

BUILDINGS, SHEDS & STRUCTURES

QUALITY ASSURANCE PLAN BUILDINGS/SHEDS/STRUCTURES

Sl.No	Item/Description	Type of check	Frequency	Responsibility				Reference documents	Records and documentation	Acceptability criteria
				P	W	V				
1	CIVIL (BUILDINGS/SHEDS & STRUCTURES)									
1.1	Foundation design	Design criteria	100%	2 or 3	2	3		Soil investigation report, Relevant codes/stds	Design report	Safe and economic designs
1.2	Construction materials/elements									
1.2.1	Coarse Aggregates	Gradation	Once per 45 cum or each change of source whichever is earlier	1	2	2		IS : 383 , IS : 2386 Part-I	Site Register	Nominal sizes of graded stone aggregates shall be 40, 20, 16 or 12.5 mm as specified. For any one of the nominal sizes, the grading shall be as given in Annexure I.
		Crushing value or impact value	Once per 45 cum or each change of source whichever is earlier	1	2	2		IS:383, IS : 2386 Part-IV	Site register or Test Certificate from approved Lab if done outside	Limit of value -45%
		Los Angeles abrasion resistance	Once per source or once in 12 weeks whichever is earlier	1	2	2		IS : 383 , IS : 2386 Part-IV	Site register or Test Certificate from approved Lab if done outside	Not more than 50%
		Deleterious materials	Once per 45 cum or each change of source whichever is earlier	1	2	2		IS:383	Site register or Test Certificate from approved Lab if done outside	Limits of deleterious materials as per IS:383 :- Coal and lignite-1% , clay lumps-1%, materials passing 75 micron IS Sieve-3%
		Alkali-Aggregate reactivity	Once per source	1		2		IS : 383 , IS : 2386 Part-VII	Test Certificate from approved Lab if done outside	Reactive rock aggregates like siliceous rocks and metamorphic rocks containing reactive minerals like opal exceeding 0.25% and Chalcedony in amount exceeding 5% by mass of aggregates shall not be used for making concrete.

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

	Flakiness index	Once per source	1	2	2	IS : 383 , IS : 2386 Part-VIII & Part-I	Site register or Test Certificate from approved Lab if done outside	Not greater than 25%
1.2.2	Fine Aggregates	Once per week/Daily during monsoon	1	2	2	IS : 383 , IS : 2386 Part-III , IS : 456	Site Register	Volume of sand & weight of water shall be adjusted as per bulkage and moisture content
	Gradation	Once per 45 cum or each change of source whichever is earlier	1	2	2	IS : 383 , IS : 2386 Part-I	Site register or Test Certificate from approved Lab if done outside	The grading shall be within limits as given in Annexure II. Fine aggregates conforming to Grading zone IV shall not be used in reinforced cement concrete unless tests have been made to ascertain the suitability of proposed mix proportions.
	Deleterious materials	Once per source	1	2	2	IS : 383 , IS : 2386 Part II	Site register or Test Certificate from approved Lab if done outside	The maximum quantities of clay, fine silt, fine dust and organic impurities in the sagd shall not exceed 5% by mass
1.2.3	Cement	Once per each source or every 100 Tons	1	2	2	IS : 269 , IS : 4031	Test Certificate from approved Lab	It shall meet the physical & chemical requirements of IS specifications for different cements reproduced in Annexure III. Cement to be stored in a place of easy access for proper inspection & identification. It shall be covered & stored properly to avoid loss of strength due to dampness & other reasons. First in First out principle shall be adopted. Manufacturer's certificate to be provided
	Soundness	Once per each source or every 100 Tons	1	2	2	IS : 269 , IS : 4031	Test Certificate from approved Lab	"
	Initial & final setting time	Once per each source or every 100 Tons	1	2	2	IS : 269 , IS : 4031	Test Certificate from approved Lab	"
	Compressive strength	Once per each source or every 100 Tons	1	2	2	IS : 269 , IS : 4031	Test Certificate from approved Lab	"
	Chemical composition	Once per each source or every 100 Tons	1	2	2	IS : 269 , IS : 4032	Test Certificate from approved Lab	"

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

1.2.4	Water	Suitability for concrete	Once for any particular supply	1	2	IS : 456, IS : 3025	Test Certificate from approved Lab	In general the potable water shall be considered fit for mixing of concrete. Should the suitability of water be in doubt, particularly in remote areas or where water is derived from sources not normally utilized for domestic purposes, such water should be tested in a lab for the following.
		Percentage of solids	Once for any particular supply	1	2	IS : 3025	Test Certificate from approved Lab	Maximum permissible limits of solids shall be as under:- 200 mg/litre, inorganic-3000 mg/litre, Sulphates-500 mg/litre, Chlorides 2000 mg/litre for plain concrete work and 1000 mg/litre for RCC work, suspended matter-2000 mg/litre
		Acidity	Once for any particular supply	1	2	IS : 3025	Test Certificate from approved Lab	PH Value to be generally not less than 6, Limits of acidity- To neutralise 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
		Alkalinity	Once for any particular supply	1	2	IS : 3025	Test Certificate from approved Lab	Limit- To neutralise 200 ml sample of water using methyl orange as an indicator, it should not require more than 10ml of 0.1 normal HCL.
1.2.5	Reinforcement steel(High strength deformed bars)	Dimensional conformity	One per lot per class	1	2	IS : 1786	Site register	To be checked at site and manufacturer's certificate to be provided. The weight per unit length of each dia of bar shall be established
		visual examination	At random, once per lot	1	2			Steel shall be free from excessive cracks. It should be cleaned of excess rust before use. Reinforcement is to be stored diameterwise so as to permit easy identification. It shall not be stacked directly over ground.
		Tensile test	One per lot	1	2	IS:1608	Test Certificate from approved Lab	As per Annexure IV

QUALITY ASSURANCE PLAN BUILDINGS/SHEDS/STRUCTURES

	Bend test	One per lot	1	2	IS:599	Test Certificate from approved Lab	As per Annexure IV
1.2.6	Concrete	Workability	One per 15 cum, Minimum 3 samples per day	1	2	IS:456, IS: 1199	Site register
		Compressive Strength	One set of 6 cubes of 15 cm size per 35 cum of concrete or part thereof for each grade of concrete per 8 Hrs of work or portion thereof.			IS:456, IS: 1199 IS: 516	Site register
		Water cement ratio	At random at the time of batching	1	2	Approved mix & IS : 456	Site register
		Volume batching	At random	1	2	Approved mix & IS : 456	It should comply with the design mix specification
		Compacting	At random	1	2	Approved mix & IS : 456	It should comply with the design mix specification

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

1.2.7	Bricks	visual examination, dimensional conformity, colour	At random	1	2	IS : 1077 & Technical specifications		Bricks shall have smooth rectangular faces with sharp corner and shall be uniform in colour and emit a clear ringing sound when struck.
		Water absorption	One set of samples for each stack of 10000 nos or less	1	2	IS : 3495 Part-III, IS : 1077	Site register or Test Certificate from approved Lab if done outside	Not more than 20% by weight
		Compressive strength	One set of samples for each stack of 10000 nos or less	1	2	IS : 3495, Part-I, IS : 1077, Tech specs	Site register or Test Certificate from approved Lab if done outside	Shall have minimum average compressive strength specified.
		Efflorescence	One set of samples for each stack of 10000 nos or less	1	2	IS : 3495 Part-III, IS : 1077	Site register or Test Certificate from approved Lab if done outside	Shall be not more than moderate
1.2.8	Soil for backfilling	Grain size analysis	Once per source	1	2	IS : 2720	Test Certificate from approved Lab	Earth used for filling shall be free from shrubs, rank vegetation, grass and boulders, organic or any other foreign matter. Earth containing deleterious materials shall not be used for filling. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before it is being used for filling.
1.2.9	Marble	Moisture absorption	50 Sqm or part thereof	1	2	IS : 1124	Test Certificate	
		MHOS scale Hardness test	50 Sqm or part thereof	1	2	IS : 1124	Test Certificate	
1.2.10	Stones for Random Rubble	Compressive strength	Random	1	2	IS : 1121 (Part-I)	Site register or Test Certificate from approved Lab if done outside	
1.2.11	Timber	Moisture content	Once for every cum or part thereof	1	2	IS : 287	Test report	Max 16%

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

1.2.12	Flush shutters	End immersion test	Random	1	2	IS : 2202	Test report	There shall be no delamination at the end of the test
		Knife test	Random	1	2	IS : 2202	Test report	
		Glue adhesion test	Random	1	2	IS : 2202	Test report	There shall be no delamination in the glue lines at the end of the drying period.
1.2.13	Terrazzo tiles	Transverse strength	Once per 2000 Tiles or part thereof	1	2	IS : 1237	Test report	Average wet transverse strength shall not be less than 3 N/sq.mm
		Abrasion	Once per 2000 Tiles or part thereof	1	2	IS : 1237	Test report	Average wear shall not exceed 3.5 mm and the wear on individual specimen shall not exceed 4 mm.

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

		Water absorption	Once per 2000 Tiles or part thereof	1	2	IS : 1237	Test report	Average percentage of water absorption shall not exceed 10.
1.2.14	Glazed tiles	Water absorption	Once per 3000 Nos or part thereof	1	2	IS : 777	Test report	Shall not exceed 20%
		Crazing	Once per 3000 Nos or part thereof	1	2	IS : 777	Test report	Tiles subject to two cycles of crazing test shall not show any sign of crazing
		Impact resistance	Once per 3000 Nos or part thereof	1	2	IS : 777	Test report	Tiles when tested for impact resistance shall remain intact apart from surface marking.
		Warpage	Once per 3000 Nos or part thereof	1	2	IS : 777	Test report	Warpage shall not exceed -0.4 to +0.7 for 149x 149 mm and -0.3 to +0.5 for 99x99 mm tiles.
		Chemical resistance	Once per 3000 Nos or part thereof	1	2	IS : 777	Test report	The glazed surface of tiles shall show no modification when tested.
1.2.15	Bitumen	As prescribed by IS: 73	At random	1	2	IS : 73	Test report	
1.2.16	Structural steel	Tensile strength/ Bend test	One per every 20 Tonne	1	2	IS : 1599	Test report	Tensile strength-42 to 54 Kg/sqmm (Below 6 mm only bend test shall be required) Yield stress - 26 kg/sqmm for sections having 6 mm to 20 mm nominal thickness, 24 kg/sqmm for sections having 20mm to 40 mm nominal thickness, 23 kg/sqmm for sections having 40 mm and above nominal thickness. Percentage elongation-23

QUALITY ASSURANCE PLAN

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**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

		Placing	At random	1	2	2	Approved mix design, IS: 456	Concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. It shall be laid gently so as to avoid segregation and shall be thoroughly vibrated/compacted before setting commences and should not be subsequently disturbed.
		Compacting	At random	1	2	2	Approved mix design, IS: 456	Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of formwork. It shall be done by using mechanical vibrators of appropriate type till a dense concrete is obtained.
		Finishing	At random	1	2	2	Approved mix design, IS: 456	The top surface shall be finished even and smooth before concrete begins to set.
		Curing	At random	1	2	2	Approved mix design, IS: 456	The exposed surface shall be continuously in damp or wet condition by ponding or covering with a layer of sacking etc. and kept wet for 7-10 days.
1.3.4	Brick Masonry	Plumb/Alignment/Curing	At random	1	2	2	As per drawing/specs	a) Deviation from vertical within a storey shall not exceed 6mm per 3 M height
1.3.5	Roofing (A.C. Sheet)							
1.3.5.1	A.C. Sheets	Visual	At random	1	2	2	IS: 459/Specs	Sheets shall be free from cracks, chipped edges or corners and other damages
1.3.5.2	Laying							
	Roof slope	Dimensions	100%	1	2	2	Drawings/specs	Roof pitch not to exceed 1 vertical to 5 horizontal
	Spacing of purlins	Dimensions	100%	1	2	2	Drawings/specs	Maximum spacing of purlins shall be 1.4 mts in case of 6mm sheets. Ridge purlins to be fixed at 75mm to 115mm from roof apex.
	Side/end lap	Dimensions	100%	1	2	2	Drawings/specs	Side lap to be half a corrugation and end lap to be 15cm minimum.
	Free overhang at eaves	Dimensions	100%	1	2	2	Drawings/specs	Not to exceed 30cm.
	J/L hook bolts, nuts, bitumin washers	Visual/dimensional	Random	1	2	2	Specs	Conformity to specs
	Finish, workmanship	Visual/Dimensions	100%	1	2	2	Specs	Uniform slope and line of corrugations to be straight and true.
1.3.6	Plastering/Pointing							

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

1.3.6.1	Surface preparation	Visual	Random	1	2	3	Specs		Surface to be free from dust and loose mortar, joints to be raked properly
1.3.6.2	Mortar	Mix ratio	Random	1	2	3	Specs		Specified mix
1.3.6.3	Thickness	Dimensions	Random	1	2	3	Specs		Minimum thickness shall be as specified
1.3.6.4	Curing	Visual	Random	1	2	3	Specs		Minimum curing for 7 days after application of plaster
1.3.7	Decorative painting for buildings/structures								
1.3.7.1	Paint Materials	Brand/Manufacturer	Random	1	2	3	IS:428/Specs	Invoice	Shall be of approved brand as per specs/to be used within shelf life
1.3.7.2	Surface preparation	Visual	Random	1	2	3	IS:428/Specs		Surface shall be smooth, clean and even
1.3.7.3	Application/Finish	Visual	Random	1	2	3	Specs		No of coats applied/even and uniform shade
1.3.8	Formwork	Check for dimension (length & breadth)	Before every lift	1	2	2	Approved drawings	Site register	Formwork shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with tolerance given below. A) Deviation from specified dimension of cross section of columns, beams and footings +12 mm
		Shape & alignment (Longitudinal)	Before every lift	1	2	2	Approved drawings		
		Check for warping, damage	At random	1	2	2			To be checked at site before and after placement of concrete
		Check level & height	Before every lift of concreting	1	2	2	Approved drawings	Site register	
		Plumb line	Before every lift of concreting	1	2	2	Approved drawings		
		Ground support	At random	1	2	2			
		Insufficient, loose connection	At random	1	2	2			
		Cleaning & oiling	Before every use	1	2	2			To be checked at site before and after placement of concrete. Joints in shuttering shall be tightly butted so as to avoid leakage of slurry. If required rubberized lining material shall be provided in the joints.
		Tightness & leaks	100%	1	2	2			

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

1.3.9	Placement of reinforcement steel	Check for bar bending schedule, necessary hooks, laps, spacers & chairs for all concreting works before start of work	100%	1	2	2	Bar bending schedules, approved drawings, specifications	Fabricated reinforcements shall be placed in position as shown in the drawings.
		Check all bent bars are as per approved bar bending schedule	100%	1	2	2	Bar bending schedules, approved drawings, specifications	Reinforcement shall be placed within the following tolerances:- a) For effective depth of 200 mm or less +/- 10 mm b) For effective depth of more than 200 mm +/- 15 mm
		Check all joints & crossing of bars are tied properly with right gauge of binding wire as per specifications	At random	1	2	2	Bar bending schedules, approved drawings, specifications	The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm thickness twisted tight so that reinforcement does not get displaced during deposition of concrete.
		Check any of the bars selected for use shall be free from cracks, surface flaws, lamination & roughed, jagged & imperfect edge	At random	1	2	2	IS : 456	
		Check for proper cover, distance & spacing of bars, spacers & chairs after the reinforcement stage has been put inside the formwork	At random	1	2	2	Bar bending schedules, approved drawings, specifications	The cover shall in no case be reduced by more than one-third of specified cover or 5 mm whichever is less.
		Lapping of bars	100%	1	2	2	IS : 456 & Approved drawings	
1.3.10	Structural steel fabrication work							
1.3.10.1	Steel	Dimensions, Pitting-physical verification	At random	1	2	2	relevant drawings, IS : 2062	

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

	Tensile strength/Bend test	1 per 20 MT or part thereof	1	2	IS : 1599	Test report	Bend test will be required only for sections below 6 mm thick. Tensile strength 42 to 54 kgf/sqmm, yield stress 23 to 26 kgf/sqmm and percentage elongation 23.
	Electrodes	At random	1	2	IS : 814	Invoice	Conformity to code and make
	Bolts	At random	1	2	IS : 1367/1363 & relevant IS standards	Invoice	Conformity to code and specs
	Paint	At random	1	2	IS : 2074/ Relevant standards	Invoice/Manufacturer's test certificate	Approved make, Shelf life
1.3.10.2	Fabrication work						
	Marking	Random	1	2	Relevant drawings & specs		
	Cutting including edge preparation	Random	1	2	Relevant drawings & specs		
	Pre-welding fit-up	Random	1	2	Relevant drawings & specs		
	Welders qualification	Each welder	1	2	IS : 817/ ASME Sec. IX	Qualification certificate	
	Welding procedure and procedure qualification	All procedures	1	2	ASME Sec. 9	Qualification certificate	
	Assembly and final inspection	100%	1	2	Relevant drawings	Inspection report	
	Surface preparation / Painting	100%	1	2	Specifications	Inspection report	
	Foundation preparation	100%	1	2	As per drawing		
		Cleaning of foundation	1	2			

**QUALITY ASSURANCE PLAN
BUILDINGS/SHEDS/STRUCTURES**

	Fixing of bearing plates & anchor bolts	At random	1	2	2	As per drawing		
	Grouting	100%	1	2	2	As per drawing		
	Leveling & alignment, plumb line, level & orientation					As per drawing		
	a) Column axis/Ties	Dimensional conformity	100%	1	2	As per drawing	Site register	Tolerance not more than 5 mm
	b) Structure as a whole	Dimensional conformity	100%	1	2	As per drawing	Site register	Tolerance 1 in 1000 with max. of 25 mm for structures upto 50 M ht.
	c) Actual levels of supports of trusses collar beams, purlins	Dimensional conformity	100%	1	2	As per drawing	Site register	Tolerance of 20mm
	d) Sweep of trusses	Dimensional conformity	100%	1	2	As per drawing	Site register	Tolerance of 1 in 1500 of span
	e) Deviation of spacing of purlins	Dimensional conformity	100%	1	2	As per drawing	Site register	Within 5 mm
	f) Deviation of upper chord trusses	Dimensional conformity	100%	1	2	As per drawing	Site register	Within 1 in 250 of truss height

		ANNEXURE I	
Grading requirements for coarse stone aggregates			
IS Sieve	Percentage passing (by weight) for nominal size of		
Designation			
(mm)	40 mm	20mm	16mm
75	100	-	-
37.5	95-100	100	100
19	30-70	95-100	90-100
16	-	-	-
11.2	-	-	30-70
9.5	10-35	25-55	0-10
4.75	0-5	0-10	-

ANNEXURE II			
Grading requirements for Fine aggregates			
IS Sieve Designation	Percentage passing (by weight) for nominal size of		
	Grading zone I	Grading zone II	Grading zone III
9.5 mm	100	100	100
4.75 mm	95-100	90-100	90-100
2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 microns	15-34	35-59	60-79
300 microns	5-20	8-30	12-40
150 microns	0-10	0-10	0-10

ANNEXURE III			
Physical and chemical requirements of Indian standard specifications for different cements			
Characteristic	OPC (IS:269)	Portland Pozzolana cement (IS:1489)	Portland slag cement (IS:455)
PHYSICAL REQUIREMENTS			
Fineness (sqm/kg) min	225	300	225
Setting time (mts)			
Initial (Min)	30	30	30
Final (Max)	600	600	600
Comp. strength (N/Sqmm) (Min)			
3-day	16	16	16
7-day	22	22	22
28-day	33	33	33
Soundness			
Le Chatelier mm(max)	10	10	10
Autoclave %, Max	0.8	0.8	0.8
CHEMICAL REQUIREMENTS			
Loss on ignition %	5	5	5
Insoluble residue %	4	$\{x+4(100-x)\}/100$ where x=% of pozzolana content	4
Mgo %	6	6	8
SO3 %	2.5/3	3	3

ANNEXURE IV

Physical properties of Steel Bars

Sl.No	Property	Min value
1	0.2% proof stress/yield stress N/sq.mm	500
2	Elongation, percent on a gauge length 5.65-A, where A is the X-sectional Area of the test piece	12
3	Tensile strength	8% more than actual 0.2% proof stress but not less than 545 N/sq.mm