KARNATAKA RURAL INFRASTRUCTURE DEVELOPMENT LIMITED

(FORMERLY KARNATAKA LAND ARMY CORPORATION LIMITED)

GRAMEENABHIVRUDDHI BHAVANA, 4th & 5th FLOOR, ANAND RAO CIRCLE BANGALORE-9

Instructions for Quality Control at site for buildings

Prescribed By:
Quality Control Cell,
KARNATAKA RURAL INFRASTRUCTURE DEVELOPMENT LIMITED, BANGALORE

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Contents

All these specifications and tables have been drawn by referring IRC codes, Building codes, KRRDA norms and IS codes, compiled and rearranged by
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1. CONCRETE FOR STRUCTURES

A. Methodology

A 1 General

1. Plan all activities before mixing and placing of concrete in Works. This includes procurement ofmaterials, sample testing of cement, coarse and fine aggregates, water and trial mix of the ingredients to achieve the desired strength and workability.

2. Estimate the total quantity of concrete required for the day's work besides additional quantity required for sampling (cubes, cylinders, beams) and plan production of concrete. All ingredients of concrete shall be specified by weight.

A 2 Production of Concrete

1. Designate concrete in grades viz M10, M15, M20, M25, M30 where the characteristic strength of concrete is defined as the strength of concrete below which not more than 5 percent of the results are expected to fall.

2. Choose Design Mix of grades higher than M20 for large works. For culverts and small bridges involving small quantity of concrete, nominal mix of grades M20 and M25 may be used with adequate supervision and quality control measures.

3. The suggested grades of concrete (based on 20 mm aggregate) together with cement content, maximum water-cement ratio for different exposure conditions indicated in Table 1.1.

TABLE 1.1: CEMENT CONTENT AND WATER CEMENT RATIO

	Grade of Concrete		Minimum Cement Content (kg/m3)		Minimum Water Cement Ratio	
Condition of Exposure	Normal	Severe	Normal	Severe	Normal	Severe
a) Plain Cement Concrete (PCC)	M 15	M 20	250	310	0.50	0.45
b) Reinforced cement Concrete (PCC)	M 20	M 25	310	400	0.45	0.40

4. Use Mechanical mixer (min. one bag capacity) fitted with water measuring device for culverts and small bridges with length less than 60 m and individual span less than 15 m. However for control mix of M 25 for superstructure, use mechanical mixer of minimum 200 litre capacity having integral weigh batching facility, automatic water measuring and dispensing device.

5. Avoid hand mixing of concrete for use in structural concrete except for isolated culverts (upto 2 m) in remote areas or for certain other reasons. Add 10% extra cement in such situations.

6. Use Admixtures where necessary to meet specific requirements of concrete.

A 3 Transportation, Placing and Compaction of Concrete.

1. After mixing, transport concrete to the formwork as quickly as possible in wheel borrows to site. Transport and place concrete such that no contamination, segregation or loss of its constituent materials or ingress of foreign material or water takes place.

2. Proceed with concreting continuously, over the areas between construction joints. Deposit concrete in horizontal layers to a compacted depth of not more than 450 mm, when internal vibrators are used and not more than 300 mm in other cases.

3. Choose appropriate methods of placing concrete so as to preclude segregation.

4. Compact concrete using internal (needle/poker) vibrators of suitable size or form vibrators, during placing and worked around the reinforcements, to produce dense, homogeneous and void free mass.

5. Compact before the initial setting but not later than 30 minutes of its discharge from the mixer

A 4 Concreting under Water and in Extreme Weather

1. When it is necessary to deposit concrete under water, add 10 percent more cement than required and place the mix dry. Proportion the materials so as to produce a slump between 100-180 mm.

2. Make cofferdams or forms in water, sufficiently tight to prevent loss of mortar through the joints in the walls. Avoid pumping of water, while concrete is being placed or until 24 hours thereafter.

3. Where concrete is to be deposited at or near freezing temperatures, heat the mixing water to a temperature below 65^0C and if necessary heat the aggregates as well, before mixing.

4. When concrete is to be deposited in hot weather, ensure that the temperature of green concrete does not exceed 40^0C before placement. Ensure this by mixing water with ice and keeping the aggregates under shade before use and cool the outside of formwork by water sprinkling.

A 5 Curing Protection and Finishing

1. Commence curing and protection immediately after the compaction of concrete, to prevent premature drying, leaching out by rain etc.

2. After initial set (about two hours) of concreting, cover the work with moist gunny bags, canvas, hessian or similar material.

3. After 24 hours, keep all exposed surfaces of concrete in damp or wet condition by pouring or by wet covering with a layer of sacks, canvas, hessian for a period of not less than fourteen days from the date of placement.

4. Use curing compounds only in special circumstances. Avoid use of curing compound at locations where concrete surfaces are required to be bonded together.

5. Examine concrete immediately on removal of formwork and any defects are be made good. Cut all exposed bars or bolts passing through RCC member and used for shuttering or any other purpose, to a depth of 50 mm below the surface of the concrete and close the holes with cement mortar.

A 6 Construction Joints

1. Do not place fresh concrete against concrete which has hardened in position for more than 30 minutes or initial set unless proper construction joint is formed.

2. Before concreting fix a stopping board at predetermined position, for vertical construction joint, which has adequate lateral rigidity to withstand lateral displacement or bulging during concreting.

3. Continue concreting upto the board. Remove the board before expiry of 24 hours.

4. Before resuming work on a partially hardened surface , remove all laitance by scrubbing the wet surface with wire or bristle brush. Coat the prepared surface, thoroughly wetted, with cement grout. Keep thickness of first layer of fresh concrete upto 150 mm and well ram against old work.

5. Before resuming work on a fully hardened surface, hack the surface without dislodging coarse aggregate, clean loose material, wet it and cover with a layer of cement grout. Apply a 10 mm thick layer of cement mortar and resume concrete. Keep the proportion of cement and sand in cement mortar equal to that in concrete mix proportion.

6. Ram the first batch of concrete against old work, to avoid formation of any pockets, by paying attention to corners and close spots.

7. Carefully tool all construction and expansion joints in the completed work, free from any mortar and concrete. Leave expansion joint filler exposed for its full length with clean and true edges.

B. Quality Control Requirements

1 Materials

(i) Cement

Use any of the following types of cement given in Table 1.2 for Structural Concrete

TABLE 1.2: TYPES OF CEMENT

Type	IS Code
Ordinary Portland Cement 33 Grade	IS:269
Ordinary Portland Cement 43 Grade	IS:8112
Rapid Hardening Portland Cement	IS:8041
Portland Pozzolana Cement	IS:1489 (Part 1)
Portland Blast Furnace Slag Cement	IS:455
Sulphate Resistance Portland Cement	IS:12330

Obtain samples of cement once for each source of supply and occasionally when called for determine various properties given in Table 1.3

TABLE 1.3: REQUIREMENTS OF CEMENT

Property	Permissible Value	Tested as per
Fineness	Specific surface not less than 225 m2/kg	IS: 4031 (Part 1,2 & 15)
Setting	Time Initial set > 30 minutes Final Set < 600 minutes	IS: 4031 (Part 1)
Soundness	Not to exceed 10 mm in Lechatelier Mould	IS:4031 (Part 3)
Compressive Strength At 3 days At 7 days At 14 days	33 Grade 43 Grade 16 Mpa 23 Mpa 22 Mpa 33 Mpa 33 Mpa 43 Mpa	(IS:4031:Part 6)

** The initial setting of test blocks shall not differ by ± 30 minutes from the initial setting of control test blocks prepared with the same cement and distilled water.*

(ii) Coarse aggregates

The gradation of coarse aggregate shall satisfy the requirements given in Table 1.4

TABLE 1.4: GRADATION OF COARSE AGGREGATE

	Percent by weight passing the sieve for Nominal size of		
IS Sieve Size	**40 mm**	**20 mm**	**12.5 mm**
63 mm	100	-	-
40 mm	95-100	100	-
20 mm	30-70	95-100	100
12.5 mm	-	-	90-100
10.0 mm	10-35	25-55	40-85
4.75 mm	0-5	0-10	0-10

(iii) **Fine Aggregates**

The gradation of fine aggregates shall satisfy the requirements given in Table 1.5

TABLE 1.5: GRADATION OF FINE AGGREGATES

	Percent by weight passing the sieve		
IS Sieve Size	**40 mm**	**20 mm**	**12.5 mm**
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 Micron	15-34	35-59	60-79
300 Micron	5-20	8-30	12-40
150 Micron	0-10	0-10	0-10

(iv) **Water**

Samples of water used in making mortar and concrete are tested once for approval of source of supply and subsequently only in case of doubt The permissible limits for solids in water are got tested in an approved laboratory as directed by Engineer as given in Table 1.6

TABLE 1.6: LIMITS FOR SOLIDS IN WATER

	Maximum permissible limit
Organic	200 mg/litre
Inorganic	3000 mg/litre
Sulphates (as SO4)	400 mg/litre
Chlorides (as Cl)	2000 mg/litre (For Plain Concrete) 500 mg/litre (For Reinforced Concrete
Suspended matter	2000 mg/litre

Tests on Water:

Sample: Reference No: Date & Time:

Name of project: Place of work:

Name of work: Estimation cost:

Laboratory tests on Water

Sl. no.	Tests carried out	BIS code Ref.	Results obtained		Remarks
			As per Standard	As per report	
1	PH value	IS 3025-1964			
2	Concentration of solids in water				
3	Sulphate impurities				
4	Organic / Inorganic solids	456-1978			
5	Chloride content				

(v) **Concrete**

The grades of concrete and their equivalent nominal mix (using 43 Grade cement) are given in Table 1.7

TABLE 1.7: NOMINAL MIXES OF CONCRETE

Grade of Concrete	Nominal Mix
M 10	1 :3 :6
M 15	1:2 ½: 5
M 20	1:2:4
M 25	1: 1½ :3

- Add approved quality of plasticizer @ 300 ml per 50 kg of cement to M 25 grade concrete as per Manufacturers specifications

a. The workability of fresh concrete by slump test is determined as per IS:1199 @ one test per 3m3 of concrete at the place of mixing and/or at worksite.

b. Samples of concrete cubes for making three test cubes shall be taken from a batch of concrete at the point of discharge from the mixer as per the procedure laid down in IS: 1199. Only 150 mm cubes shall be made cured and tested at 28-day age, to determine compressive strength as per IS:516.

(vi) Frequency of Sampling

The minimum frequency of sampling of concrete of each grade is given in Table 1.8

TABLE 1.8: FREQUENCY OF SAMPLING

Quantity of concrete in work (m3)	No. of samples
1-5	1
6-15	2
16-30	3
31-50	4

Acceptance Criteria

a. Take decision for acceptance based on sample tests lot by lot.
b. The mean strength of any group of four consecutive samples shall exceed the specified characteristic compressive strength by 3 Mpa.
c. The strength of any sample shall not be less than the specified compressive strength minus 3 MPa.
d. The quality of concrete represented by test results shall include the batches from which the first and last samples were taken, together with all intervening batches.

(vii) Sulphate and Chloride Content

The total water soluble sulphate and chloride contents in concrete shall not exceed the values given in Table 1.9

TABLE 1.9: SULPHATE AND CHLORIDE CONTENTS

Details	Content
Sulphate content as (SO3)	4 percent
Chloride content	0.3 percent by mass of cement (Moderate condition)
(As Chloride ion)	0.20 percent by mass of cement (Severe condition)

(viii) Use of plums in ordinary concrete

Stone plums shall not be used in RCC or Concrete laid in water. The general requirements for the usage of plums are given in Table 1.10

TABLE 1.10 REQUIREMENT FOR USAGE OF PLUMS

Size	160-300 mm (Maximum dimension not to exceed 1/3 least dimension of member)
Quantity of Plums in works	Not to exceed 15 percent by volume

(ix). Storage of Materials (Cement, Fine and Coarse Aggregates)

a. The requirements of storage for cement and fine aggregates are as per Sub-section 2.

b. Store different sizes of coarse aggregates in separate stock piles sufficiently away from each other to prevent intermixing. Keep the height of individual stockpile below 120 mm, unless otherwise permitted. When placed directly on hard ground, do not remove them from stockpile within 300 mm of the ground. Use the bottom 300 mm of stockpile only after thorough cleaning of the material.

2. Tolerances

The accuracy of the measuring devices used for different ingredients shall fall within the limits given in Table 1.11

TABLE 1.11: ACCURACY OF MEASURING DEVICES

Measurement Quantity	in each batch
Cement	± 3% of cement quantity
Water	± 3% of water
Aggregate	± 3% of aggregate
Admixture	± 5% of admixture

3. Mechanical Vibrators

The capacity/size of the vibrators for compaction of concrete is given in Table 1.12

TABLE 1.12: CAPACITY/SIZE OF VIBRATORS

Type of Vibrator	Conforming to	Capacity/size
Internal Vibrators	IS: 2505	25-70 mm
Form Vibrators	IS: 4656 Minimum	500 Watts
Screed Vibrators	IS: 2506	Full width of carriageway (upto two lanes)

4. Quality Control Tests / Checks

4.1 Tests prior to construction

The tests and checks to be carried out prior to construction are indicated in Table 1.13

TABLE 1.13: QUALITY CONTROL TESTS PRIOR TO CONSTRUCTION

S.No.	Material / Work	Test / Check	Frequency
1.	Cement	a) Setting Time (IS:4031 Part 5) b) Soundness (IS:4031 Part 3) c) Compressive strength of mortar cube (IS:4031 Part 6) (Table 1.3)	One test for 10 tonnes of Cement (same brand & grade) - do – 3 specimens for each lot
2.	Coarse Aggregates	a) Gradation for PCC or RCC works (Table 1.4) b) Flakiness index (IS:2386 part 1) c) Deleterious constituents (IS:2386 part 2) d) Water absorption / content (IS:2386 part 3) e) Aggregate Impact value (IS:2386 part 4) f) Soundness (IS:2386 part 5) [if water absorption exceeds 2%] g) Alkali Silica reactivity (IS:2386 part 7)	3 samples for each quarry source -do - If in doubt Once for each source of supply One test per source of supply - do - If in doubt one test at approved test house

3.	Fine Aggregates	a) Gradation (IS:2386 part 1) (Table 1.5) b) Deleterious Constituents (IS:2386 part 2) c) Alkali silicate reactivity (IS:2386 part 7)	3 samples for each source of Supply If in doubt, one test If in doubt, one test
4.	Water	Normally potable water is good enough for making concreteDetermination of Impurities - Suspended matterIS:3025 (Part 17) - OrganicIS:3025 (Part 16) - Inorganic IS:3025 (Part 19) - Sulphates (as SO3)IS:3025 (Part 24) - Chlorides (as Cl)IS:3025(Part 32) (Table 1.6 for limits)	For large works If the quality is in doubt Samples taken from each source and tested at an approved test house
5.	Concrete	Mix Design (for each work)	To be approved by EE for cement content, W/C ratio and use of plasticizers, if any.

4.2 Tests / checks during construction

The tests required to be carried out during construction are indicated in Table 1.14

TABLE 1.14: QUALITY CONTROL TESTS DURING CONSTRUCTION

S.No.	Material / Work	Test / Check	Frequency
1.	Fine and coarse aggregate	Moisture content (IS:2386 part 3)	Once before commencement of work – each day
2.	Cement (consumption)	Minimum quantity (Kg/m3)	Daily
3.	Concrete	a) Workability – slump cone test (IS:1199) b) Cube Strength (IS:516)	2 tests/ day Minimum of 6 cubes (3 each to determine 7 days and 28 days strength) to be cast every day)
4.	Construction Joints	Fixing location before concreting and resumption of work	As and when work demands
5.	Formwork	For stability, leakage of slurry, bulging etc.	Throughout concreting
6.	Concreting	a) Transporting / placing segregation of concrete b) Precautions for hot weather or cold weather concreting c) Compaction with vibrators	Random check in each member Once check before commencement of work Regularly
7.	Curing of concrete	Regular (till 28 days after casting) inspection	Daily

4.3 Quality Control Checks by AE / EE

Quality checks to be exercised by AE / EE are indicated in Table 1.15

TABLE 1.15: QUALITY CONTROL CHECKS BY AE/EE

S. No.	Material / Work	Test / Check	Frequency	Designation of Inspecting Officer
1.	All concrete components	a) Soundness of concrete - Sounding Test by striking with a ½ Kg hammer - Schimdt's Rebound hammer test (if quality is in doubt)	After hardening of concrete	AE
		b) Honey Combing and Finishing	Before acceptance of work	AE
		c) Tolerances	As per drawings	AE
		d) Workmanship	As and when inspected	EE
2.	Cube Strength	Review of Cube strength test results	Random	EE

C. Do's and Don'ts

Do's	Don'ts
1. Use cement of the same grade and same source for a single work.	1. Do not mix different types of cement or mix Blast Furnace Slag with Ordinary Portland Cement at site.
2. Use 20 mm (nominal) size aggregate for RCC.	2. Do not use fine aggregates having positive alkali-silica reaction.
3. Use potable water with pH value between 6 and 8 for producing concrete.	3. Do not use sea water for mixing and curing of concrete.
4. Determine moisture content in both fine and coarse aggregates as frequently as possible to adjust.	4. Do not increase water content in concrete mix to 'enhance' its workability
5. Remix concrete, if there is segregation after unloading from the mixer.	5. Do not use of aggregates or wooden pieces to provide cover to reinforcements instead of concrete briquettes.
6. Compact before initial setting of concrete but not later than 30 minutes of its discharge from the mixer.	6. Do not drop concrete into place freely from a height exceeding 1.5 m.
	7. Do not change or increase the number of construction joints from those shown in drawings.
	8. Do not club different lots for the purpose of acceptance.

2. BRICKWORK FOR STRUCTURES

A. Methodology

A1 General Brickwork

1. Soak all bricks for a minimum period of one hour before use and remove from tank sufficiently in advance so that they are skin dry before actual laying.

2. Before laying the bricks in foundation, hack the top surface of the foundation block, clean, wet and spread a layer of mortar of 12 mm (minimum) thickness, to prepare the surface. In case of masonry works resting on rock base, lay a leveling layer of 150 mm (average) thickness in concrete of M10 grade.

3. Lay all brickwork in English bond, even and true to line, plumb or specified batter and level. Break all joints in successive courses and lay joints accurately.

4. Lay all bricks with frogs up, if any on a full bed of mortar. Slightly press the bricks so that the mortar gets into all hollow space of bricks to ensure proper adhesion. Flush all joints and pack with mortar, to fill all hollow spaces.

5. Build brickwork in uniform layers so that no part of brickwork shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing.

6. Remove all loose bricks and mortar while joining partially set or entirely set brick masonry with new one and roughen and wet with cement slurry to achieve proper bond. In case of vertical and inclined joints, achieve proper bond by inter locking the bricks.

7. Tool all joints on exposed faces to give a concave finish, the thickness of joint not exceeding 10 mm.

8. Keep masonry work in cement mortar constantly moist on all faces for a minimum period of seven days. Leave the top of masonry work flooded with water at the close of the day. During hot weather wet or cover all finished or partly completed work to prevent rapid drying of brickwork. Maintain watering and curing at the close of day's work or for other period of cessation of works.

9. Erect single scaffolding for plastering, pointing and any finishing in which one end of the putlogs/ pole shall rest in the hole provided in the header course of brick masonry. Provide double scaffolding having two independent supports clear of the work when brick work is exposed and not to be finished.

A2 Brick masonry arch

1. Erect scaffolding to withstand design loads and allowing approach to each part of work.

2. Erect centering to the correct curvature, supported on joints themselves or independently from the ground below.

3. Lay full scale shape of arch on a leveled platform near the site and mark size of brick and mortar. Place alternate brick lengthwise and widthwise in outer rings of arch. Place remaining bricks in the inner part of arch to have uniform length.

4. Build the courses as per architecture drawing provided if any. Adjust beds properly to bring them to radial planes. Make the radial joints in planes parallel to the transverse axis of the arch.

5. Dress intrados face sufficiently to permit the bricks to rest properly on the centering. Cut the bricks of the spandrel wall at their junctions with the extrados of the arch, to fit in the curvature of the arch.

6. Commence laying of arch for both ends towards the crown and carry out work symmetrically about the crown. Lay bricks in full mortar beds with tightly filled joint. Fit each dry brick first, before it is finally laid into mortar and fixed in its bed.

7. Strike the wedge in pairs from the crown outwards to the springing line, loosening them gradually without shock to the arch. In case of multiple arch spans centering shall not be struck and stripped before construction of adjoining arch. Keep one or two arches undisturbed between the arch last built and the arch being stripped off.

A3 Miscellaneous Items

1. For a surface which is subsequently plastered or pointed, make out the joints to a depth of 15 mm while mortar is green.

2. Carry out pointing using mortar of proportion not leaner than 1:3 by volume of cement and sand. Fill and press mortar into the raked out joints before giving the required finish.

3. Execute plastering using mortar of proportion where shown on the drawings but not leaner than 1:4 by volume of cement and sand to the specified thickness which will not be higher than average thickness by 3 mm.

4. Commence curing as soon as the mortar or pointing/plastering has hardened sufficiently. Keep the surface wet for a period of atleast 7 days.

5. Provide weep holes to masonry structures higher than 2 m to drain water from back filling. Use 100 mm dia AC pipes and extend to the full width of masonry with 1:20 slope

to the draining face. Stagger them suitably and their spacing shall not exceed 2 m in horizontal or 1 m in vertical direction, with the lowest one at about 150 mm above the low water level or bed level whichever is higher.

6. Provide architectural concrete coping of 150 mm thickness over the masonry where specified. While using precast or cast in site concrete coping, provide vertical construction joints at spacing of not more than 1.5 m

B. Quality Control Requirements

1 Materials

(i) Cement and Lime

Cement of any of the following types shall be used meeting the physical requirements given in Table 2.1.

TABLE 2.1: CEMENT AND LIME

Type	Grade	IS Code
Ordinary Portland Cement	33	IS: 269
Blast Furnace Slag Cement	-	IS:455
Portland Pozzolana Cement	Fly ash based	IS:1489-Part1
Portland Pozzolana Cement	Calcined Clay Based	IS:1489-Part II
Sulphate Resistance Portland Cement *	-	IS:12330
Lime in Cement-Lime (Composite) Mortar	Type A and B	IS:712

** Use in masonry structures which are likely to be affected by the presence of sulphates in surrounding soil or in ground water in concentration of 0.2 percent and 0.03 percent respectively.*

(ii) Sand/Stone Dust/Marble Dust

Sand or Stone Dust or Marble Dust shall consist of hard, durable and clean particles of natural sand, crushed gravel, crushed marble or suitable combinations there of and shall conform to the equirements given in Table 2.2

TABLE 2.2: SAND/STONE/MARBLE DUST

Material	IS Code
Sand	IS:2116
Stone/Marble Dust	IS:383

(iii) Cement Sand Mortar

Cement Sand mortar shall in general conform to IS:2250 and its consistency and water retentivity shall be determined as per the code.

The recommended values of consistency and water retentivity are given in Table 2.3

TABLE 2.3 CONSISTENCY AND WATER RETENTIVITY

Property	Work	Value
Consistency	Laying of solid brick walls - Filling cavities	90-130mm 130-150 mm
Water retentivity(Flow of suction)	Masonry work with high suction characteristics	More than 70% of flow before suction

Refer to Sub-section 1 for the strength requirement of mortar using 33 Grade cement.

(iv) Bricks

First class bricks of any of the following two types shall be used in masonry works. The physical requirements of bricks are given in Table 2.4

TABLE 2.4: PHYSICAL REQUIREMENTS

Item	Requirements
Burnt Clay bricks	IS:1077
Clay Flyash bricks	IS:13757
Fly ash	Grade 1 or 2 of IS:3812
Minimum Compressive Strength	Value specified in drawing or 7 MPa whichever is higher
Water absorption	Upto 20% by weight (IS:3495 Part 2)
Efflorescence	'Moderate' upto 50% of exposed area of brick covered ith a thin deposit of salt but unaccompanied by powdering or flaking of Surface (IS:3495 Part 3)
Preferred size	190 x 90 x 90 mm or 230 x 110 x 70 mm

(v) Storage of material

Store cement bags on wooden platforms minimum 200 mm above the floor level and minimum 600 mm above ground level whichever is higher in perfectly dry and water tight sheds. Stack and store different types of cement separately, in a manner to facilitate their removal and use in an ordinary manner.

Store lime in weather proof sheds. Store hydrated lime in the same manner as cement and the period of storage shall not be more than one month

Store bricks in regular tiers as they are unloaded to minimize breakage and defacement. Stock bricks for use in different situations or different types separately.

Store sand, stone dust, marble dust etc. at proper place so as to prevent contamination of foreign material due to wind etc. When stacked on ground, do not remove them from stock pile within 300 mm of the ground.

2 Workmanship and Tolerances

Permissible values of workmanship and tolerances for bricks and brick masonary are given in Table 2.5

TABLE 2.4: PHYSICAL REQUIREMENTS

Item	Requirements
Dimensions of Bricks	+ 5 per cent in size
Compressive Strength of Bricks	+ 2.5 MPa (No negative tolerance) on value specified or 7 MPa whichever is higher
Thickness of joints for general brick work Thickness of joints for Arches Plaster furnish	Not more than 10 mm 5 mm to 15 mm Surface thickness, not less than specified thickness by more than 3 mm.

3 Quality Control Tests

3.1 Tests prior to construction.

The tests / checks to be carried out prior to construction are indicated in Table 2.6.

TABLE 2.6: QUALITY CONTROL TESTS PRIOR TO CONSTRUCTION

Sl. No.	Material / Work	Test / Check	Frequency
1.	Bricks	a) Colour and Dimensional check b) Water absorption (IS:3495 Part 2) procurement c) Efflorescence (IS:3495 Part 3) samples at random, at source d) Compressive strength (IS:3495 Part 1)	3 samples at random at source 3 samples at source or after In case of doubt, at source3
2.	Cement	a) Setting time of cement (IS:4031 part 5)	3 samples of same type and grade of cement.
3.	Lime	Purity (IS:1514)	One test for each lot
4.	Sand (Natural and crushed stone)	a) Gradation (IS: 2115) b) Deleterious material and organic impurities (IS: 2386 Part 2)	3 samples for each source of supply If in doubt, one test
5.	Water	Normally potable water is good enough. If impurities are present test as per IS:3025 (parts 17, 24, 32)	Samples taken at each source tested at an approved test house

3.2. Tests during construction

The tests to be carried out during construction are indicated in Table 2.7

TABLE 2.7: QUALITY CONTROL TESTS DURING CONSTRUCTION

Sl. No.	Material / Work	Test / Check	Frequency
1.	Bond and Plumbness	English bond, verticality by Plumb bob	For each course
2.	Laying in Mortar	Laying in full bed of mortar with proper lapping	- do -
3.	Individual Course	Height of course and Joint thickness (IS:2212)	- do -
4.	Top of coping (If provided)	Sloping to drain off water	Daily
5.	Mortar for Joints*	a) Mix proportions (Control on quantity of cement/lime by weight) b) Consistency and water retentivity (IS:2250) c) Compressive Strength (IS:2250)	Each batch As required at close interval 3 samples of cubes where specified
6.	Arches(Additional Tests)	a) Dimensions of abutment-pier for multiple arches (IS:2118) b) Centering for arch c) Compaction and thickness of filling material over crown and haunches d) Thickness of Joints	Regularly For each span Regularly Regularly

3.3. Quality Control checks by AE / EE

The quality checks by AE / EE are indicated in Table 2.8.

TABLE 2.8: QUALITY CONTROL CHECKS BY AE/EE

Sl. No.	Material / Work	Test / Check	Frequency	Designation of Inspecting Officer
1.	Brick masonry	Verticality of Brick work and horizontality of courses/ general workmanship and compressive strength (IS 3495 Part 1).	Once in each inspection	AE / EE
2.	Weep holes	Location, size and spacing	For each work	AE
3.	Mortar for Joints	a) Consumption per m3 of brick masonry b) Quality of Mortar*	For each work, as recorded by JE -do-	AE AE
4.	Structural components	Thickness, dimensions and laying3	For each work	AE

C. Do's and Don'ts

Do's	Don'ts
1. Test the cement if it is more than 3 months old.	1. Do not Substitute 33 Grade Cement with 43 Grade or 53 Grade
2. Use lime undamaged by rain, moisture or air slaking	2. Do not mix Blast Furnace Slag with OPC at site
3. Use bricks of rectangular faces with sharp corners	3. Do not use sand containing dust lumps soft or flaky particles, mica or other harmful materials.
4. Mix Cement mortar in a mechanical mixer operated manually or by power for large works.	4. Do not use cement mortar 30 minutes after addition of water or initial setting whichever is earlier
5. Break joints in successive courses and length of lap between the joint of stretcher course with the header course not less than one fourth of the length of the brick.	5. Do not use brick bats or cut bricks except to obtain dimensions of different courses.
6. For arch construction ensure proper centering and simultaneous commencement of work from both ends.	6. Do not start masonry work earlier than 48 hours of casting foundation block
	7. Do not build brick masonry arch bridges having spans more than 6 m in seismic zones IV and V

3. STONE MASONRY FOR STRUCTURES

A. Methodology

A1 General Stone Masonry Work

1. Dress the stones of required size (least dimension not less than 150 mm) and quantity and immerse in water for 24 hours before use. Use only rectangular shaped bond stones or headers.

2. Lay masonry work to lines, levels and dimensions as shown on the drawings. The stones shall be laid on their natural beds in horizontal courses. Keep height of each course same, fine tool every stone on all bed joints with faces full and true.

3. Lay outer layers of masonry first, fix the location of headers and bond stones and lay them. Lay stones in the hearting on their broadest face to ensure filling the spaces between stones.

4. When there is to be variation in the height of the courses, place larger courses at lower levels with heights of courses decreasing gradually towards the top of the wall.

5. In tapered walls, the beds of the stones and planes of courses shall be kept right angle to the batter. In case of piers with batter on both sides, keep the course horizontal.

6. Lay all stones, full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet, immediately on placement and solidly embedded in mortar before it has set.

7. Before laying first course of stone masonry on rock, place concrete levelling course (of M 10 grade) of average thickness of 150 mm.

8. In case any stone already set in mortar, is disturbed or the joint broken, take it out without disturbing the adjacent stones and joint. Reset the stone in fresh mortar after removing dry mortar and thoroughly cleaning the stones and joints.

9. Provide sufficient transverse bonds by the use of bond stones or set of bond stones extending from the front to the back of the wall from outside to the interior and vice versa, overlapping each other by 150 mm (minimum).

10. Use selected quoin stones and arrange to bond alternately long and short in both directions.

11. Make vertical joints truly vertical and staggered as far as possible. Keep the distance between vertical joints of upper and lower layer, more than half the height of the course.

A2 Stone Masonry Arches

1. Erect scaffolding and centering as per Sub-section 2

2. Lay a full scale shape of arch on a leveled platform near the construction site and mark size of each stone and mortar thickness.

3. Cut stones sizes accordingly. For outer ring of arch, choose long length and short length stones alternately. For inner part of arch, choose uniform length of stones, as far as possible.

4. Adopt full size voussoirs throughout, with bond not less than their thickness as shown in the drawings.

5. Adjust beds to bring them to radial planes. Keep the planes of radial joints, parallel to the transverse axis of the arch.

6. Sufficiently dress the intrados face, to permit the stones to rest properly on the centering.

7. Cut the stones of the spandrel wall at their junctions with extrados of arch, to fit in the curvature of arch.

8. Commence laying of arches from both ends towards the crown and carryout work systematically with stones being placed in full mortar beds and joints grouted if required.

A3 Miscellaneous items

1. Carryout pointing, finishing and curing as detailed in Sub-section 2.

2. Provide architectural stone or concrete coping of 150 mm thick over stone masonry. Provide vertical joints as specified in Sub-section 2.

3. Provide weep holes as specified in brick masonry. Alternatively, locate the weep holes at the same height of course on which they are formed, the size being not less than 80 x 150 mm.

B. Quality Control Requirements

1. Materials

(i) Cement and lime

Same as in Section 2

(ii) Sand or Stone Dust or Marble Dust

Same as in Section 2

(iii) Cement Sand Mortar

Same as in Section 2

Adopt Cement mortar not leaner than 1:5, above bed ground level and 1:4 below bed/ground level. Mix proportion for arches not leaner than 1:4

(iv) Stone

Use stone which is hard, sound, free from cracks, decay, weathering, defects like cavities, flaws, sand holes and patches of loose or soft materials. Do not use stones with round surface.

The Specifications and requirements of stones shall satisfy those given in Table 3.1

TABLE 3.1: REQUIREMENTS OF STONES

	Item	Requirements
1.	Least Dimension (IS:1597 Part 1)	150 mm
2.	Water Absorption in stone (IS:1124)	5 percent of its weight

(v) Stone Masonry

Normally use Coursed Rubble (CR) Masonry (first sort) for load bearing structures, CR masonry (second sort) for culverts, wing/return walls of small bridges and Random Rubble (RR) Masonry for wing/return/toe walls of height less than 3 m.

The specifications and requirements of Stone Masonry shall satisfy those given in Table 3.2

TABLE 3.2: REQUIREMENTS OF STONE MASONRY

	Item	Requirements
1.	Dressing of Stone	IS:1129 and IS:1597
2.	Minimum height of individual course	160 mm
3.	Consumption of mortar in stone masonry	0.25 – 0.30 m3 for each cum of stone masonry

(vi) Precast concrete bond blocks

In case natural bond stones of requisite size are not available, use precast concrete (M15) bond blocks of size given in Table 3.3

TABLE 3.3: SIZE OF PRECAST CONCRETE BOND BLOCKS

Size	Height of course (mm)	Minimum Acceptable size of of Face Stones (mm)	Preferable Size of Force Stones (mm)	Size of Longer Stones 1/3rd of Total face Stone (mm)	Size of precast concrete bond blocks (mm)
A	160	150x150 x 200	150 x 180 x 225	150 x 180 x 300	150 x 180 x 450
B	180	170 x 170 x 210	170 x 210 x 255	170 x 210 x 340	170 x 210 x 500
C	220	190 x 190 x 225	190 x 225 x 280	190 x 225 x 380	190 x 225 x 600

(vii) Storage of Cement

Same as in Section 2

(viii) Storage of Sand/Stone Dust/Marble Dust

Same as in Section 2

2 Thickness of Joints

The thickness of cement sand mortar joints for different types of masonry is given in Table 3.4

TABLE 3.4: THICKNESS OF JOINTS

Type of Masonry	Joint Thickness (mm)	Remarks
CR Masonry (I sort)	<10 mm	The thickness should be adequate to prevent stone to stone contact and the joint completely filled with mortar
CR Masonry (II sort)	< 20 mm	
RR Masonry	< 20 mm	

3. Workmanship

The water cement ratio for different cement mortars* used in stone masonry is given in Table 3.5

TABLE 3.5: WATER-CEMENT RATIO

Location	Ratio
Above bed/ground level	1:5
Below bed/ground level	1:4

** The cement mortar shall be of the materials and proportions intended for use in construction mixed to a consistency equal to 110 to 115,and the cube samples (of 70.7 mm size) shall be tested as per IS: 1728*

4 Quality Control Tests

4.1. Tests prior to construction

The tests / checks to be carried out prior to construction are indicated in Table 3.6

TABLE 3.6: QUALITY CONTROL TESTS PRIOR TO CONSTRUCTION

S.No.	Material / Work	Test / Check	Frequency
1.	Stones	a) Shape and Dimension (IS:1597 part 1) b) Water absorption (IS:1124) c) Dressing of Stones via Hearting, Bond, Quoin, Face stones, Headers, etc. (IS:1129)	3 samples on receipt at site 3 samples on receipt at site Once for each stock after selection for individual work
2.	Cement	Setting time of cement (IS:4031 part 5)	As per Table 2.5.
3.	Lime(If used)	Purity (IS:1514)	As per Table 2.5
4.	Sand	a) Gradation (IS:2116) b) Deleterious materials and organic impurities (IS:2386 part 2)	As per Table 2.5
5.	Water	If impurities are present test as per IS:3025 (parts 17,24, 32)	As per Table 2.5
6.	Precast concrete bond blocks When natural stone of appropriate size not available	a) Size (Table 3.2) b) Cube strength of mix used	3 samples for each size (A, B, C) on receipt at site 3 samples
7.	Mortar for Joints	a) Consistency and water. etentivity (IS:2250) b) Mix proportions for different works c) Compressive Strength (IS:2250)	As required Daily 3 samples of cubes where specified

4.2. Tests / checks during construction

The tests / checks to be carried out during construction are indicated in Table 3.7

TABLE 3.7: QUALITY CONTROL TESTS DURING CONSTRUCTION

S.No.	Material / Work	Test / Check	Frequency
1.	Bond and Plumbness	For stability and appearance with plumb bob	While laying each course
2.	Laying in mortar	Horizontality of courses verticality and staggering of joints	- do -
3.	Individual course	Height Joint Thickness and laying (IS:1597 part 1 & 2 and IS:2212)	- do -

4.	Arches(Additional checks)	a) Centering and simultaneous commencement of work from both ends (IS:2118) b) Compaction and thickness of filling material over crown and haunches c) Erection of abutment pier for multiple arches d) Thickness of Joints	Check during erection As and when work is on hand As and when such work is on hand Check during construction
5.	Top of coping (If provided)	Sloping to drain off water	Once on either side of para pet

4.3 Quality control checks by AE / EE

Quality checks to be exercised by AE / EE are indicated in Table 3.8

TABLE 3.8: QUALITY CONTROL CHECKS BY AE/EE

S. No.	Material / Work	Test / Check	Frequency	Designation of Inspecting Officer
1.	Stone Masonry	Verticality of stone masonry work, Horizontality of courses and Architectural features.	Once in each inspection	AE / EE
2.	Mortar	a) Quality of Mortar* b) Consumption per m3 of stone masonry work	For each work as recorded -do-	AE -do-
3.	Weep holes	Location, size and spacing	For each work	AE
4.	Structural Components	Thickness, dimensions and laying	For each work	AE
5.	General Workmanship	Colour, aesthetics, elegance, Pin headers, corner stones and plumbness etc.	For each work	EE

C. Do's and Don'ts

Don'ts	Don'ts
1. Fit each stone dry, correct in accuracy by cutting, before finally laid in mortar and fixed in bed. 2. Mix mortar thoroughly and pour fluid mortar in joints. 3. Restrict use of chips to fill interstices 4. Ensure that mortar is confined to joints without smearing the faces. 5. Protect stone masonry during construction against rain or frost.	1. Do not have any dry or hollow space in masonry nor use water to push mortar into joints. 2. Do not dress or hammer masonry once placed in position 3. Do not use quantity of chips more than 20 per cent of the quantity of stone masonry. 4. Do not use stone masonry arch bridges having span more than 6 m in seismic zones IV and V

4. Finishing works(Form work, Plastering, Painting, Water supply, Sanitation and Electrification)

4.1 Materials and Design

All materials, design, erection and removal of formwork shall conform to IRC: 87 "Guidelines for Design and Erection of Falsework for Road Bridges" and these Specifications.

The forms shall be constructed with metal or timber. The Contractor shall submit the design and drawings of complete formwork (i.e. the formwork as well as its supports) for the approval of the Engineer before any erection is taken up.

4.1.1 CONSTRUCTION OPERATIONS

Forms shall be mortar-tight and shall be made sufficiently rigid by the use of ties and bracings to prevent any displacement or sagging between supports. They shall be strong enough to withstand all pressures, ramming and vibration, without deflection from the prescribed lines occurring during and after placing the concrete.

The inside surfaces of forms shall be coated with a release agent supplied by an approved manufacturer or a material approved by the Engineer to prevent adhesion of concrete to the formwork. Release agents shall be applied strictly in accordance with the instructions of the manufacturer and shall not be allowed to come in contact with the reinforcing steel.

The workmanship of formwork shall be strong and joints shall be leak-proof.

4.1.2 REMOVAL OF FORMWORK

The scheme for removal of formwork (i.e. de-shuttering and decentering) shall be planned in advance and furnished to the Engineer for scrutiny and approval Where not approved, the time of removal of formwork (when Portland Cement is used without any admixtures at an ambient temperatures exceeding 100C) shall as under

(a) Walls, piers, abutments, columns and vertical faces of structural members : 12 to 48 hours as shall be decided by the Engineer
(b) Soffits of slabs (with props left under) : 3 days
(c) Props (left under slabs) : 14 days
(d) Soffit of girders (with props left under) : 7 days
(e) Props (left under girders) : 21 days

Table: 4.1 Tests before construction for Formwork

Sl. no.	Tests	Description and Remarks	Remarks
(a)	Type and Thickness of Steel tubes		
(b)	Dia of 'ballies'		
(c)	Straightness		
(d)	Cleanliness		

Checked by : AEE/EE Tested by : AE/JE

Table:4.2 Tests/Checks for Formwork during construction

Sl. no.	Test/Check	Description and Remarks	Remarks
1	Clamps for strength and stability of Form work		
2	Camber and Surface smoothness		
3	Mortar tightness		
4	Supporting system on ground (To prevent settlement and distribution of load)		
5	Safe access onto and about the formwork		
6	Height of panels for supporting structures and return walls		

Checked by : AEE/EE Tested by : AE/JE

Do's and Don'ts

Do's	Don'ts
1. Use large size panels to keep the number of joints to a minimum. 2. Use clamps of adequate strength to hold the forms together. 3. Avoid sharp corners by providing fillets of 25 x 25 mm (minimum) size at all angles of formwork. 4. Use screwjacks or hardwood wedges to make up for any settlement of formwork before and after concreting. 5. Provide suitable camber of 1/500 of span in horizontal members to counter the effects of any deflection. 6. Use angle iron (not steel bars) bracings for column supports.	7. Do not use form panels of height less than 1.0 m for abutments, piers and return walls. 8. Do not permit deflection of unsupported areas more than 3 mm or 0.003 of span whichever is less. 9. Do not allow releasing agent come into contact with reinforcement. 10. Do not keep centering and shuttering on soft or filled up earth. 11. Do not allow stagnation of water near the base plate supporting the staging. 12. Do not use more than one plank/timber block at the base of a prop to plug the gap, if any.

4.2 Tile flooring:

- Sub grade concrete or RCC slab on which the tiles are laid are cleaned, wetted and mopped.
- Mortar is spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to set.
- Over the mortar bedding, neat grey cement slurry (1.5 bags of cement in 100 lits of water) of honey like consistency is spread.
- Tiles are soaked in water, washed, cleaned and are fixed in the grout one after another.
- Joints are kept as thin as possible and in straight lines or to suit required pattern.
- The surface of the flooring during laying is frequently checked with a straight edge about 2 mtrs long, so as to obtain a true surface with the required slope.
- Curing shall be done for at least 7 days & fixing of skirting should be done only after curing period is over.
- Skirting is fixed using 1:1 mortar proportion and skirting joints are matched with joints of flooring.
- Finished floor level of bathrooms and WC should be lower than the adjacent floor level by approximately 18 mm.
- The finished work should not sound hollow when tapped with a wooden mallet.

Flooring

Flexural Strength of Glazed, Ceramic, Vitrified Tiles, Granite, Marble for floor

Sl. No.	Length of bed (mm)	Width of bed face (mm)	Area of bed face (mm^2)	Average area of bed face (mm^2)	Max load at failure P N_n	Flexural strength Max load / area of bed face (N/mm)	Whether comp. stg is within the permissible limit? Y/N	Whether comp.stg is within the permissible limit? Y/N	If no, date of Issue of NCR and page no. of Reg. Part II	Tested by - Signature of AE/JE
Test 1		Date:								
Test 2		Date:								
Test 3		Date:								

Checked by : AEE/EE

Compressive Stg. Of Cement Mortor for flooring
Test 1

Road / Section details : Date of testing :

Sample No.

Sl. No.	Test Nos	Specimen No.	Plan area of Cube mould A (mm2)	Load at failure w (N)	Compressive Stg=W/A N/mm2
1.	Test No.1				
2.					
3.					
1.	Test No.2				
2.					
3.					
1.	Test No.3				
2.					
3.					

Checked by : AEE/EE Tested by : AE/JE

4.3 Plumbing and water supply

a) GI Plumbing on Walls:

- Take measurements of required lengths of pipe, make an assembly of pipes as per layout. Fix it on the wall and ensure all heightsand measurements.
- Leakages to be checked through pressure testing.

b) GI Downtake:

- Mark all the GI lines on the wall in plumb as per layout and design, on completion of external plastering.
- Fix all the vertical GI pipes in line and level with proper clamping.
- Minimum 3 clamps should be fixed one at centre and one at each joint for each pipe using drill machine only.
- Provide control valves for all the toilets, kitchen and master valve at terrace level as per design, location and specification.

c) Terrace:

- GI work on the terrace should be done after water proofing of the terrace is completed.
- It should be laid as per given layout and design.
- Preferably terrace looping pipes to be run 0.6 m above the water proofing level, on the parapet wall with clamping.

d) Supply of water and from underground water tank:

- Before doing the roadwork, lay the required water supply lines from the source such as, municipal line, bore well, open well, treatment plant, up to the underground water tank.
- Lay the delivery lines from UGR to OHR.
- Check the position of delivery lines, air vents, washout, drain pipes, manholes for both the tanks.

e) Drainage system:

- Drainage line to be constructed as per the design & layout.
- Excavation to be done considering the invert level of chambers.
- The joints of the chambers should be packed with packing rope, soaked in cement slurry and seated with cement mortar to the cemented joints.
- Proper curing should be done at least for 7 days.
- Testing of drainage line should be done as per IS standards and defects found if any should be repaired instantly and back filling work should be done only after confirmation of no leakage in the line.

For Water supply and Sanitation works

Sl. No.	Description	Items	Name of the Branded material used	Whether as per specifications or not	Remarks
1.	**Water Supply work**	Diameter of pipe GI/PV/UPVC/other			
		* Brand material for WC pans/water supply materials			
		* Diameter/ Thickness of pipes SWR/PVC for sanitary			
2.	**Sanitation work**	Diameter of pipe GI/PV/UPVC/other			
		* Brand material for WC pans/water supply materials			
		* Diameter/ Thickness of pipes SWR/PVC for sanitary			

Checked by : AEE/EE

Tested by : AE/JE

4.4 Painting:

- Great skill of workmanship is required as painting affects the total appearance of the building from inside and outside.
- Surface should be cleared with wire brush for dust, loose scales, etc and should be completely dried.
- All gaps, cracks and undulations shall be filled and smoothened.
- After preparation of surface, apply thick coat of primer to walls and ceilings followed by filler (putty) in horizontal and vertical directions.
- Apply first coat of paints after 24 hours on cleaning the surface.
- Second coat and subsequent coats of paints if required, should be applied at an interval of minimum 24 hours.
- For external painting, normally cement paint is used with sand faced finished wall.
- For external painting, second coat is cured for 7 days with a spray pump or water pipe.

Sl. No	Description of sample	Minimum No. of tests	Total minimum tests	Minimum requirement for acceptance
1.	**Cement paint IS:5410-1969**			1. Composition per/wt a) Portland cement 60 min b) Hydrated lime 25 max. c) Alkali resistant pigment 3 min. 2. Drying time for recoating not more than 24 hours 3. Fastness to right to pass the test 4. Residue or sieve 5.0 5. Resistance to dry rubbing to pass the test 6. Water repellency to pass the test
2.	**Plastic emulsion paint** interior use IS:54 (Part 1) 1979			1. Drying time max a) Surface dry 15 minutes b) Hard dry 4 minutes 2. Fasteners to right to pass the test 3. Resistance to alkali - to pass the test 4. Resistance to abrasion - pass the test 5. Temperature stability - to pass the test

4.5 Electrical Works:

- Check the number of points in each room as per drawing.
- Check the location of the points.
- Ensure that the height of all the boards and points is as specified.
- Check the line, level and alignment of battening/casing-capping.
- Ensure that the quality and specification of all the material is as approved.
- Check the sizes of boards as per the pictures on it.
- Check the internal connections in board for phase and neutral distribution.
- Check the color codes and sizes of the wire used for various points.
- Check the operation of all the switches for smooth working.
- Ensure that there is no gap between the batten and wall.
- Ensure that rust-proof clips are fixed.
- Check the quality and tightening of all the screws with required spacing and with proper gripers/rawal plugs.
- Check the earthing connections for effective working.
- Check the supply for all the points by megger or test lamp and prepare the final testing report.
- Check all the points in the staircase.
- Check the wiring in meter cabinet for quality, color codes of wires, gauge of wire, main switches, connections in bus-bar etc.
- Ensure that the name of the flat owner is painted on the respective meter and the main switch.
- Check the sizes of cables for the required capacity.
- Check the main supply for sufficient voltage.
- Check the parking, street lighting and all common supply.

For Electrical works

Sl. No.	Description	Items	Name of the Branded material used	Whether as per specifications or not	Remarks
1.	Electrification work	a) Electrical cable type 1.5/2.5/4.00/6.00 etc… ISI Mark			
		b) Brand Switches & sockets ISI Mark			
		c) Brand Distribution board			
		d) Brand Lighting fixtures ISI Mark			
		e) Brand Submersible pump ISI Mark			
		f) Earthing			
		g) Cable termination LT power & control			

Checked by : AEE/EE Tested by : AE/JE

4.5 Joinaries(Timber/Aluminium)

Sl. No	Description of sample	Minimum No. of tests	Total minimum tests	Minimum requirement for acceptance
1.	**Timber/Teak wood** IS:287			1. moisture content (a) for flames 14% (b) for planks 12% 2. Knots (a) for first class TW - diameter of knots not more than 2.5 cm (b) for 2nd class TW - diameter of knots not more than 4cm
2.	**For grade A-90, IS:73-1961**			Softening paint Penetration @ 25 C i.e. 5 seconds 100gm load - 80 to 100mm
3.	**Aluminium**			Anodising test - not less than 15 microns or as specified in item specification.