by using the supplied material in place of standard sand and the strength value so obtained shall be compared with that of another mortar made with a sand of acceptable and comparable quality.

4.3 Water

Water for masonry work shall conform to “General Concrete Specification.

4.4 Bricks

4.4.1 General

Bricks for masonry works shall conform to IS 1077 with minimum compressive strength of 50 kg/cm². If locally available bricks are used they shall not be less than 35 kg/cm² compressive strength. Specific requirement for any other class of bricks shall be as shown in drawings or as described in the contract for a particular site or type of work. Physical requirements, quality, dimensions, tolerances, etc of common burnt clay building bricks shall conform to the requirements of IS:1077.

Bricks shall be hand moulded or machine moulded and shall be made from suitable soils. The bricks shall have smooth rectangular faces with sharp corners and shall be well burnt, sound, hard, tough and uniform in colour. These shall be free from cracks, chips, flaws, stone or humps of any kind. Bricks shall give a clean ringing sound when struck. These shall have plane rectangular faces with parallel sides and sharp straight right angle edges.

4.4.2 Tests after delivery

The CONTRACTOR shall take samples of each type of brick as directed by the Engineer-in-Charge as per the requirements of IS:5454 and tests shall be carried out as per IS 3495. The cost for carrying out any or all the tests, shall be borne by the CONTRACTOR. The bricks, when tested, as per IS:3495 shall have a minimum average compressive strength, as given in the Code, for a particular class of brick.

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Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

Brick samples so approved, shall be deposited with the Engineer-in-Charge. All subsequent deliveries shall be upto the standards of the approved samples.

4.4.3 Stacking of Bricks

Bricks shall be stored at site as per the requirements given in IS 4082 and shall not be dumped at site. They shall be unloaded from trucks to a place on a levelled surface near to the work site. They shall be stacked in regular tiers even as they are unloaded, to minimise breakages and defacement of bricks. Bricks of different class shall be stacked separately.

4.4.4 Local Bricks

Where shown on drawings, locally available bricks of non modular size (230mmx115mmx75mm) in place of bricks of modular size (190mmx90mmx90mm) may be used in case the bricks satisfy the other requirements of IS:1077.

4.5 Stone

4.5.1 General

All Stones used for masonry works shall conform to the requirements of IS 1123, IS 1127, IS 1129.

4.5.2 Quality of Stones

Stones shall be of approved quality, hard, dense, strong, sound, durable, clean and uniform in colour. They shall also be free from veins, adherent coatings, injurious amount of alkalies, vegetable matters and other deleterious substances such as iron pyrites, coal, lignite, mica, sea shells etc. Unless otherwise approved, by Engineer-in-Charge, stones from one single quarry shall be used for any one work. The strength of stones should be adequate to carry the imposed load and shall meet all the requirements of IS 1905, taking into account the appropriate crushing strength of stone and type of the mortar used. The percentage of water absorption, when tested in accordance with IS 1124, shall not exceed 5 percent.

4.5.3 Unloading/ Stacking

The stones shall be unloaded from the trucks to a site near to the place of work as defined in IS 4082 and shall be stacked on a firm ground having adequate slope for drainage.

5.0 CEMENT MORTAR

5.1 Cement mortar shall be prepared in accordance with IS 2250.

5.2 Cement mortar shall be prepared by mixing cement, sand and water in specified proportions. The mortar shall be used as soon as possible after mixing and before it has begun to set and in any case within 30 minutes after the water is added to the dry mixtures. Mortar unused for more than 30 minutes shall be rejected and removed from the site of work.

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5.2.1 Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50kgs and this shall be taken as 0.035m³. Sand in specified proportion shall be measured in boxes of suitable size. It shall be measured on the basis of its dry volume. In case of damp sand its quantity shall be increased suitably to allow for bulkage.

Unless otherwise specified, the cement mortar proportion shall be as follows :

Sr.No.	Thickness of Masonry Work	Cement Sand Proportion
1	115mm thk brickwork, hollow concrete block work	1:4
2	230mm thk brickwork, solid concrete block work, stone masonry work.	1:6

5.2.2 Mixing

The mixing of mortar shall be done in mechanical mixer operated manually or by power. The Engineer-in-Charge may, however, relax this conditions at his discretion, taking into account the nature and location of work, practicability of the use of these machines. For items, where the mixers are not to be used, the CONTRACTOR shall take the approval of the Engineer-in-Charge before the commencement of work.

(a) Mixing in Mechanical Mixer

Cement and sand in specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of a stiff paste.

Only the quantity of mortar which can be used within 30 minutes of its mixing, shall be prepared at a time.

Mixer shall be cleaned with water each time before suspending the work.

(b) Hand Mixing

The measured quantity of sand shall be levelled on clean water tight platform, and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of a stiff paste.

6.0 **CONSTRUCTION OF BRICK MASONRY**

6.1 Soaking of bricks

Bricks shall be thoroughly soaked in clean water before use until air bubbles cease to come out. The soaked bricks shall be kept on suitable platform to avoid earth being smeared on them.

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The practice of dipping the bricks in water just before use shall not be allowed. All necessary water cisterns for this purpose shall be constructed or tubs brought by the contractor shall be to the satisfaction of the Engineer-in-Charge to ensure proper soaking of bricks.

6.2 Laying

All masonry work shall comply with the requirements of IS:2212 and shall be laid in English bond unless otherwise specified.

No half or broken bricks shall be used, except as closures. No underburnt or overburnt bricks shall be used.

Bricks shall be laid with frog upwards. While laying, bricks shall be thoroughly bedded and flushed in mortar. They shall be tapped into position with a mallet and the superfluous mortar removed.

Each brick shall be adjusted to its final position in the wall, while the mortar is still soft and plastic. Any unit which is disturbed after mortar has stiffed, shall be removed and re-laid with fresh mortar.

All courses shall be laid truly horizontal and all vertical joints shall be truly vertical.

The levels and verticality of the brick work in walls shall be checked up at every 1m interval.

Masonry work shall be raised in a uniform manner, so that no one portion is being raised more than 1m above another portion, at one time.

At the junction of any two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

Masonry work, if unfinished shall be stepped back for joining with new work. Toothing may be resorted to only if specifically approved. Before the new work is started, all loose mortar shall be removed and the exposed joints thoroughly cleaned, before the laying of new work.

Spaces around metal door frames and other built up items shall be solidly filled with mortar. Anchors, wall plugs, accessories, flashings and other items required to be built in with masonry shall be provided in the walls, as the work progresses. Iron holdfasts shall be given a coating of Bitumen to avoid rusting.

6.3 Jointing

All horizontal bed joints shall be 10mm thick and the vertical joints 6mm wide.

The vertical joints in alternate courses shall come directly one above the other and shall be truly vertical.

Care shall be taken that all joints are fully mortared, well flushed up and in case where no pointing is to be done, neatly struck as the work proceeds.

The joints in faces which are to be plastered or pointed shall be squarely raked out, to a depth of 12mm, while the mortar is still green.

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All raked out joints shall be well brushed to remove loose particles. After the work, the faces of the brick work shall be cleaned with wire brush and all mortar droppings removed.

6.4 Half Brick Walls

These walls shall be provided a horizontal reinforced concrete band (M15). The band shall be provided at every fourth course and shall consist of 2 nos. of 6mm mild steel round bars with 3mm binders spaced at 150mm centers. Such bands shall also be provided at the free edge of all masonry work including window sills and top of free standing walls.

The walls shall be provided with reinforced concrete posts (M15), of size 230mmx115mm at every 3m and at corners. These posts shall have 4nos. of 6mm vertical mild steel round bars with 6mm rings spaced at 150mm centers.

The partition walls shall be constructed in two stages. In the first stage, the brick work with horizontal bands shall be constructed, leaving the gaps for vertical posts, which shall be concreted in the second stage.

6.5 Curing

Green work shall be protected from rain by suitable covering. Masonry work as it progresses shall be kept thoroughly well watered on all faces for atleast 7 days. Curing shall start commence 24 hours after laying.

6.6 Tolerances

The permissible tolerance in brickwork as per IS 1905 shall be as follows:

Sr. No.	Item	Tolerance (Not more than)
1	Deviation from position shown on plan of any brick work.	12.5mm
2	Deviation from vertical within a storey.	6mm per 3m height
3	Deviation from vertical in total height of building.	12.5mm
4	Relative displacement between load bearing walls in adjacent storeys and intended to be in vertical alignment.	6mm
5	Deviation from line in plan upto 12m.	6mm
6	Deviation from line in plan over 12m.	10mm (total)
7	Deviation of bed joint from horizontal	
	In any length upto 12m	6mm
	In any length over 12m	12mm (total)

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7.0 CONSTRUCTION OF STONE MASONRY

7.1 Stone

7.1.1 Stone masonry, wherever required shall conform to the requirements of IS:1597 and shall be composed generally of large stones.

7.1.2 The stones shall be roughly dressed and uniform in colour and of equal in size on the face. The face stone shall be flat beaded, shall tail back and bound well into body of the wall and shall not be of height greater than either the breadth on face or length of the tail.

7.1.3 Face stones shall be hammer and chissel dressed on all beds and joints so as to give them approximately rectangular shape. These shall be square on all joints and bed faces. The bed joints faces shall be chisel drafted for atleast 80mm back from the face and for the side joint faces for at least 40mm. No portion of the dressed surface shall show a gap more than 6mm from straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints.

7.1.4 Through stones covering the whole width of walls or 600mm long, where the walls are thicker than 600mm, shall be inserted at every 800mm measured horizontally and vertically.

If the wall is more than 600mm thick, a line of headers, shall be laid from face to back, which shall overlap each other, by atleast 150mm.

7.1.5 The stones shall be clean bedded, properly selected for their places and carefully laid with a suitable proportion of smaller stones and chips, to fill up the interstices. The mortar including the constituents, shall conform to the requirements of IS:2250.

7.1.6 The whole masonry shall be hand set, solidly bedded and surrounded with mortar on every side except the face.

There shall be no hollows or dry portions in work nor pinning on the face.

Joints shall not exceed 25mm in thickness.

7.1.7 The masonry work as far as possible, shall be carried up, at one uniform level throughout. Where breaks are unavailable, the joint shall be made in long steps, so as to prevent cracks arising between the new and old work.

7.1.8 The stones shall be arranged to break joints as far as possible. Long vertical lines shall be avoided in the face work.

7.1.9 All fixtures, plugs, frames shall be placed securely as the work proceeds and not after completion of the masonry. Iron holdfasts shall be given a coating of Bitumen to avoid rusting.

7.2 Laterite Blocks

7.2.1 Laterite blocks used in construction shall conform to IS 3620. The stone blocks shall be without any soft veins, cracks, cavities, flaws and similar imperfections.

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- 7.2.2 The blocks shall be exposed atleast for the period of three months before being used in the construction of masonry to ensure adequate stabilization. Exposure to rain shall be avoided.
- 7.2.3 Blocks shall have specific gravity not less than 2.5 and shall absorb water not more than 12% by mass, when tested in accordance with IS:1124. Compressive strength of blocks when tested in accordance with IS:1121 (Part I) shall not be less than 3.5N/mm². The compressive strength is for saturated dry samples.
- 7.2.4 Block sizes shall be generally in accordance with IS:3620. If CONTRACTOR intends to use other sizes manufactured locally, the same shall be submitted for approval to Engineer-in-Charge. Tolerance of ± 5 mm shall be allowed on dimension.
- 7.2.5 In any consignments, all the blocks from the same quarry shall be grouped together to constitute a lot. Sample blocks shall be selected by Engineer-in-Charge and tested separately for each lot for determining its conformity to the requirements of the specification. The number of blocks to be selected for the sample, shall depend on the size of the lot and shall be generally in accordance with Table-1.
- 7.2.6 All the blocks selected as given in Column 2 of Table-1 shall be examined for general requirements, dimensions and workmanship. Any block failing in any one or more of the above requirements shall be considered defective. A lot shall be considered as conforming to these requirements, if number of defective blocks is not more than the permissible number given in Column 3 of Table 1.
- 7.2.7 The lot shall be further tested for physical properties for which a sub-sample as given in Column 4 of Table-1, shall be selected at random. These blocks shall be first tested for compressive strength and then for water absorption and specific gravity. A lot shall be considered satisfactory, if none of the blocks tested fails in any of these tests.

TABLE - 1

No. of Blocks	No. of Blocks in Sample	Permissible No. of Defectives	Sub-Sample Nos.
1	2	3	4
Upto 100	5	0	3
100 to 300	8	0	3
301 to 500	13	0	6
501 and above	20	1	6

- 7.2.8 All materials rejected by Engineer-in-Charge, due to non-conformity to specifications shall be promptly removed and replaced by new material for Engineer-in-Charge's approval at CONTRACTOR's own cost.

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8.0 CONCRETE BLOCK WORK

8.1 Constituents of Concrete Block

8.1.1. Aggregates

For reason of economy, strength and density it is desirable to use coarse aggregate which is retained on a 4.75mm sieve and a well graded sand. The maximum size of aggregate should not exceed 12.50mm. A Fineness Modulus (FM) of the combined aggregate of 3.6 to 4.20 is recommended.

8.1.2 Admixtures

Admixtures like air-entraining agents, colouring pigments, substance to control or adjust the set and hardening of the mix, substance to improve workability of the mix can be mixed as per manufacturer's specifications with the approval of Engineer-in-Charge.

8.1.3 Mix of Concrete

The mix shall be 1 part of cement and 6 parts of combined aggregates by weight.

8.1.4 Quantity of mixing water

In block manufacturing, a mix much drier than that of ordinary field concrete is used, since the block is removed from the mould as soon as it is compressed.

8.1.5 Mixing

Concrete shall be mixed in a mechanical mixer till uniform distribution of material in uniform colour is obtained.

8.1.6 Curing

Blocks should not be removed from the place of casting for curing until they are sufficiently strong. From casting platform, the blocks are removed to a curing yard where they are frequently sprinkled with water and kept continuously moist for atleast 10 days. Curing blocks by immersing in a water tank shall not be allowed.

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8.2 Physical Requirements

At the time of delivery to the work site, concrete blocks shall conform to the physical requirements as given in table below. Water absorption shall not be more than 20% by its dry weight, when soaked in cold water for 24 hours.

TABLE – 2 PHYSICAL REQUIREMENTS

Type and grade of concrete masonry unit	Minimum compressive strength, kg/cm ² of average gross area	
	Average of 3 units	Individual Unit
Hollow blocks	50	40
Solid blocks	85	70

8.2.1 Dimensions

The nominal size of concrete block are :-

Length : 400mm, 500mm, 600mm

Height : 200mm, 100mm

Width : 100mm, 150mm, 250mm and 300mm

In addition blocks may also be manufactured in half lengths of 200mm, 250mm and 300mm to correspond to the full lengths.

8.2.2 Tolerances

The maximum variation in the overall dimensions of the units (length, height and width) should not be more than ± 3 mm.

8.3 Construction

Construction of block masonry shall be same as that of brick masonry explained earlier.

8.4 Joints

Same as in brick masonry. The joints are classified as horizontal and vertical joints. The thickness of the joints should be restricted to 10mm.

8.5 Curing

Green work shall be protected from rain by suitable covering. The blockwork shall be kept wet for a period of atleast 7 days commencing from 24 hours after laying.

9.0 SCAFFOLDING

Scaffolding shall be properly planned and designed by the CONTRACTOR. It shall be approved by Engineer-in-Charge before commencement of work. Double scaffolding, sufficiently strong so as to withstand all loads likely to come upon it and having two sets of vertical supports, shall be provided. Where two sets of supports are not possible, the inner end of the horizontal scaffolding member shall rest in a hole provided in the header course only. Only one header for each member shall be left out. Such holes shall be filled up immediately after removal of scaffolding.

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The following measures shall be considered while designing and erecting of scaffolding.

- (a) Sufficient sills or under pinnings in addition to base plates shall be provided particularly where scaffoldings are erected on soft grounds.
- (b) Adjustable bases to compensate for uneven ground shall be used.
- (c) Proper anchoring of the scaffolding/ staging at reasonable intervals shall be provided in each case with the main structure wherever available.
- (d) Horizontal braces shall be provided to prevent the scaffolding from rocking.
- (e) Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
- (f) The scaffolding/ staging shall be checked at every stage for plumb line.
- (g) All nuts and bolts shall be properly tightened.
- (h) Wherever steel tubes are used care shall be taken that all the clamps/ couplings are firmly tightened so as to avoid any slippage.

10.0 PITCHING

10.1 Materials

10.1.1 Stone

Stone shall be of best quality and approved by Engineer-in-Charge. It shall be hard, sound and free from delay, weathering and fissures. Stone with round surface shall not be used. The size of stone shall be 150 to 300mm thick.

10.1.2 Sand

Sand shall conform to IS 2116 and IS 1542, and as approved by Engineer-in-Charge.

10.2 Dressing of stones

Stones shall be hammer dressed on the face and side. The projections shall not be more than 40mm on exposed face and 15mm on the face to be plastered.

10.3 Thickness of Pitching and size of stones

The thickness of pitching shall be 300mm, unless specified otherwise.

The size of stones shall be 150 to 300mm thick, unless specified otherwise.

10.4 Mortar

Cement mortar 1:6 shall be used for jointing and 1:4 for pointing.

10.5 Preparation of Sub Grade

10.5.1 The sub grade shall be prepared, dressed and rolled true to level and according to required levels and cross sections to form a firm compacted bed for the pitching.

10.5.2 If at any point, material of prepared subgrade has been excavated beyond the required levels of pitching, the excess excavation shall be filled with material compatible with subgrade material and thoroughly compacted.

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10.5.3 The sub grade shall then be uniformly soaked with water, without making it slushy to ensure that water penetrates to a depth to about 300mm in sandy soil and about 150mm in other soils.

10.6 Laying

The surface to be stone pitched shall be properly dressed and rammed prior to commencement of the work and the approval of the Engineer-in-Charge shall be obtained. Stones used shall be wetted before use. The surface shall be properly watered before placing the stone. The stones shall be carefully laid and hammered down with a mallet to positions. The bond shall be obtained by fitting in closely the adjacent stones and properly applying the cement mortar to the joint. The slopes as shown in the drawing shall be maintained.

10.7 Joints

Stones shall be so laid that all joints are full of mortar. Face joints shall not be more than 25mm thick, joints shall be struck flush and finished at the time of laying. Joints shall be raked to a depth of 20mm during construction in case of plastering or pointing.

10.8 Flush Pointing

The joints shall be brushed clean of dust with a wire brush and wetted thoroughly for 6 hours before pointing is commenced. The raked joints shall be filled with cement mortar of specified grade and shall be well pressed on the face and rubbed smooth. After pressing the mortar to the joints, a neat cement wash shall be given to the mortar area only and finished smooth. The finished work shall give a clean, well worked look without blotches or runs or mortar on stone surface.

10.9 Curing

Green work shall be protected from rain by suitable covering. Pitching work shall be kept constantly moist for a minimum period of 10 days.