

TECHNICAL SPECIFICATION

VOLUME – 2

CONTENTS

SR. NO.	PARTICULARS	PAGE NO.
1.	GENERAL NOTE	1 - 2
2.	PREAMBLE AND SPECIFICATIONS	3 - 5
3.	LIST OF NOMINATED MATERIALS AND SUPPLIERS	6 - 7
4.	APPENDIX “A” - LIST OF BUREAU OF INDIAN STANDARDS CODES	8 - 13
5.	LIST OF MANDATORY TESTS	14 - 19
6..	SECTION A: CIVIL WORK	20 - 153
5.	APPENDIX “B” - THEORETICAL STANDARD REQUIREMENT OF CEMENT FOR VARIOUS ITEMS OF WORK	154 - 156
6.	APPENDIX “C1” - CONSUMPTION OF PAINT FOR SOME PAINTING ITEMS	157 - 158
7.	APPENDIX “C2” - CO-EFFICIENT FOR EQUIVALENT PLAIN AREAS FOR PAINTING ITEMS :	159 - 160
8.	APPENDIX “D” - PROFORMA FOR GUARANTEE TO BE EXECUTED BY CONTRACTORS FOR STABILITY OF PILE FOUNDATION SYSTEM AGAINST RISK OF SETTLEMENT & OTHER TYPE OF DISTRESS TO THE BUILDING(S).	161 - 163

TECHNICAL SPECIFICATIONS

GENERAL

- i. The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein & shall be guidance for proper execution of work to the required standards.
- ii. It may also be noted that the specification are of generalized nature & these shall be read in conjunction with the description of item in schedule of quantities & drawings. The work also includes all minor details of construction which are obviously & fairly intended & which may not have been referred to in these documents but are essential for the entire completion in accordance with standard Engineering practice.
- iii. Unless specifically otherwise mentioned, all the applicable codes & standards published by the Indian standard Institution & all other standard which may be published by them before the date of receipt of tenders, shall govern in all respects of dosing workmanship quality & propitious of materials & methods of testing, method of measurements etc. Wherever any reference to any Indian Standard specifications occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued to or revisions thereof, if any, up to the date of receipt of tenders.
- iv. In case there is no I.S.I specification for the particular work, such work shall be carried out in accordance with the instructions in all respects, & requirements of the Engineers-in-Charge. Wherever any reference to any Indian standard specification occurs in the documents relating to this contract, the same shall be inclusive of all amendment issued there to or revisions thereof, if any, up to the date of receipt of tenders.
- v. The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of the Municipal Committee/Municipal Corporation/Development Authority/Improvement Trust under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and, unless otherwise mentioned, nothing extra shall be paid on this account.
- vi. Samples of various materials, fitting etc. proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineers-in-Charge before order for bulk supply is placed.
- vii. The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials in any place. No excavated earth or building materials shall be stacked on areas where other buildings, roads, services, compound walls etc. are to be constructed.
- viii. The contractor shall maintain in perfect condition all works executed till the completion of the entire work allotted to him. Where phased delivery is contemplated, this provision shall apply to

each Phase.

- ix. The contractor shall give a performance test of the entire installation(s) as per standard specifications before the work is finally accepted & nothing extra whatsoever shall be payable to the contractor for the test.
- x. The contractor shall clear the site thoroughly of all scaffolding materials & rubbish etc. left out of his work & dress the site around the building to the satisfactions & his decision in writing shall be final & binding on all concerned.
- xi. **Post construction inspection and testing:** After completion of the work and during maintenance period liability of the contractor, the work shall also be subjected to 'Post construction inspection and testing'. In case the materials or articles incorporated in the work are found to be inferior, though the sample collected for the same might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same at his own cost, failing which the Department may rectify the same at the risk and cost of the contractor or Department may accept the work as sub-standard, and cost be adjusted from the outstanding security deposit, as per the terms and conditions of the contract for the work.
- xii. The Dean (I.P.S.), shall be the sole deciding authority as to the meaning, interpretations and implications for various provisions of the specifications and his decision in writing shall be final and binding on all concerned.
- xiii. In case any different or discrepancy between the specification & the description in the schedule of quantities, the schedule of quantities shall take precedence. In case of any difference or discrepancy between specification & drawing, the specification shall take precedence.

PREAMBLE AND SPECIFICATIONS

The quantities given in this schedule of quantities are approximate and subject to variations without vitiating the contract.

Pricing

The rate for each item of work shall, unless expressly stated otherwise, include the following (but not limited to the list given below) for the completion of works in all respects as per conditions of Contract, technical specifications, drawing etc.:

Rates are inclusive of all Taxes, Royalties, Transportation, Freights, Packing and forwarding charges Insurance etc.

All requirements and expenses for completion of work as per Rules and Regulations of Local Bodies, State Government and Central Government of India.

All materials, equipments, accessories, consumable, controls and instruments, tools, tackles, plants, scaffolding/double scaffolding labour, maintenance, fixing, cleaning, making good hauling, hoisting etc.,

Waste on material and labour.

Loading, Unloading, handling/double handling, setting out protection from weather, temporary supports, platforms etc., and the maintenance, of the same, dismantling of temporary works, disposal of debris and all other labour necessary for the execution of works.

Testing the installation as often as necessary, Contractors to arrange for all special instruments and tools required for such testing.

Painting of all equipment, pipes, supports etc., as per color codes to be decided for various systems.

Apportion of costs for general facilities to be used by the Contractor's staff such as lifts, electricity, telephones etc. during execution if such facilities are provided by other contractors and who arrange for such facilities in the first instance.

Fees for testing the materials, equipment or overall installation by appropriate authorities.

Supervising Civil/ Masonry / Carpentry Works done by other agencies on behalf of the Institute for Interior contractor.

All requirements of specification and drawings. Description of work given in the schedule of quantities is a brief description and shall be read in conjunction with specifications and drawings.

Removal of POP covering and carting away all unwanted material including POP.

The rates quoted by the Tenderer will be deemed to be for the finished work complete in all respects with accessories, fitting, mounting arrangements normally provided with such equipment and/or needed for execution, completion, safe operation of equipment as required through they may not have been specifically mentioned in technical specifications, drawings and/or schedule of equipment.

All minor Masonry, Carpentry and Civil works such as cutting opening in Masonry Walls, Internal Partitions, Chasing on walls, etc. and making good the same to match existing works shall be provided by the contractor, Whenever asked for by the Architect/Consultant.

SCHEDULE OF QUANTITIES

All items of work contracted for shall be executed strictly in accordance with the description of the item in the Schedule of Quantities, relevant drawings and specifications read in conjunction with the appropriate Indian Standard specifications and conditions of the contract and established Engineering practices.

The rate for each item of work included in the schedule of quantities shall unless expressly stated otherwise include cost of:

All materials, fixing materials, accessories sequence of operations, appliances, tools, plant equipment, transport labour and incidentals required and completion of the work called for in the

item and as per specifications and drawings completely

Wastage on materials and labour

Loading transporting, unloading, handling as necessary, hoisting to all levels, and setting, fitting and fixing the position, protecting, disposal of debris as directed and all other labour necessary and to fully complete the job in accordance with contract documents, good practice and recognized principles of trade laid down in codes of practice.

Liabilities, obligations and risks arising out of conditions of contract.

All requirements of specifications, whether such requirements are mentioned in the item or not shall be provided for the specifications and drawings where available are to be read as complimentary to any part of the schedule of quantities and any work called for in one shall be taken as required for all similar items.

In the event of conflict between Schedule of Quantities and other documents including the specifications the most stringent among them shall apply and the interpretations of the consultants/owner shall be final and binding.

The Contractor shall be paid for the actual quantity of work executed by him in accordance with the drawings at the accepted rates.

This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK. The entries under amount column shall be rounded off to the nearest Rupee.

No alterations whatsoever is to be made either to the description of items in the Schedule of quantities or specifications unless such alterations, is clarified in writing by the consultant/owner. Any such alterations, notes or additions shall unless clarified in writing be disregarded when tender documents are considered. Any observation on BOQ should be made in the letter accompanying technical bid for proper consideration and on disfiguring or overwriting in the documents is permitted.

In event of an error occurring in the amount column of the schedule, as a result of wrong extension of unit rate and quantity, the unit rate quoted by the Tenderer shall be regarded as firm and the extensions shall be amended on the basis of rates.

All errors in totaling in the amount column and in carrying forward totals shall be corrected.

Unless otherwise stated, all measurements shall be taken in accordance with Indian standard for building of Measurements IS 1200 latest revision effective on the date of measurement for interior items as applicable.

Any errors in quantity of items from the contract schedule shall not vitiate this contract but shall be corrected and deemed to be a variation by the Architect/Consultant/Owner.

DRAWINGS AND DATA

Within two weeks of placement of order/letter of intent contractor shall furnish the following data in triplicate for approval by Architect/Consultant/Owner.

General arrangement drawing of the equipment on orders showing plan, elevations, and sectional views, mounting details.

Bill of materials.

Descriptive catalogues, characteristic curves, duty point efficiency factor and technical particulars of all the various equipments offered.

SPARE PARTS AND MAINTENANCE FOR MATERIALS SUPPLIED

Tenderer shall offer along with the bid, duly recommended by manufacturer set of spare parts required for a period of 1 years continuous operation. Itemized unit prices with exact quantities recommended for these spares shall be separately indicated for consideration of the Owner/Consultant.

DOCUMENTS MUTUALLY COMPLIMENTARY

The several documents forming the contract are to be read as mutually complementary to each

other and in case of ambiguities/ discrepancies, the same shall be explained and clarified by the Consultant/Owner to the Contractor in what manner the work is expected to be carried out to meet the end requirements.

INSTRUCTIONS DURING EXECUTION

On the advice of the Owner, the consultants may issue further drawings and written instructions, details, directions and explanations collectively referred to as "Site instruction" in regard to:

Variations for modification of the design, quality or quantity of works as addition or omission or substitution of any works therein.

Any discrepancies in the drawings or between the schedule of quantities and/or specifications and/or drawings.

Removal from the site any material brought by the contractor and substitution of any other materials therefore.

The dismissal or removal from work of any person employed thereupon.

Removal/re-examination of any works executed in case of doubt of any nature.

Opening up for inspection of any work covered up without proper tests by the Architect/Consultant.

Oversight on the part of the Architect/Consultant/his assistant to disapprove any defective work or material shall not prejudice the Owner/Consultant, thereafter to disapprove such work or materials and to order pulling down, replacement, removal breaking up or reconstruction.

The Contractor shall make his own arrangement for the engagement of all labour and shall be responsible for regulating their service conditions, work conditions in conformity with all Acts, Regulations, Rules or order of competent authority under relevant laws in force during the pendency of the contract.

Contractor shall indemnify the Owner from all claims relating to the workers/ staff/ sub-contractors, Salaries, Wages, Overtime, Leave, Provident Fund, Medical facilities, gratuity, Bonus or any other claim as applicable and stipulated in any statutory provisions, rules or order of competent authority.

All materials so far as procurable shall be of the reputed make in the category of manufacture and bear the stamp of quality of the Bureau Standards wherever applicable. The contractor shall furnish documentary proof, test certificates and guarantees as relevant to such materials from manufacturers, which shall match with the date of procurement.

LIST OF NOMINATED MATERIALS & SUPPLIERS

MDF	NUWUD/Duratuff , Ventura or equivalent ISI make
Laminated sheet (1.0 mm thick)	Greenlam, Royal touche, Merino
Particle board	NOVAPAN(India)Ltd.or equivalent ISI make
Acrylic sheet	ICI, GE or equivalent ISI make
Commercial Ply wood	Archidply, Greenply , Anchor, Century ply
MR grade ply Conforming to IS 303	Archidply, Greenply, Anchor, Century ply
Marine grade Ply wood Conforming IS 710	Archidply, Greenply, Anchor, Century ply
Marine grade Block Board	Archidply, Greenply, Anchor, Century ply
Melamine Finish	Asian Paints or equivalent ISI make
Latex	MM Foam or equivalent ISI make
b) High density foam	U Foam or equivalent ISI make
Carpet	
3000 gms Woolen Carpet	Armstrong, Shaw
(woolen or woolen/synthetic blend).	
b) Close loop pile synthetic imported Carpet	Armstrong, Shaw
(synthetic or woolen/synthetic blend	
Ceramic Tiles/vitrified homogeneous glazed tiles.	RAK,HR Johnson, Kajaria, Nitco, Quotone
Vinyl Flooring	Armstrong, Tarkett
Glazing (Clear)	St. Gobain, Indo Asahi
a) Hardware for general staff areas	Dorma, Haffle, Hettich
b) Hardware for main Glass doors (patch fittings)	Dorma, Haffle, Hettich
c) Door Closers (general use)	Dorma, Haffle, Hettich
d) Floor springs (general use)	Dorma, Haffle, Hettich
e) Floor springs for main glass doors	Dorma, Haffle, Hettich
Sanitary Ware	Kohler, Jaquar
Sanitary Fittings	Kohler, Jaquar
Geyser	Venus / Sphere Hot
Stainless Steel sink	A.M.C. ,Diamond , Nirali
C.I. Pipe	NECO / BIC / Kapilansh
PVC Pipe	Prince or equivalent ISI make
Nahani Trap	NECO or equivalent ISI make
G.I. Pipe	TATA, Zenith or equivalent ISI make
Gate Valve	Leader or equivalent ISI make
Sanitary Convenience Fittings	Kimberly Clarke or equivalent

Venetian / Vertical Blinds	Hunter Douglas, Aerolux, MAC or equivalent
Aluminium Sections	Indal, Jindal
Glass Blocks	Pilkington, Fishfa
False Ceilings: Gypsum	Gyproc
False Ceilings: Baffle ceiling/linear panel ceiling	Armstrong, Venus Laban
Veneers a) Indian Veneers b) Imported Veneers	Archid, Anchor, Greenply, Century ply, Jalaram, Turakhia
Patch Fittings Automated systems for furnishing	Dorma, hettich, haffle or equivalent ISI make
Italian Marble	Nitco, Royale RK Marbles, or equivalent
Wooden laminated flooring	Pergo, Quick step, Tarkett
Paint	Asian, Jotun
Water Proofing	Ardex Endura ,Roffe, Xypex, fosroc, Sika,
Signage Access floor systems Specialized Light Fittings Specialized Switches	Signage & Graphics, Prolite, Tate, Unitile Gemini Global, Lumiere, Tulip Clipsal zencelo
Fiber Optic Lights	Gemini Global, Lumere, Krishnaray
Textured wall paint	Kemtex, Spectrum
Fabrics a) Upholstery b) Leather	Maspar, Bharat Furnishings, Pride Stanley, Baron
Audio Visual Equipment	AMX, Actis
Whiteboards	Whitemark or Equivalent

Relavant IS Codes:

SR.NO.	IS CODE	TITLE
1	1200	Latest measurement of building and civil engineering works, methods of
2	287-1973	Recommendation for maximum permissible moisture content of timber used for different purpose in different climate zones.
3	1141-1973	Code of practice for seasoning to timber.
4	6534-1971	Guiding principles for grading and inspection of timber
5	1200 (part XXII - 1973)	Method of measurement of building and civil engineering works.
5a	1200 (part XXI - 1973)	Code for wood work and joinery.
6	3845-1966	Code of practice for joints used in wooden furniture.
7	4020-1967	Wooden flush doors.
8	4970-1973	Key for identification of commercial timber.
9	3364 (part III - 1976)	Methods of measurement and evaluation of defects in timber, part - II for converted timber.
10	1708-1969	Methods of testing small clear specimens of timber.
11	6342-1971	Rosewood logs for production of sliced veneers.
12	5248-1969	Teak logs for production of sliced veneers.
13	2202 (part I)-1973	Specification for wooden flush door shutters(solid core type, part I plywood panel).
14	2338 (part I) - 1967	Code of practice for finishing of wood and wood based materials - operations and workmanship.
15	7638-1975	Methods of sampling plywood.
16	30.3-1975	Specification for plywood for general purpose.
17	3129-1965	Specification for particle board for insulation purpose.
18	3515 (part III & IV) - 1966	High and medium density wood based laminates Part III - General Purpose Part IV - Sampling Test

19	1659 - 1979	Block boards
20	7316-1974	Decorative plywood using plurality of veneers for decorative faces.
21	3478-1966	High density wood particle boards
22	1737 (part I to XX)	Plywood method of test for Part I - General Part II - Plywood Part - III Battens
23	1328-1970	Veneers decorative plywood.
24	710	Marine Ply
25	3087-1969	Wood particle boards (medium density)
26	848-1974	Specification for synthetic resin adhesive ply wood (Phenolic and Amino plastic)
27	2046-1969	Specification for decorative laminate
28	8273-1976	Fibrous gypsum plaster boards.
29	2095-1965	Gypsum plaster boards.
30	2542 (part I) - 1978	Gypsum plaster concrete and products, methods of test for Part I Plaster and concrete.
31	8272-1976	Gypsum plaster for use in the manufacture of fibrous plasterboards.
32	2441-1963	Fixing ceiling covering
33	2935-1977	Specification for transparent sheet glass
34	2395 (part-1) 1966 and 2395 (partIII - 1967)	Painting to concrete, masonry, plaster surfaces - code of practice for part I Operation and workmanship, part II - Schedule.
35	3548-1966	Glazing in building
36	6278-1971	White washing and colour washing.
37	137-1965	Specification for ready mixed paint, brushing, matt or egg-shell flat finishing interior to Indian Standard colour, as required.
38	113-1965	Specification for ready mixed paint, brushing, matt or egg-shell flat finishing interior to Indian Standard colour, as required.

39	133-1965	Specification for enamel, interior (a) under coating, finishing	(b)
40	129-1950	Specification for ready mixed paint, brushing grey filler for enamel for use over primers.	
41	129-1950	Specification for ready mixed paint, brushing, finishing, interior, oil glass, for general purpose to Indian Standard Colours.	
42	533-1973	Specification for gum spirit of turpentine (Oil Turpentine)	
43	101-1964	Methods of tests for ready mixed paints and enamels.	
44	75-1973	Specification for linseed oil and refined.	
45	77-1976	Specification for linseed oil, boiled for paint.	
46	124-(part 11 - 1976)	Specification for ready mixed paint (brushing, finishing, semi glosses for general purpose)	
47	5884	Specification for woolen carpets.	
48	104-1979	Specification for ready mixed paint, brushing, zinc chrome primer.	
49	5391-1969	Adjustable metal chairs for use of typist and operators in telephone exchange	
50	8756-1978	Ball catches for use in wooden almirahs	
51	3499-1976 (part - III)	Chairs for office purpose metal revolving and tilting	
52	5416-1969	General purpose wooden chairs, method of test for	
53	6185-1971	High chairs, specification and safety requirements for	
54	4116-1976	Joints used in wooden furniture code of practice	
55	3845-1966	Joints used in wooden furniture code of practice	
56	7070-1973	Shelving racks wooden (adjustable and non adjustable)	
57	4414-1977	Table tops (wooden)	
58	5967-1969	Tables, wooden, of test for	
59	3564-1975	Door closers (hydraulically regulated)	
60	799-1979	Drawers lock, cupboards and box locks	

61	7981 (part II - 1975)	Glossary of terms relating to builders hardware part I locks
62	704 (part I and III - 1978)	Tower bolts ferrous metal and non-ferrous metals
63	204	Specification for Tower bolts
64	204 (part I) - 1978	Ferrous metals (Fourth Revision)
65	204 (part II) - 1978	Non Ferrous Metals (Fourth Revision)
66	205-1978	Specification for non ferrous metal butt hinges (Third Revision)
67	206-1981	Specification for Tee and strip Hinges (Third Revision)
68	208-1979	Specification for door handles (Third Revision)
69	281-1973	Specification for mild steel sliding door bolts for use with padlock (Second Revision)
70	362-1982	Specification for parliament Hinges (Fourth Revision)
71	363-1976	Specification for hasps and staples (Third Revision)
72	364-1970	Specification for fanlight catch (Second Revision)
73	452-1973	Specification for door spring ratfail type (Second Revision)
74	533-1973	Specification for drawer locks, cupboard locks and box locks (Third Revision)
75	729-1979	Specification for drawer locks, cupboard locks and box locks (Third Revision)
76	1019-1974	Specification for rim latches (Second Revision)
77	1341-1981	Specification for steel butt hinges (Fourth Revision)
78	1823-1980	Specification for floor door stopper (Third Revision)
79	1837-1966	Specification for fanlight pivots (First Revision)
80	2209-1976	Specification for mortise locks (vertical type) (Third Revision)

81	2681-1976	Specification for nonferrous metal sliding door bolts for use with padlocks (Second Revision)
82	3564-2975	Specification for door closures (hydraulically regulated)(Second Revision)
83	3818-1971	Specification for continuous (piano) hinges (First Revision)
84	3828-1966	Specification for ventilator chains
85	3843-1966	Specification for steel back-flap hinges.
86	3847-1966	Specification for mortis night latches
87	4621-1975	Specification for indicating bolts for use in public baths & lavatories (First Revision)
88	4948-1974	Specification for welded steel wire fabric for general use (First Revision)
89	4992-1975	Specification for door handles for mortise lock (vertical type) (First Revision)
90	5187-1972	Specification for flush bolts (First Revision)
91	5899-1970	Specification for bathroom latches
92	5930-1970	Specification for mortise latch (Vertical Type)
93	6315-1971	Specification for floor spring (hydraulically regulated) for heavy doors
94	6318-1971	Specification for plastic windows stay and fasteners
95	6343-1982	Specification for door closures (pneumatically regulated) for light doors weighing up to 40 kg (First Revision)
96	6602-1972	Specification for ventilator poles
97	6607-1972	Specification for rebated mortise locks (Vertical Type)
98	7196-1974	Specification for hold fasts
99	7197-1974	Specification for double action floor springs (without oil check) for heavy doors

100	7534-1974	Specification for mild steel locking bolts with holes for padlock
101	7540-1974	Specification for mortise dead locks
102	8756-1978	Specification for ball catches to use in wooden almirah
103	8760-1978	Specification for mortise sliding door locks with lever mechanism
104	9106-1979	Specification for rising butt hinges
105	9460-1980	Specification for flush rim locks
106	9460-1980	Specification for flush door handles for drawers
107	9899-1981	Specification for hat, coat and wardrobe hooks
108	10019-1981	Specification for steel window stays and fasteners
109	10090-1982	Specification for numerical
110	10342-1982	Specification for curtain rail system

NOTE :-

Where ever applicable only I.S.I. Approved first class materials are to be used. In other cases where I.S.I. specifications/certifications are not available the superior range quality materials are to be used and all the products got approved by the Architect/Consultant/Client.

The Architect/Consultant/Client reserves the right to specify a particular brand name of a product, in his sole discretion, for use in the contract. No excuse from the contractor as regard variation in rates, in this context will be valid.

All dimensions mentioned for all wooden sections (covered or exposed) are "OUT OF" dimensions. All site items procured by the contractor from the manufactures, such as ply, veneer, laminates, wood, italian marble, ceramic tiles etc., shall be within the allowable tolerances as specified by the manufacturer.

III – MANDATORY TESTS

NOTES:

1. The mandatory tests shall be carried out when the quantity of materials to incorporated in the work exceeds the minimum quantity specified.
2. Optional tests specified or any other tests, shall be carried out in case of specialised works or important structures as per direction of the Engineer-in-Charge.
3. Testing charges, including incidental charges and cost of sample for testing shall be born by the contractor for all mandatory tests.
4. Testing charges for optional tests shall be reimbursed by the Department. However, the incidental charges and cost of sample for testing shall be born by the contractor.
5. In case of non-IS materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant IS specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractor for such tests.

THE MANDATORY TESTS SHALL BE AS FOLLOWS:

Material	Test	Field / laboratory test	Test procedure	Minimum quantity of material / Work for carrying out	Frequency of testing
Reinforced cement concrete work					
Water for Construction purposes	Ph value Limits of Acidity Limits of Alkalinity Percentage of solids Chlorides Suspended matter Sulphates Inorganic solids Organic solids	Lab	IS 3025	Water from each source	Before commencement of work & thereafter: Mandatory – Once in one year from each source; Optional: once in 3 months from each source; Municipal supply - optional.
Reinforced cement	b) slump test	Field	IS: 1199	a) 20 cu.m. for slabs, beams and connected columns. b) 5 Cum. in case of cloumns	a) 20 cu.m. Part there of or more frequently as require by the Engr.-in-Charge. b) Every 5 Cu.m.

concrete	c) cube test	Lab	IS : 516	a) 20 cu.m. In slab, beams, & connected columns. b) 5 cum in case of columns	a) every 20 cum of a day's concreting. (Ref. as per frequency of sampling). b) Every 5 cum.
Ready mixed cement (IS-4926) concrete	Cube test	Lab	IS-516 and as per para 6.3.2 of IS-4926-2003	50 cum	One for every 50cum of production or every 50 batches, whichever is the greater frequency
Note : for all other small items and where RCC done in a day is less than 5 cum, test may be carried out as required by Engineer-in-Charge.					
Mortars:					
Lime	Chemical & physical properties of lime	Laboratory	IS; 6932 (part 1 to x)	5 M.T.	10 M.T. or part thereof as decided by the Engineer-in-Charge
Sand	Bulking of Sand	Field		20 CU.M.	Every 20 cu.m or part thereof or more frequently as decided by Engineer-In-Charge
	Silt content	Field	IS:383	20 CU.M.	Every 20 cu.m or part thereof or more frequently as decided by Engineer-in-Charge
	Particle size and distribution	Field Laboratory decided by Engr -in-Charge	IS:383	40 CU.M.	Every 40 cu.m. of fine aggregate / sand required in RCC. work only.
	Organic Impurities	Field	.. DO..	20 CU.M.	Every 20 cu.m. or part thereof or more frequently as decided by the Engineer-in-Charge
	Chloride & sulphate content tests		Optional		Once in three months.

Material	Test	Field / laboratory test	Test procedure	Minimum quantity of material / Work for carrying out the test	Frequency of testing
Cement	Test requirement	Fineness (m ² /kg)	IS 4031 (Part-II)	Each fresh lot	Every 50 MT or part Thereof
		Normal consistency	IS 4031 (Part-IV)		
		Setting time (minutes) a) Initial b) Final	IS 4031 (Part-V)		
		Soundness a) Le-Chat expansion (mm) b) Autoclave (%)	IS 4031 (Part-III)		
		Compressive Strength (Mpa) a) 72+/-1 hr b) 168+/-2hr	IS 4031 (Part-VI)		
Stone Aggregate	a) Percentage of soft or deleterious materials	General visual inspection / Lab test where required by the Engr-in-Charge	IS 2386 Part II	One test for each source	One test for each source
	Particle size distribution	Field / Lab	-	10 cu.m	Every 40 cum. Or part thereof and
Once in three months for each source for coarse and fine aggregates required in RCC works, for a minimum quantity - 10 cum for coarse aggregate and 40 cum for fine aggregate.					
	Estimation of Organic impurities	Field / Lab	IS 2386 Part II	10 Cum	-do-
	b) Specific Gravity	Field / Lab	IS 2386	10 Cum	-do-
	Bulk Density	Field / Lab	IS 2386	10 Cum	-do-

Material	Test	Field / laboratory test	Test procedure	Minimum quantity of material / Work for carrying out the test	Frequency of testing
	b)Aggregate crushing strength	Field / Lab	IS 2386	10 Cum	-do-
	c)Aggregate impact value	Field / Lab	IS 2386	10 Cum	-do-
Timber	Moisture	Field (by moisture meter) Laboratory test as required by Engineer-in-Ch.		1 Cu.M.	Every one Cum or part thereof
Flush Door	End immersion test Knife test Adhesion test	Laboratory	IS: 2202 (Part 1) & (Part II)	26 shutters	As per sampling and testing as instructed by TheEngineer-in-
Bricks	Testing of bricks / brick tiles for dimensions Compressive strength Water absorption Efflorescence	Laboratory	IS 3495 Part I to IV	No. of bricks to be selected & bricks lot 20 : 2001 to 10000 32 : 10001 to 35000 50 : 35001 to 50000 20 : for every addl. 50000 or part thereof. If < 20000, As per decision of EIC.	Permissible defective bricks in the sample 1 2 3

Material	Test	Field / laboratory test	Test procedure	Minimum quantity of material / Work for carrying out the test	Frequency of testing
Concrete Blocks	Dimensions of block Block Density Compressive strength Water absorption Drying shrinkage Moisture movement Retest – Drying shrinkage & Moisture movement if required	Field Laboratory	IS 2185 – Part 1	20 blocks from every consignment of 5000 blocks.	As per sampling and testing as instructed by the Engineer-in-Charge.
Steel for RCC	Physical tests a) Tensile strength b) Retest c) Re-bond test d) Nominal mass e) Bend test f) Elongation test g) Proof stress	Lab / field	IS 1608 IS 1786 IS 1786 IS 1786 IS 1599 IS 1786 IS 1786	Each lot from each source from each diameter of bar	Below 100 Tonnes Dia < 10 mm one sample for each 25 tonnes or part thereof If dia is >10 mm but less than 16 mm: One sample each 35 tonnes or part thereof. If dia >16 mm one sample for each 45 tonnes
	Chemical Tests: 1. Carbon Constituent 2. Sulphur 3. Phosphorus 4. Phosphorus & Sulphur		IS 1786		For every fresh lot of one truck or less as directed by the Engineer-in-Charge.

Soil core test	OMC Proctor density		As per IS 12175	Two for every 50 sqm	As per para 1.10 & 1.11 of this book
Mosaic tiles			As per IS 13801 Para 14.6	5000 tiles and more for each manufacturer & thereafter for every 10000 tiles or part thereof.	
Ceramic tiles			As per IS 13630	3000 tiles and more for each manufacturer and thereafter for every 3000 tiles or part thereof.	

OTHER MANDATORY TESTS: Soil core tests; Testing aggregate - particle size distribution; Ceramic tiles, Mosaic tiles

CI pipes: Dimensional, mass, Hydrostatic; GI pipes; Lead; RCC hume pipes; Stoneware pipes

ROAD WORK: Soil core tests; Grading of metal for WBM; Bitumen grade; Bitumen content; Load test on concrete gratings.

OPTIONAL TESTS: Testing aggregate-surface moisture, impact value petrographic; alkali reaction; Dimensional tests of bricks; Testing the mass of zinc coating on GI door frame, steel windows, test for chemical and physical properties; Anodic coating on aluminium fittings and aluminium sections, Unit weight of aluminium sections;

Testing structural steel; Chequered plate, Unit weight, Thickness, Chemical and physical properties

Presence of preservative on factory made panelled door, kiln seasoned chemically treated wood products, Moisture content in wood products.

TESTING, TOLERANCE, ACCEPTANCE AND MODE OF PAYMENT:

- The material should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant IS for acceptance. Such materials shall be accepted as standard.
- Payment shall be restricted to standard unit mass, or as specified in the schedule of work, without making any cost adjustment towards mass or any other properties, provided the material pass all the tests and tolerances are within the specified limits. In case of non-standard materials, materials not covered under any IS Specifications, such as aluminium sections, the payment shall be made based on the actual unit weight basis as determined by testing at random sampling.

SECTION 'A' - CIVIL WORKS**1. EARTH WORK****1.1. SCOPE OF WORK:**

The scope of work covered under this specifications pertains to excavation of foundations, trenches, pits and over areas, in all sorts of soils, soft and hard rock, correct to dimensions given in the drawing including shoring, protections of existing underground utilities if any, such as water lines, electric cables etc., dewatering and shoring if necessary, stacking the useful materials as directed within the lead specified, refilling around the foundation and into the plinth with selected useful excavated earth and disposing off the surplus earth/materials within specified lead and finishing the surface to proper levels, slopes and camber etc. all complete.

1.2. SITE CLEARANCE:

Before the earth work is started the area coming under cutting and filling shall be cleared of all obstructions, loose stones, shrubs, rank vegetation, grass, brush-wood, trees and saplings of girth upto 30 cm. measured at a height of one metre above ground and rubbish removed upto a distance of 150 metres outside the periphery of the area under clearance. The roots of trees shall be removed to a minimum depth of 60 cm. below ground level, or a minimum of 30cm. below formation level whichever is lower, and the hollows filled up with earth, levelled and rammed. This work is deemed to be included in the earth work items and no separate payment will be admissible for the work.

The trees of girth above 30 cm. measured at a height of one meter above ground, shall only be cut after permission of the Engineer-in-charge is obtained in writing. The roots shall also be removed as described in the preceding sub-para. Payment for cutting and removing roots of such trees shall be made separately. Any material obtained from the site will be the property of the Department and the useful materials as decided by the Engineer-incharge will be conveyed and properly stacked as directed within the lead specified.

1.3. SETTING OUT AND MAKING PROFILES :

Masonry or concrete pillars will be erected at suitable points in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G. T. S. or any other permanent bench mark approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings or Burjis shall be made to show the correct formation levels before the work is started. The contractor shall supply labour and materials for setting out and making profiles and Burjis for the work at his own cost and the same shall be maintained during the excavation work. The Department will show grid Co-ordinate or other reference points. It shall be the responsibility of the contractor to set out centre lines correctly with reference to the drawings and install substantial reference marks. Checking of such alignment by the Department will not absolve the contractor from his responsibility to execute the work strictly in accordance with the drawings.

1.4. EXCAVATION :

The contractor shall notify the Engineer-in-charge before starting excavation and before the ground is disturbed, to enable him to take existing levels for the purpose of measurements. The ground levels shall be taken at 5 to 15 metres intervals in uniformly sloping ground and at closer distance where local mounts, pits or undulations are met with, as directed by the Engineer-in-charge. The ground levels shall be recorded in field books and plotted on plans, which shall be signed by the Contractor and the Engineer-in-charge, before the earth work is actually started. The labour required for taking levels, shall be supplied by the Contractor at his own cost. The Contractor shall perform excavation in all types of soils, murrum, soft and hard rock, boulders etc. in foundation, over areas and in trenches to widths, lines, levels, grades and curves as shown in the drawing or lesser widths, lines and levels as directed by the Engineer-in-charge and as per items in the schedule of quantities.

1.4.1. The item in the schedule of quantities shall specify the excavation in trenches or over areas. For this purpose, the excavation for any depth in trenches for foundation not exceeding 1.5 m. in width or 10 sqm. on plan shall be described as **Excavation in foundation trenches.**

1.4.2. Excavation exceeding 1.5m in width as well as 10 sqm. on plan (excluding trenches for pipes, cables etc.) and exceeding 30 cm in depth shall be described as **Excavation over areas.**

1.4.3. Excavation exceeding 1.5m in width as well as 10 sqm. on plan but not exceeding 30 cm. in depth shall be described as Surface Excavation.

1.5. Classification of Earth Work: The earth work shall be classified under the following main categories and measured separately for each category.

- a) All types of soils, murrum, boulders.
- b) Soft rock.
- c) Hard rock.

1.5.1.

- a) **All types of Soils, Murrum, Boulders :** This includes earth, murrum, top deposits of agricultural soil, reclaimed soil, clay, sand or any combination thereof and soft and hard murrum, shingle etc. which is loose enough to be removed with spades, shovel and pick axes. Boulders not more than 0.03 cum. in volume found during the course of excavation shall also fall under this classification.
- b) **Excavation in Soft Rock :** This shall include all materials which are rock or hard conglomerate, all decomposed weathered rock, highly fissured rock, old masonry, boulders

bigger than 0.03 cum. in volume but not bigger than 0.5 cum. and other varieties of soft rock which can be removed only with pick axes, crow bars, wedges and hammers with some difficulty. The mere fact that the contractor resorts to blasting and/or wedging and chiselling for reasons of his own, shall not mean the rock is classifiable as hard rock.

- c) **Excavation in Hard Rock** : This includes all rock other than soft rock mentioned in para 1.5.1 (b) viz. soft rock, occurring in masses, boulders having approximate volume more than 0.5 cum. plain or reinforced cement concrete, which can best be removed by blasting or chiselling and wedging where blasting cannot be permitted owing to any restriction at site.
 - i) **Excavation in Hard Rock by Blasting** : Where blasting is permitted the excavation in rock shall be done by means of blasting. No heavy blasting will be permitted and only controlled/muffled blasting will be permitted at the discretion of the Engineer-in-Charge. The Contractor shall be governed by the relevant statutory laws, rules and regulations on explosives, pertaining to the acquisition, transport, storage, handling and use of explosive which shall be rigidly followed and shall obtain himself all necessary materials and equipment for blasting. Blasting shall be executed through a licensed blaster with prior permission from police authorities. Prior to blasting sufficient notice shall be given to concerned parties to avoid danger to people, materials and nearby structures. All the damages caused by careless blasting if any shall be made good by the contractor at his own expenses.
 - ii) **Excavation in Hard Rock by Chiselling and Wedging** : Where blasting is not permitted and if the Engineer-in-Charge so desires, the excavation shall be done by chiselling and wedging or any other agreed method.

NOTE : All the excavated hard rock obtained shall be stacked properly and neatly within the specified lead by the contractor as directed by the Engineer-in-Charge.

- 1.6. EXCAVATION PARAMETERS** : The excavation under all classifications in areas in trenches or in pits shall be carried out systematically. Cutting shall be done from top to bottom and no under-pining or undercutting will be allowed. The bottom and sides of excavation shall be dressed to proper level, slopes, steps, camber etc. by removing high spots, and ramming thoroughly as directed by the Engineer-in-charge.

All the excavation shall be carried out strictly to the dimensions given in the drawing. The width shall generally be of the width of mudmat concrete and depth as shown in drawing or as directed by the Engineer-in-Charge, according to availability of the desired bearing capacity of soil below. Any excavation if taken below the specified depths and levels, the contractor shall at his own cost fill up such overcut to the specified level with cement concrete 1:4:8 in case of excavation in all types of soils and with cement concrete 1:2:4 in case of excavation in soft and hard rock.

After the excavation is completed, the contractor shall notify the Engineer-in-Charge to that effect and no further work shall be taken up until the Engineer-in-Charge has approved the

depth and dimensions and also the nature of foundation materials. Levels and measurements shall also be recorded prior to taking up any further work.

1.7. SHORING :

Unless separately provided for in the schedule of quantities, the quoted rate for excavation shall include excavation of slopes to prevent falling in soil by providing and/or fixing, maintaining and removing of shoring, bracing etc. The contractor would be responsible for the design of shoring for proper retaining of sides of trenches, pits etc. with due consideration to the traffic, superimposed loads etc. Shoring shall be of sufficient strength to resist the pressure and ensure safety from slips and to prevent damage to work and property and injury to persons. It shall be removed as directed after items for which it is required are completed. Should the slips occur, the slipped material shall be removed and slope dressed to a modified stable slope. Removal of the slipped earth will not be measured for payment.

1.8. DEWATERING :

Unless specifically provided for as a separate item in the schedule of quantities, rate shall also include bailing or pumping out all water which may accumulate in the excavation during the progress of further works such as mud mat concrete, R.C. footings, shuttering etc. either due to seepage, springs, rain or any other cause and diverting surface flow by bunds or other means. Care shall be taken to ensure that the water discharged sufficiently away from the foundations to keep it free from nuisance to other works in the neighbourhood.

1.9. DISPOSAL OF EXCAVATED MATERIALS :

- a) **ANTIQUITES** : Any finds of archaeological interest such as relics of antiquity, coins, fossils or other articles of value shall be delivered to the Engineer-in-Charge and shall be the property of the Government.
- b) **USEFUL MATERIALS** : Any material obtained from the excavation which in the opinion of the Engineer-in-Charge is useful, shall be stacked separately in regular stacks as directed by the Engineer-in-Charge and shall be the property of the Government.

No material excavated from foundation trenches of whatever kind they may be are to be placed even temporarily nearer than about 3 m. from the outer edge of excavation. Discretion of the Engineer-in-Charge in such cases is final. All materials excavated will remain the property of the Department. Rate for excavation includes sorting out of the useful materials and stacking them separately as directed within the specific lead.

Materials suitable and useful for backfilling or other use shall be stacked in convenient place but not in such a way as to obstruct free movement of materials, workers and vehicles or encroach on the area required for constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or other elevation shown on the plan or as directed by the Engineer-in-Charge. **Materials not useful in anyway shall be disposed off, levelled and compacted as directed by the Engineer-in-**

charge within a specified lead. The site shall be left clean of all debris and levelled on completion.

1.10. BACKFILLING IN SIDES OF FOUNDATIONS, PLINTH, UNDER FLOOR ETC. :

The back filling shall be done after the concrete or masonry has fully set and shall be done in such a way as not to cause under-thrust on any part of the structure. Where suitable excavated material is to be used for back filling, it shall be brought from the place where it was temporarily deposited and shall be used in backfilling. The scope of work for back filling/filling in foundation, plinth, under floors etc. shall include filling for all the buildings covered under the contract. Surplus earth available from one building, if required, shall be used for backfilling/filling for other buildings also within the specified lead mentioned in the item.

All timber shoring and form work left in the trenches, pits, floors etc. shall be removed after their necessity ceases and trash of any sort shall be cleared out from the excavation. All the space between foundation masonry or concrete and the sides of excavation shall be backfilled to the original surface with approved materials in layers not exceeding 150 mm. in thickness, watered and well consolidated by means of rammers to atleast 90% of the consolidation obtainable at optimum moisture content (Proctor density). Flooding with water for consolidation will not be allowed. Areas inaccessible to mechanical equipment such as areas adjacent to walls and columns etc. shall be tamped by hand rammer or by hand held power rammers to the required density. The backfill shall be uniform in character and free from large lumps, stones, shingle or boulder not larger than 75 mm. in any direction, salt, clods, organic or other foreign materials which might rot. The backfilling in plinth and under floors shall be done in similar way in layers not exceeding 150 mm. thick and shall be well consolidated by means of mechanical or hand operated rammers as specified to achieve the required density.

Test to establish proper consolidation as required will be carried out by the Department at rates specified. Two tests per 50 sqm. will be taken to ascertain the proper consolidation. The cost of tests carried out will be recovered from the contractors bill.

1.11. FILLING IN PLINTH AND UNDER FLOORS:

After the available suitable excavated materials are exhausted as backfilling, the contractor shall notify the Engineer-in-Charge, of the fact and levels taken jointly with Engineer-in-Charge. The earth, murrum, sand, gravel etc. or such materials suitable for filling proposed to be filled under floors and so mentioned in the item of schedule of quantities shall then be brought to site from approved locations and sources.

- i) **Earth Filling** : The earth, soft murrum etc. so brought shall be filled up in layers of 15 cm depth, each layer being well watered and consolidated by approved hand or mechanical tampers or other suitable means to achieve the required density.
- ii) **Gravel or Sand Filling** : Gravel if required to be filled under floors, shall be single

washed gravel of approved quality and of size varying from 12 mm. to 20 mm. it shall be uniformly blinded with approved type of soil and/or sand to obtain full compaction. Gravel shall be filled in specified thickness and shall be well watered and rammed entirely to the satisfaction of the Engineer-in-Charge.

If sand is required to be filled under floors, it shall be clean, medium grained and free from impurities. The filled in sand shall be kept flooded with water for 24 hrs. to ensure maximum consolidation. Any temporary work required to maintain sand under flooded condition shall be done by the contractor at his own cost. The surface shall then be well dressed and got approved from Engineer-in-Charge before any other work is taken over the fill.

1.12. LEAD & LIFT

LEAD : The lead for disposal/deposition of excavated materials shall be as specified in the respective item of work. For the purpose of measurements of lead, **the area to be excavated or filled or area on which excavated material is to be deposited/disposed off shall be divided in suitable blocks and for each of the block, the distance between centre lines shall be taken as the lead which shall be measured by the shortest straight line route on the plan and not the actual route adopted.**

LIFT : Lift shall be measured from ground level. Excavation up to 1.5 m depth below ground level and depositing excavated material on the ground shall be included in the item of earthwork for various kinds of soil. Extra lift shall be measured in unit of 1.5 m or part thereof. Obvious lift shall only be measured; that is lifts inherent in the lead due to ground slope shall not be measured except for lead upto 250 m. All excavation shall be measured in successive stages of 1 .5 m stating the commencing level. This shall not apply to cases where no lift is involved as in hill side cutting.

1.13. MODE OF MEASUREMENTS:

1.13.1. All excavation in areas having depth more than 30 cm. pits, trenches etc. shall be measured net. The dimensions for the purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, rafts or other foundations, multiplied by the mean depth from the surface of ground determined by levels. Excavation for side slopes will not be paid for. Excavation in areas having depths less than 30 cms. shall be measured as surface excavation on square metre basis, mentioning the average depth of excavation.

Reasonable working space beyond concrete dimensions shall be allowed for waterproofing and shuttering works in underground water tanks, sumps, septic tanks etc., where considered necessary in the opinion of the Engineer-in-Charge. However the same shall be limited to the following:

i) Waterproofing and works upto 2M depth	shuttering	Maximum upto 600mm from wall face or 300mm from the edge of offset / raft, whichever is more.
ii) Waterproofing and works beyond 2M depth	shuttering	Maximum upto 900mm from wall face or 300mm from the edge of offset / raft, whichever is more.

Reasonable working space beyond concrete dimension required for waterproofing and shuttering where considered necessary in the opinion of Engineer-in Charge will be allowed in execution and considered for payment for underground water tank, sump, septic tank etc.

1.13.2. Wherever direct measurements of rock excavation are not possible, volume of rock be calculated on the basis of length, breadth and depth of stacks made at site as mentioned in para 1.5.1 (c). The net volume shall be worked out by reducing it by 50%, taking the voids into consideration as 50%. Similarly to arrive at net quantity to be paid in the case of soil, reduction @ 20% of corresponding stack/truck measurements shall be made.

1.13.3. The rate for excavation shall include carting and disposing and levelling the excavated materials within the specified lead. The rate shall also be inclusive of cost of all tools, plants, explosives, shoring, dewatering at various stages, labour, materials etc. to complete all the operations specified.

1.13.4. The backfilling and consolidation in sides of foundation and in plinth with excavated material will not be paid for separately. The rate quoted for excavation shall be deemed to have been included the cost of stacking of excavated materials, conveying within the specified lead, picking of selected stacked materials, conveying it to the place of final backfill, compaction to the required proctor density etc.

1.13.5. Payment for filling and consolidation inside the trenches, sides of foundations, plinth etc. with selected materials brought by the contractor other than the excavated material, shall be paid for separately as per the rates in schedule of quantities which includes cost of such materials/excavation, royalty, its conveyance within the specified lead, watering, consolidating, dressing etc. Actual quantity of consolidated filling shall be measured and paid in cubic metres upto two places of decimal.

1.13.6. The rate quoted in cum. for items of excavation is deemed to include the necessary additional quantity of excavation involved beyond the plan dimensions of the work which may be necessary to be carried out for carrying out the work in an engineering manner, decided upon by the contractor. Therefore no extra payment will be made for any excavation done other than the required quantity as per the plan dimension indicated in the drawings.

1.13.7. Measurements for excavation over areas shall be determined by levels or by “Dead men” or both at the discretion of the Engineer-in-Charge. If however the Engineer-in-Charge decides on measurement by levels, levels of site shall be jointly taken and recorded by the Engineer-in-Charge or his representatives and the contractor, before commencement of the work and after completion of the work and the quantity of work done shall be computed based on these levels. The volume of earth work shall be computed based on “Simpsons formula” or any other approved method at the discretion of the Engineer-in-Charge.

* * * *

2. ANTITERMITE TREATMENT:

2.1.GENERAL :

Preconstructional anti-termite treatment is a process in which soil treatment is applied to a building in early stages of its construction. The purpose of antitermite treatment is to provide the building with a chemical barrier against the sub-terranean termites.

Antitermite treatment being a specialized job, calls for thorough knowledge of the chemicals, soils, termite to be dealt with and the environmental conditions, in order to give effective treatment and lasting protection to the property undergoing treatment. It is, therefore, imperative that the works of antitermite treatment should be got executed through specialized agencies only. The specialized agency should be preferably a member of the Indian Pest Control Association and shall have sufficient experience of carrying out similar works of magnitude envisaged in this tender.

The preconstructional soil treatment is required to be applied during the construction stages of the sub-structure upto plinth level. The contractor has to be watchful of the various stages of sub-structure works and arrange to carry out the soil treatment in time after proper co-ordination with Department and other contractors if any, working at site.

2.2.SCOPE :

The scope of preconstructional antitermite treatment covers the soil treatment with approved chemicals in water emulsion in foundation trenches for columns, plinth beams, pile caps, brick walls, service trenches, lift pits, steps, ramps etc. in top surfaces of plinth filling, at junction of walls and floor, in expansion joints etc. in stages as detailed in this specifications and drawings. Unless otherwise stipulated, the antitermite treatment will be carried out as per I.S.6313 (part II) 1981 and/or as per direction of the Engineer-in-Charge.

2.3.SITE PREPARATION :

In order to ensure uniform distribution of the chemical emulsion and to assist penetration, the following site preparation shall be carried out:

- a) Remove all trees, stumps, logs or roots from the building site.
- b) Remove all concrete form work if left anywhere, levelling pegs, timber off-cuts and other builders debris from the area to be treated.
- c) If the soil to be treated is sandy or porous, preliminary moistening will be required to fill capillary spaces in soil in order to prevent the loss of emulsion through piping or excessive percolations.
- d) In the event of water logging of foundation, the water shall be pumped out before application of chemical emulsion and it should be applied only when the soil is absorbent.
- e) On clays and other heavy soils where penetration is likely to be slow and on sloping sites, where run-off of the treating solution is likely to occur, the surface of the soil should be scarified to a depth of 75 mm. atleast.
- f) All sub-floor levelling and grading should be completed, all cutting, trenches and excavations should be completed with backfilling in place, borrowed fill must be free from organic debris and shall be well compacted. If this is not done supplementary treatments should be made to complete the barrier.

2.4.CHEMICAL TO BE USED :

The effectiveness of chemical depends upon the choice of the chemical, the dosage adopted and the thoroughness of application. The chemical solutions or emulsions are required to be dispersed uniformly in the soil and to the required strength so as to form an effective chemical barrier which is lethal and repellent to termites.

Soil Treatment : One of the approved chemicals in water emulsion, recommended by the Indian Pest Control Association (IPCA), and approved by the Engineer-in-Charge, shall be used uniformly over the area to be treated.

The contractor should produce voucher(s) for the chemical purchased and should get verified the sealed container(s) of the specified chemical from the Engineer-in-Charge before preparing the emulsion/use for the treatment.

2.5.MODE AND RATE OF APPLICATION :

The chemical emulsion as stated above will be applied uniformly by sprayers at the prescribed rates as detailed below in all the stages of the treatment.

- 2.5.1. Treatment in Foundation Trenches :** In case of normal wall load bearing structures, column pits, wall trenches and basement, the treatment shall be @ 5 ltrs./sqm. of surface area of the bottom and sides to a height of atleast 300 mm. After the foundation work, the

sides shall be treated @ 7.5 ltrs./sqm. of vertical surface of substructure on each side. After the earth filling is done, treatment shall be done by rodding the earth at 150 mm. centers close to wall surface and spraying the chemical with the above dose i.e. 7.5 ltrs./sqm.

In case of framed structure, the treatment shall start at a depth of 500 mm. below ground level. From this depth the backfill around the columns, beams and R.C.C. basement walls shall be treated @ 7.5 ltrs./sqm. of the vertical surface and @ 5 ltrs./sqm. for the horizontal surface at the bottom in the trenches/pits.

2.5.2. Treatment on Top Surfaces of Plinth Filling : The top surface of the filled earth within plinth walls shall be treated with chemical emulsion at the rate of 5 litres/sqm. of the surface area before sub-base to floor is laid. If filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes upto 50 to 75mm. deep at 150 mm. centers both ways shall be made with crow bars on the surface to facilitate saturation of the soil with the emulsion

2.5.3. Treatment at Junction of Walls and Floors : Special care shall be taken to establish continuity of the vertical chemical barrier on the inner wall surfaces from the finished ground level (or from level where the treatment had stopped) upto the level of the filled earth surface. To achieved this a small channel 30 x 30 mm. shall be made at all the junctions of wall/column with floor (before laying sub-grade) and rod holes made in the channel upto the finished ground level at 150 mm apart and the iron rod moved backward and forward to break the earth and chemical emulsion poured along the channel @ 7.5 litres (or at recommended quantity) per sqm. of the vertical wall/column surfaces so as to soak the soil right upto the bottom. The soil shall be tamped back into place after this operation.

2.5.4. Treatment for Expansion Joints : The soil beneath the expansion joints shall receive special attention when the treatment under 2.5.1 above is in progress. This treatment shall be supplemented by treating through the expansion joint after sub-grade has been laid at the rate of 2 litres per metre length of expansion joint.

2.6. PRECAUTIONS DURING TREATMENT :

- a) Utmost care shall be taken to see that the chemical barrier is complete and continuous. Each part of the area shall receive the prescribed dosage of chemical emulsion.
- b) The treatment should not be carried out when it is raining or when the soil is wet with rain or sub-soil water.
- c) Once formed, the treated soil barrier shall not be disturbed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

2.7. PRECAUTIONS FOR HEALTH HAZARDS AND SAFETY MEASURES :

2.7.1. All the chemicals mentioned above are poisonous and hazardous to health. These chemicals

can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mist or swallowed. Persons handling or using these chemicals should be warned of these dangers and advised that absorption through the skin is the most likely source of accidental poisoning. They should be cautioned to observe carefully the safety precautions given in 2.7.2 to 2.7.5 particularly when handling these chemicals in the form of concentrates

- 2.7.2.** These chemicals are usually brought to the site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so that children and pets cannot get at them. They should be kept securely closed.
- 2.7.3.** Particular care should be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions should also be avoided. Workers should wear clean clothing and should wash thoroughly with soap and water specially before eating and smoking. In the event of severe contamination, clothing should be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they shall be flushed with plenty of soap and water and immediate medical attention should be sought.
- 2.7.4.** The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. Flames should not be allowed during mixing.
- 2.7.5.** Care should be taken in the application of chemicals/soil-toxicants to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

2.8. GUARANTEE :

The contractor has to furnish the guarantee for 10 (ten) years from the date of completion of work, stating that in case of reappearance of termites within the building area due to defective materials or workmanship or due to any other reasons, the contractor will carry out the necessary post constructional treatment to keep the entire area free from termite, once again, without any extra cost to the Department during the guarantee period.

2.9.MODE OF MEASUREMENT :

The payment will be made on the basis of plinth area measurements at ground floor only for all the stages of treatment in sqm. correct to two places of decimals. Rate includes the cost of materials, labour and all tools,plants, sprayers required for complete operation.

* * * *

3. HARD CORE / SOLING UNDER FLOORS / FOUNDATIONS :

3.1. SCOPE OF WORK :

The work covered under this specification includes all type of soling work either by bricks or by rubble stones laid under floors/foundations, hand packed, complete as per under mentioned specification and applicable drawings.

3.2.1. RUBBLE STONE SOLING : The rubble stone shall be of best variety of black trap/granite/basalt or other approved variety of stone available locally. The stone shall be hard, durable, free from defects and of required size and shall be approved by the Engineer-in-Charge before incorporation in the work.

3.2.2. Preparation of Surface : The bed on which rubble soling is to be laid shall be cleared of all loose materials, levelled, watered and compacted and got approved by the Engineer-in-Charge before laying rubble soling. Cable or pipe trenches if shown in the drawing and as required by the Engineer-in-Charge shall be got done before the soling is started.

3.2.3. Workmanship : Over the prepared surface, the stone shall be set as closely as possible and well packed and firmly set. The stones shall be of full height and shall be laid so as to have their bases of the largest area resting on the sub-grade. Soling shall be laid in one layer of 230 mm. or 150 mm. or other specified thickness and no stones shall be less than 230 mm. or 150 mm. depth or specified thickness of soling with a tolerance of 25mm.

After packing the stones properly in position, the interstices between them shall be carefully filled with quarry spoils or stone chips of larger size possible, to obtain a hard, compact surface. Spreading of loose spoils or stone chips is prohibited.

The entire surface shall be examined for any protrusions and the same shall be knocked off by a hammer and all interstices shall be filled with approved murrum. Excess murrum if any over the surfaces shall be removed. Unless otherwise specified, the murrum shall be supplied by the contractor at his own cost from the selected areas. The surfaces shall then be watered and consolidated with mechanical or sufficiently heavy wooden tampers and log-rammers as approved by the Engineer-in-Charge to give the required slope or level and dense sub-base. After compaction, the surface shall present clean look. Adequate care shall be taken by the contractor while laying and compacting the rubble soling to see that concrete surfaces in contact with soling are not damaged.

3.3. MODE OF MEASUREMENT :

The quoted rate shall be per square metre of the soling of specified thickness. The linear dimensions shall be measured upto two places of decimals of a metre and are worked out correct to the two places of decimals of a square metre. Plan areas of soling work actually done limiting to the dimensions as per drawings shall be measured for payment. The rate shall include all the materials, labour, transport etc. and no extra payment shall be made for work done at different levels. The rate shall also include the cost of preparation of surface, all materials and labour, watering, consolidation etc. all complete.

* * *

4. PLAIN / REINFORCED CONCRETE AND ALLIED WORKS:

4.1. SCOPE :

Scope of the specification deals with the structural and general use of plain and reinforced cement concrete.. The specifications cover the qualitative and quantitative requirements in respect of selection of ingredients, proportioning, manufacture of concrete, transport, placing, consolidation, curing, finishing, acceptance criteria etc., These specifications also cover the requirement of form work and reinforcement.

- 4.2.** Unless otherwise specified, the manufacture and placing of concrete shall be done by weigh batching. However, in the specific cases where mechanized batching system (Ready mix concrete), mechanical transport and pumping is specified the same shall be followed as per the terms of the contract.

4.3. CEMENT CONCRETE (PLAIN AND REINFORCED):

- 4.3.1.** The quality of materials and method and control of manufacture and transportation of all concrete work in respect of mix, whether reinforced or otherwise, shall conform to the applicable portions of these specifications.

- 4.3.2. Mandatory tests:** The Engineer-in-Charge shall have the right to inspect the sources of materials, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipments and the quality control system. The contractor shall arrange such an inspection and the Engineer-in-Charge approval shall be obtained prior to starting the concrete work. List of mandatory test for RCC to be carried out is enclosed as Annexure "A".

- 4.3.3. Materials for Standard Concrete :** The ingredients to be used in the manufacture of standard concrete shall consist solely of a standard type Portland/Portland puzzolana cement, clean sand, natural coarse aggregate, clean water, ice and admixtures if specially called for on drawings or schedule of quantities.

- 4.3.3.1.Cement:** Unless otherwise specified or called for in the contract specifications, cement shall be any of the following and the type selected should be appropriate for the intended use and as per the contract conditions, specifications and drawings.

- a) 33 Grade Ordinary Portland cement conforming to IS 269
- b) 43 Grade ordinary Portland cement conforming to IS 8112
- c) 53 Grade ordinary Portland Cement conforming to IS 12269
- d) Portland slag cement conforming to IS 455.
- e) Portland pozzolana cement (fly ash based) conforming to IS 1489 (Part I)
- f) *Portland pozzolana cement (calcined clay based* conforming to IS 1489 (Part 2)
- g) Sulphate resisting Portland cement conforming to IS 12330.

In case the job requires specific use of any of the following cements the same shall be used

with the prior approval of the EIC and necessary precautions with regard to their setting and hardening time, time required for de-shuttering, curing etc., shall be taken after carefully complying with specific literature with regard to those types.

1. High Alumina cement - conforming to IS 6452
2. Low heat cement - conforming to IS 12600
3. Super sulphate cement - conforming to IS 6909
4. Rapid Hardening cement - conforming to IS 8041
5. Blended Cement for finishing work as below

Other combinations of Portland Cement with mineral admixtures of quality conforming to relevant Indian Standards laid down may also be used in the manufacture of concrete provided that there are satisfactory data on their suitability, such as performance test on concrete containing them and only in such case where in specifically called for in the contract.

4.3.3.1(A). Mineral Admixtures

Pozzolana: Pozzolanic materials conforming to relevant Indian Standards may be used with the permission of Engineer-in-charge, provided uniform blending with cement is ensured.

Fly ash (pulverized fuel ash): Fly ash conforming to Grade 1 of IS 3812 may be used as part replacement of **ordinary** Portland cement provided uniform blending with cement is ensured.

Silica fume: Silica fume conforming to a standard approved by the deciding authority can be used as part replacement of cement provided uniform blending with the cement is ensured.

Note: The silica fume (very fine non –crystalline silicon dioxide) is a by-product of the manufacture of silicon, ferrosilicon or the like, from quartz and carbon in electric arc furnace. It is usually used in proportion of 5 to 10 **percent** of the cement content of a mix.

Rice husk ash: Rice husk ash giving required performance and uniformity characteristics may be used with the **approval** of the deciding authority.

Note: Rice husk ash is produced by burning rice husk and contain large proportion of silica. To achieve amorphous state, rice husk may be burnt at controlled temperature. It is necessary to evaluate the **product** from a particular source for performance and uniformity since it can range from being as deleterious as silt when incorporated in concrete. Water demand and drying shrinkage should be studied before using rice husk.

Metakaoline: Metakaoline having fineness between 700 to 900m²/kg may be used as pozzolanic material in concrete.

Note: Metakaoline is obtained by calcination of pure or refined kaolintic clay at a temperature between 650 0C and 850°C, followed by grinding to achieve a fineness of 700 to 900 m²/kg. The resulting material has high pozzolanicity.

Ground Granulated Blast Furnace Slag: Ground granulated blast Furnace slag obtained by grinding granulated blast furnace slag conforming to IS 12089 may be used as part replacement of ordinary Portland cement provided uniform blending with cement is assured.

A certified report attesting to the conformity of the cement to I.S. specifications by the cement manufacturers chemist shall be furnished to the Engineer-in-Charge, if demanded. The Contractor, shall make his own arrangements for the storage of adequate quantity of cement at no extra cost at the site of work as per instructions and approval of the Engineer-in-Charge.

Specification for Storage:

Cement in bags shall be stored and stacked in a shed, which is dry, leak-proof and moisture proof as far as possible. Storage under tarpaulins will not be permitted. Flooring of the shed shall consists of the two layers of dry bricks laid on well consolidated earth to avoid contact of cement bags with the floor. Stacking shall be done about 150 to 200 mm clear above the floor using wooden planks. Cement bags shall be stacked at least 450 mm clear off the walls and in rows of two bags leaving in a space of at least 600 mm between two consecutive rows. In each row the cement bags shall be kept closed together so as to reduce air circulation. Stacking shall not be more than ten bags high to avoid lumping under pressure. In stacks more than eight bags high, the cement bags shall be arranged in header and stretcher fashion i.e alternately lengthwise and crosswise so as to tie the stacks together and minimize the danger of toppling over.

Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage arrangements shall be such that there is no dead storage consignments in cement shall be stored as received and shall be consumed in the order of their delivery.

Cement held in store for a period of ninety (90) days or longer shall be retested before use in work. Should at any time the Engineer-in-Charge have reasons to consider that any cement is defective, then irrespective of its origin and/or manufacturers test certificate, such cement shall be tested immediately at a National Test Laboratory/Departmental Laboratory or such approved laboratory, and until the results of such tests are found satisfactory, it shall not be used in any work.

4.3.3.2. Aggregates :

- a) **“Aggregate”** in general designates both fine and coarse inert materials used in the manufacture of concrete.
- b) **“Fine Aggregate”** is aggregate most of which passes through 4.75 mm I.S. sieve.
- c) **“Coarse Aggregate”** is aggregate most of which is retained on 4.75 mm I.S. sieve. Aggregate shall comply with requirement of IS 383. As far as possible preference shall be given to **machine** broken and graded aggregate.

All fine and coarse aggregates proposed for use in the work shall be subject to the Engineer-in-Charge's approval and after specific materials have been accepted, the source of supply of such materials shall not be changed without prior approval of the Engineer-in-Charge.

Aggregate shall, except as noted above, consists of natural sand, crushed stone and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion to the reinforcement or may impair the strength and/or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the “mix design” and preliminary test on concrete specified herein-after.

Sampling and testing : Sampling of the aggregates for mix design and determination of suitability shall be taken under the supervision of the Engineer-in-Charge and delivered to the laboratory, well in advance of the schedule for placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to the Engineer-in-Charge in advance of the work for use, in determining suitability of the proposed aggregate.

Storage of aggregates : All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but also at the time of loading into mixer. Rakers shall be used for lifting the coarse aggregate from bins or stock piles. Coarse aggregate shall be piled in layers not exceeding 1.00 metres in height to prevent conning or segregation. Each layer shall cover the entire area of the stock pile before succeeding layers are started. Aggregates that have become segregated shall be rejected. Rejected material after re-mixing may be accepted, if subsequent tests demonstrate conformity with required gradation.

Specific Gravity : Aggregates having a specific gravity below 2.6 (saturated surface dry basis) shall not be used without special permission of the Engineer-in-Charge.

4.3.3.2.1.Fine Aggregate: Fine aggregate except as noted above, and for other than light weight concrete shall consist of natural or crushed sand conforming to I.S. 383. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, loam, alkali, organic matter, mica, salt or other deleterious substances which can be injurious to the setting qualities/strength/durability of concrete.

4.3.3.2.2.Machine Made Sand : Machine made sand will be acceptable, provided the constituent rock composition is sound, hard, dense, non-organic, uncoated and durable against weathering. Machine made sand shall be accepted provided grading & finer particle limits conform to IS 383.

4.3.3.2.3.Screening and Washing : Sand shall be prepared for use by such screening or washing or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions. Sand with silt content more than 3 percent will not be permitted to be used unless the same is washed and silt content is brought within 3% by weight.

Foreign Material Limitations : The percentages of deleterious substances in sand, delivered to the mixer shall not exceed the following:

Sl.No	Substances	Percent by weight	
		Uncrushed	Crushed
i)	Material finer than 75 micron I.S. Sieve	3.00	15.00
ii)	Shale	1.00	--
iii)	Coal and lignite	1.00	1.00
iv)	Clay lumps	1.00	1.00
v)	Total of all above substances including items (i) to (iv) for uncrushed sand and items (iii)	5.00	2.00

GRADATION : Unless otherwise directed or approved, the grading of sand shall be within the limits indicated hereunder.

I.S. Sieve Designation	Grading Zone -I	Percentage passing for		
		Grading Zone -II	Grading Zone -III	Grading Zone -IV
9.5 mm	100	100	100	100
4.75mm	90-100	90-100	90-100	95-100
2.36mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100

600 micron	15-34	35-59	60-79	80-100
300 micron	5-20	8-30	8-30	20-65
150 micron	0-10	0-10	0-10	0-15

Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 micron (I.S.) sieve by not more than 5%, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron (I.S.) sieve or to percentage passing any other sieve size on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to Grading Zone IV shall not be used unless mix designs and preliminary tests have shown its suitability for producing concrete of specified strength and workability.

Fineness Modulus : The sand shall have a fineness modulus of not less than 2.2 or more than 3.2. The fineness modulus is determined by adding the cumulative percentages retained on the following I.S. sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron) and dividing the sum by 100.

4.3.3.2.4. Coarse Aggregate : Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to I.S. 383. This shall consist of natural or crushed stone and gravel, and shall be clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, sag, alkali, mica, organic matter or other deleterious matter.

The coarse aggregate and fine aggregate shall be tested from time to time as required by the Engineer-in-Charge to ascertain its suitability for use in construction and the charges for testing aggregate shall be born by the contractor as specified herein after.

Screening and Washing : Crushed rock shall be screened and/or washed for the removal of dirt or dust coating, if so demanded by Engineer-in-Charge.

Grading : Coarse aggregates shall be either in single or graded, in both the cases. The grading shall be within the following limits:

I.S. Sieve Designation	Percentage passing for single sized aggregates of nominal size						Percentage passing for graded aggregates of nominal size			
	63 mm	40 mm	20 mm	16mm	12.5mm	10 mm	40 mm	20 mm	16 mm	12.5
75 mm	100	-	-	-	-	-	-	-	-	-
53 mm	85-100	100	-	-	-	-	100	-	-	-
37.5 mm	0-30	85-100	100	-	-	-	95-100	100	-	-
19 mm	0-5	0-20	85-100	100	-	-	30-70	95-100	100	100
13.2 mm	-	-	-	85-100	100	-	-	-	90-100	-
11.2 mm	-	-	-	-	85-100	100	-	-	-	90-100

9.5 mm	-	0-5	0-20	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75 mm	-	0-5	0-5	0-10	0-20	0-20	0-5	0-10	0-10	0-10
2.36 mm	-	-	-	-	0-5	0-5	-	-	-	-

The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, in the opinion of Engineer-in-Charge, affect adversely the strength and/or durability of concrete, the maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of form. Plums above 160 mm. and upto any reasonable size can be used in plain mass concrete work of large dimensions upto a maximum limit of 20% by volume of concrete when specifically approved by Engineer-in-Charge. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm. less than the minimum clear distance between the reinforcing main bars or 5mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the Free State or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per I.S. 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by I.S.2386.

Foreign Material Limitations : The percentages of deleterious substances in the coarse aggregate delivered to the mixer shall not exceed the following :

Sl.No.	Substances	Percentage by weight of aggregates	
		Uncrushed	Crushed
i)	Material finer than 75 micron I.S. Sieve	3.00	3.00
ii)	Coal and lignite	1.00	1.00
iii)	Clay lumps	1.00	1.00
iv)	Soft fragments	3.00	--
v)	Total of all the above substances	5.00	5.00

4.3.3.3.WATER :

Water used for both mixing and curing shall be clean and free from injurious amounts of deleterious materials.viz oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable waters are generally satisfactory for mixing and curing concrete. In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in I.S. 456 - 2000. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The

samples shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 days compressive strength of at least three 150 mm. concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water as per IS - 516.

The initial setting time of test block made with the appropriate cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than (+/-) 30 minutes from the initial setting time of control test block prepared with the same cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of I.S. 4031 (Part 5).

Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer-in-Charge may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values:

- a) **Limits of acidity** : To neutralize 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml. of 0.02 normal NaOH. The details of test shall be as per I.S. 3025 (Part 22)
- b) **Limits of alkalinity** : To neutralize 100 ml sample of water, using mixed indicator , it should not require more than 25 ml. of 0.02 normal H₂SO₄. The details of test shall be as per I.S. 3025 (Part 23).
- c) **Permissible limits for solids shall be as under (water):**

Sl.No.	Type of solid	Tested as per	Permissible limit (Max.)
i)	Organic	IS 3025 (Part 18)	200 mg / l
ii)	Inorganic	IS 3025 (Part 18)	3000 mg / l
lii)	Sulphates (as SO ₂)	IS 3025 (Part 24)	400 mg / l
iv)	Chlorides (asCl)	IS 3025 (Part 32)	2000 mg / l for concrete not containing embedded steel and 500 mg/l for
v)	Suspended matter	IS 3025 (Part 17)	2000mg / l

- d) **The PH value of water shall be not less than 6.**

DESIGN MIX CONCRETE :

All reinforced concrete in the works shall be “Design Mix Concrete” as defined in I.S. 456-2000.

- 4.4.1. Mix Design :** This is to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give works cubes of the characteristic strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to the ACI standard designation ACI- 613 or Design of concrete mixes - Road research Note No.4, Department of Scientific and Industrial Research U.K. or I.S. 10262 - 1982.

After award of the work, if so desired by the contractor, he/they may be allowed by the Engineer-in-Charge, till the designed mix is obtained, to carry out the reinforced concrete work in foundation and plinth as per equivalent nominal mix against the specified design mix concrete as per I.S. Codes. However, all other specification for design mix shall govern for nominal mix also and nothing extra shall be paid for use of extra cement or else on this account whether the cement is supplied by the Department or procured by the contractor. Where the quantity of RCC is very small, under such circumstance equivalent nominal mix can also be permitted by the Engineer-in-Charge.

GRADES OF CONCRETE : The concrete shall be in grades designated as below.

Group	Grade	Specified Characteristic compressive strength of
Ordinary concrete	M 10	10
	M 15	15
	M 20	20
Standard Concrete	M 25	25
	M 30	30
	M 35	35
	M 40	40
	M 45	45
	M 50	50
	M 55	55
High strength concrete	M 60	60
	M 65	65
	M 70	70
	M 75	75
	M 80	80

NOTE :

1. The characteristic strength is defined as the strength of material below which not more than 5% of the test results are expected to fall.

- In the designation of a concrete mix, letter "M" refers to the mix and the number to the specified characteristic compressive strength of 150 mm. size cubes at 28 days expressed in N/ mm².
- Minimum Cement Content, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum size.*

Sl No.	Exposure	Plain concrete			Reinforced concrete		
		Minimum cement content Kg/m ³	Maximum Free Water Cement	Minimum grade of concrete	Minimum Cement Content Kg/m ³	Maximum Free Water Cement	Minimum Grade of concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	-	300	0.55	M-20
ii)	Moderate	240	0.60	M-15	300	0.50	M-25
iii)	Severe	250	0.50	M-20	320	0.45	M-30
iv)	Very severe	260	0.45	M-20	340	0.45	M-35
v)	Extreme	280	0.40	M-25	360	0.40	M-40

NOTE:

- Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in mineral admixtures. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.
- Minimum grade for plain concrete under mild exposure condition is not specified.

Nominal cover to meet Durability Requirements

Exposure	Nominal concrete cover in mm not less than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

NOTES

- For main reinforcement up to 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.

2. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10 mm
3. For exposure conditions 'severe' and 'very severe', reduction of 5 mm may be made, where concrete grade is M 35 and above.

Nominal cover to meet specified period of fire resistance

Fire resis- -tance			Nominal cover				
	BEAMS		SLABS		RIBS		COLUMNS
	Simply Supported	Continuous	Simply Supported	Continuous	Simply Supported	Continuous	
H	mm	mm	mm	mm	mm	mm	mm
0.5	20	20	20	20	20	20	40
1	20	20	20	20	20	20	40
1.5	20	20	25	20	35	20	40
2	40	30	35	25	45	35	40
3	60	40	45	35	55	45	40
4	70	50	55	45	65	55	40

NOTES

1. The nominal covers given relate specifically to the minimum member dimensions as per drawing
2. Cases that lie below the bold line require attention to the additional measures necessary to reduce the risks of spalling.

Adjustments to Minimum cement contents for Aggregates other than 20 mm Nominal Maximum size:

Sl.No	Nominal maximum Aggregate size mm	Adjustments to Minimum cement content kg/ m3
(1)	(2)	(3)
i)	10	+40
ii)	20	0
iii)	40	-30

For concrete of compressive strength greater than M55 design parameters given in the standard may not be applicable and the values may be obtained from specialized Literatures and experimental results.

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in the table above.

DEGREE OF CONTROL:

Selection of Water Cement Ratio : Since different cements and aggregates of different maximum size, grading, surface texture, shape and other characteristics may produce concretes of different compressive strength for the same free water cement ratio, the relationship between strength and free water-cement ratio should preferably be established for the materials actually to be used. In the absence of such data, the preliminary free water-cement ratio (by mass) corresponding to the target strength at 28 days may be selected from the relationship shown in Fig.1 of I.S. 10262 .

Alternately, the preliminary free water cement ratio (by mass) corresponding to the target average strength may be selected from the relationship in Fig.2- I.S. 10262, using the curve corresponding to the 28 days cement strength to be used for the purpose.

Other relevant items to be used with design of mix should strictly conform to the relevant clauses and appendices of I.S. 10262 .

The calculated mix proportions shall be checked by means of trial batches as per IS 10262

The free water cement ratio selected as above, should be checked against the limiting water cement ratio for the requirement of durability and the lower of the two values should be adopted.

Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, fresh tests shall be carried out to determine the revised proportion of the mix to suit the altered conditions. While designing mix proportions, over wet mixes shall always be avoided.

While fixing the value for water cement ratio for Design Mix assistance may be derived from the standard graph showing the relationship between the 28 days compressive strength of concrete mixes with different water-cement ratios and the 7 days compressive strength of cement tested in accordance with I.S.269.

It will be contractors sole responsibility to establish the concrete mix designs for different grades of concrete specified in the work consistent with the workability required for nature of work and also taking into consideration the assumed standard deviation which will be expected at site or by establishing the standard deviation based on 30 test results at site for each grade of concrete so as to produce concrete of required strength, durability and surface finish. The materials and proportions used in making the tests to be carried out either at site or under laboratory, conditions shall be similar in all respects to those to be actually employed in the works, as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce the concrete of the required consistency to give such specified strength.

4.4.2. STANDARD DEVIATION:

The standard Deviation for each grade of concrete shall be calculated separately.

STANDARD DEVIATION BASED ON TEST RESULTS :

- a) **Number of test results** - The total number of test results required to constitute and acceptable record for calculation of standard deviation shall be not less than 30. Attempts should be made to obtain the 30 test results, as early as possible, when a mix is used for the first time.
- b) **Standard deviation to be brought up to date** - The calculation of the standard deviation shall be brought upto date after every change of mix design and at least once a month.

Determination of standard deviation :

- i) Concrete of each grade shall be analysed separately to determine its standard deviation.

The standard deviation of concrete of a given grade shall be calculated using the following formula from the results of individual tests of concrete of that grade obtained as specified for test strength of sample:

- ii) Estimated standard **deviation S** = $\sqrt{\sum \Delta^2 \div (n-1)}$
- iii) Where Δ = Deviation of the individual test strength from the average strength of a sample and n = Number of sample test results.
- iv) When significant changes are made in the production of concrete (for example changes in the materials used, mix design, equipments or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

Assumed Standard Deviation:

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in table below may be assumed for design of mix in the first instance. As soon as the results of samples are available, actual calculated standard deviation shall be used and the mix designed properly. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in table below, it shall be permissible to use that value.

Grade of Concrete	Assumed Standard Deviation	N/
M 10 M 15	3.5	
M 20 M25	4.0	

M30	5.0	
M35		
M40		
M45		
M50		

Note: The above values correspond to the site control having proper storage of cement: weigh batching of all materials: controlled addition of water: regular checking of all materials: aggregate gradings and moisture contents : and periodical checking of workability: and strength. Where there is deviation from the above the values given in the above table shall be increased by 1 N / mm.²

4.4.3. Proportioning, Consistency, Batching and Mixing of Concrete:

4.4.3.1. Proportioning :

Aggregate : The proportions which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weigh batchers conforming to I.S. 2722, capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of **properly** graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stacked in separate stock piles. The gradings of coarse and fine aggregates shall be checked as frequently as possible, as determined by the Engineer-in-Charge, to ensure maintaining of grading in accordance with samples used in preliminary mix design. The materials shall be stock piled well in advance of use.

Cement : The cement shall be measured by weight. Every facility should be provided to the Engineer-in-Charge for sampling and inspection of stored cement at site of work.

Exposure conditions: General environment:

S.No:	Environment	Exposure Conditions
(1)	(2)	(3)
i)	Mild	Concrete surfaces protected against weather or aggressive conditions.
ii)	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet Concrete exposed to condensation and rain Concrete continuously under water Concrete in contact or buried under non-aggressive soil/ground water Concrete surfaces sheltered from saturated salt air in coastal area

iii)	Severe	Concrete surfaces exposed to severe rain, alternate wetting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in sea water
iv)	Very severe	Concrete surfaces exposed to seawater spray, corrosive fumes or severe freezing conditions whilst wet.
v)	Extreme	Surface of members in tidal zone Members in direct contact with liquid/solid aggressive chemicals.

WATER : Only such quantity of water shall be added to the cement and aggregate in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of materials or the collection of excessive free water on the surface of the concrete.

Definition of water cement ratio : The water cement (W/C) ratio is defined as the weight of water in mix (including the surface moisture of the aggregates) divided by the weight of the cement in the mix.

Water cement ratio : The actual water cement ratio to be adopted shall be determined in each instance by contractor and approved by the Engineer-in-charge.

Proportioning by water-cement ratio : The W/C ratio specified for use by the Engineer-in-Charge shall be maintained. Contractor shall determine the water content of the aggregate as frequently as directed by the Engineer-in-Charge as the work progresses and as specified in I.S. 2386 part III and the amount of mixing water added at the mixer shall be adjusted as directed by the Engineer-in-charge so as to maintain the specified W/C ratio. To allow for the variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

4.4.3.2.Consistency and slump : Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests etc. in accordance with I.S. 1199, shall be conducted from time to time to ensure the maintenance of such consistency.

The following tabulation gives a range of workability which shall generally be used for various types of construction unless other wise instructed by the Engineer-in-Charge.

Workability of concrete :

Placing condition	Degree of workability	Slump (mm)
(1)	(2)	(3)

Blinding Concrete; Shallow Sections; Pavement using pavers	Very low	See note 1.
Mass concrete; Lightly reinforced Sections in slabs, Beams, walls, columns; Floors; Hand placed pavements; Canal	Low	25-75
Heavily Reinforced sections In slabs, beams, walls, columns, slip form work; pumped concrete	Medium	50-1 00 75-100
Trench fill, In-situ piling	High	100-1 50
Tremie Concrete	Very High	See note 2.

Note :

1. For most of the placing conditions, internal vibrators (needle vibrators) are suitable. The diameter of the needle shall be determined based on the density and spacing of reinforcement bars and thickness of sections. For tremie concrete, vibrators are not required to be used.
2. the 'very low' category of workability where strict control is necessary, for example pavement quality concrete, measurement of workability by determination of compacting factor will be more appropriate than slump (see IS 1199) and a value of compacting factor of 0.75 to 0.80 is suggested.
3. In the 'Very high' category of workability, measurement of workability by determination of flow will be appropriate (see IS 9103).

PRODUCTION OF CONCRETE:

QUALITY ASSURANCE MEASURES:

In order that the properties of the completed structure be consistent with the requirements and the assumptions made during the planning and the design, adequate quality assurance measures shall be taken. The construction should result in satisfactory strength, serviceability and long term durability so as to lower the overall life-cycle cost. Quality assurance in construction activity relates to proper design use of adequate materials and components to be supplied by the producers, proper workmanship in the execution of works by the contractor and ultimately proper care during the use of structure including timely maintenance and repair by the owner.

Quality assurance measures are both technical and organizational. Some common cases should be specified in a general Quality Assurance Plan which shall identify the key elements necessary to provide fitness of the structure and the means by which they are to be provided and measured with the overall purpose to provide confidence that the realized project will work satisfactorily in service fulfilling intended needs. The job of quality control and quality

assurance would involve quality audit of both the inputs as well as the outputs. Inputs are in the form of materials for concrete; workmanship in all stages of batching, mixing, transportation; placing, compaction and curing; and the related plant, machinery and equipments; resulting in the output in the form of concrete in place. To ensure proper performance, it is necessary that each step in concreting which will be covered by the next step is inspected as the work proceeds.

Each party involved in the realization of a project should establish and implement a Quality Assurance Plan, for its participation the project. Suppliers and contractors activities shall be covered in the plan. The individual quality assurance plans shall fit into the general Quality Assurance Plan. A quality assurance plan shall define the tasks and responsibilities of all persons involved, adequate control and checking procedures, and the organization maintaining adequate documentation of building process and its results. Such documentation should generally include:

- a) test reports and manufacturers certificate for materials, concrete mix design details;
- b) pour cards for site organization and clearance for concrete placement;
- c) record of site inspection of workmanship, field tests
- d) non-conformance reports, change orders;
- e) quality control charts;
- f) statistical analysis.

NOTE – Quality control charts are recommended wherever the concrete is in continuous production over considerable period.

4.4.3.3. Batching and mixing of concrete :

BATCHING

To avoid confusion and error in batching, consideration should be given to using the smallest practical number of different concrete mixes on any site or in any one plant. In batching concrete, the quantity of both cement and aggregate shall be determined by mass; admixture, if solid, by mass; liquid admixture may however be measured in volume or mass; water shall be weighed or measured by volume in a calibrated tank (see also IS4925)

Ready mixed concrete supplied by ready-mixed concrete plant shall be preferred. For large and medium project sites the concrete shall be sourced from ready-mixed concrete plants or from on site or off site batching and mixing plants (see IS 4926)

Except where it can be shown to the satisfaction of the engineer-in-charge that supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes

and blending them in the right proportions when required, the different sizes being stocked in separate stock – piles. The material should be stock-piled for several hours preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible, the frequency for a given job being determined by the engineer-in-charge to ensure that the specified grading is maintained.

The accuracy of the measuring equipment shall be within $\pm 2\%$ of the quantity of cement being measured and within $\pm 3\%$ percent of the quantity of aggregate, admixtures and water being measured.

Proportion / Type and grading of aggregate shall be made by trial in such a way so as to obtain densest possible concrete. All ingredients of the concrete should be used by mass only.

Volume batching may be allowed only where weigh-batching is not practical and provided accurate bulk densities of materials to be actually used in concrete have earlier been established. Allowance for bulking shall be made in accordance with IS 2386 (Part 3). The mass volume relationship should be checked as frequently as necessary, the frequency for the given job being determined by engineer-in-charge to ensure that the specified grading is maintained.

It is important to maintain the water-cement ratio constant at its correct value. To this end determination of moisture contents in both fine and coarse aggregates shall be made as frequently as possible the frequency for a given job being determined by the engineer-in-charge according to weather conditions. The amount of the added water shall be adjusted to compensate for any observed variations in the moisture content. For the determination of moisture content in the aggregates IS 2386 (Part 3) may be referred to. To allow for the variation in mass of aggregate due to variation in their moisture content, suitable adjustments in the masses of aggregates shall also be made. In the absence of exact data only in the case of nominal mixes the amount of surface water may be estimated from the values given in table below.

Surface water carried by aggregate

Sr. No.	Aggregate	Approximate quantity of surface water	
		Percent by mass	l/m ³
(1)	(2)	(3)	(4)
i)	Very wet sand	7.5	120
ii)	Moderately wet sand	5.0	80
iii)	Moist sand	2.5	40
iv)	Moist gravel or crushed rock	1.25 – 2.5	20 – 40
	Coarser aggregate less the water it will		

No substitutions in materials used on the work or alterations in the established propositions

except as permitted as above shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

MIXING:

Concrete shall be mixed in a mechanical mixer. The mixer should with IS 1791 and IS 12119. The mixers shall be fitted with water measuring (metering) devices. The mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency. If there is segregation after unloading from the mixer, the concrete should be remixed.

For guidance, the mixing time shall be at least 2 min. For other types of more efficient mixers, manufacturers recommendations shall be followed; for hydrophobic cement it maybe decided by the Engineer-in-Charge.

Workability should be checked at frequent intervals.

Dosage of retards, plasticisers and superplasticisers shall be restricted to 0.50, 1.0 and 2.0 % respectively by weight of cementitious materials and unless higher value is agreed upon between the manufacturer and constructor based on performance test.

Each time the work stops, the mixer shall be cleaned out and when next commencing the mixing, the first batch shall have 10% additional cement to allow for sticking in the drum.

4.5. SAMPLING AND TESTING CONCRETE IN THE FIELD: Facilities required for sampling materials and concrete in the field, if Engineer-in-Charge so desires, shall be provided by contractor at no extra cost. The following equipment with operator shall be made available at Engineers request (all must be in serviceable condition):

1.	Cast iron cube moulds 15 cm. Size	12 Nos.(min.)
2.	Slump cone complete with tamping rod	1 Set
3.	Lab. balance to weigh upto 5 kg. with sensitivity of 10 gm.	1 No.
4.	Laboratory balance of 2 kg. capacity and of sensitivity of 1 gm.	1 No.
5.	I.S. sieves for coarse and fine aggregates.	1 Set
6.	A set of measures from 5 ltrs. to 0.1 ltr.	1 Set
7.	Electric oven with thermostat upto 120 OC.	1 No.
8.	Pycnometer	1 No.
9.	Calibrated glass jar 1 ltr. Capacity	2 Nos.
10.	Glass flasks and metal containers	As required
11.	Concrete cube testing machine (optional)	1 No.

4.6. TESTING CHARGES : Different tests required to be carried out for concrete works including the mix design, cube tested as per the above specifications shall be got done by the contractor at his own cost in one of the approved laboratories. The choice of laboratory shall rest with the Department. All incidental charges / cost shall be borne by the contractor.

In case the testing is carried out by the Department in its laboratory at Anushaktinagar, Bombay - 400 094, the contractor has to arrange to transport all the materials, cubes etc. to be tested, to the laboratory at Anushaktinagar at his own cost. The contractor shall bear the testing charges which are given below:

Sl.No.	Name of test	Testing charges
1.	Concrete	
	i) Crushing strength for cubes	Rs. 16/- per cube.
	ii) Design Mix (Determination for mix proportion)	Rs. 2000/- per mix design
2	Aggregates:	
	i) Sieve analysis for combined grading	Rs. 65/- per test
	ii) Moisture content and absorption test	Rs. 65/- per test
	iii) Crushing value	Rs. 50/- per test
	iv) Specific gravity and bulk density	Rs. 30/- per test
	v) Void ratio	Rs. 25/- per test
3	Bricks:	
	i) Absorption test	Rs. 25/- per test
	ii) Crushing strength	Rs. 40/- per test
4	Core test in soil	Rs. 25/- per test
5	Physical test of cement (set of following test)	Rs. 400/- per test
	i) Initial and final setting time;	
	ii) Fineness by sieve analyses	
	iii) Sound ness	
	iv) 3 and 7 days compressive strength	
	v) Consistency	
6	Non - Destructive Tests:	
	i) Rebound Hammer test	Rs. 1500 /- per visit for both tests
	ii) Ultrasonic Pulse Velocity test	
7	Ply wood / Block Boards	
	i. Moisture content tests	Rs. 65/- per test
	ii. Adhesion of Plies	Rs. 90/- per test
	iii. Knife test	Rs. 65/- per test
8	Flush door shutters:	
	i. End immersion test	Rs.125/- per test
	ii. Glue adhesion test	Rs.125/- per test
	iii. Knife test	Rs. 65/- per test

4.7. SAMPLING AND STRENGTH TEST OF CONCRETE:

Samples from fresh concrete shall be taken as per I.S. 1199 and cubes shall be made, cured and tested at 28 days in accordance with I.S. 516 .

In order to get a relatively quicker idea of the quality of concrete, option tests on beams for modulus of rupture at 72 (+/-) 2 hours or at 7 days or compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values given in table below may be taken for general guidance in the case of concrete made

with ordinary cement. In all cases, the 28 days compressive strength specified shall alone be the criterion for acceptance or rejection of the concrete. If however, from test carried out in particular job over a reasonably long period, it has been established to the satisfaction of the Engineer-in-Charge that a suitable ratio between 28 days compressive strength and modulus of rupture at 72 (+/-) 2 hours or 7 days or compressive strength at 7 days may be accepted, the Engineer-in-Charge may suitably relax the frequency of 28 days compressive strength, provided the expected strength values at the specified early age are consistently met.

Optional Tests Requirements of Concrete:

Grade of Concrete	Compressive strength on 15 cm cubes min. at 7 days	Modulus of rupture by beam	
		At 72 (+/-) 2 hours N / mm ²	At 7 days N / mm ²
M 10	7.0	1.2	1.7
M 15	10.0	1.5	2.1
M 20	13.5	1.7	2.4
M 25	17.0	1.9	2.7
M 30	20.0	2.1	3.0
M 35	23.5	2.3	3.2
M 40	27.0	2.5	3.4

4.7.2. Frequency of Sampling :

Sampling Procedure : A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested, i.e. the sampling should be spread over the entire period of concreting and cover all mixing units.

Frequency : The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of concrete in the work (in cum.)	Number of samples
1-5	1
6-15	2
16-30	3
31-50	4

51 and above	4 plus one additional for each additional 50 cum. or part there of
--------------	---

At least one sample shall be taken from each shift. Where concrete is continuous production unit, such as ready - mixed concrete plant, frequency of sampling may be agreed upon mutually by suppliers and purchasers.

4.7.3. Test Specimen : Three test specimen shall be made from each sample for testing at 28 days. Additional cubes may be required for various purposes such as to determine the strength of concrete at 7days or at the time of striking the form work or to determine the duration of curing or to check the testing error. Additional cubes may also be required for testing cubes cured by accelerated methods as described in I.S. 9013 - 1978. The specimen shall be tested as described in I.S. 516 - 1959.

4.7.4. Test Strength of Samples : The test strength of the samples shall be the average of the strength of three specimen. The individual variation should not be more than (+/-) 15 percent of the average.

4.7.5. Consistency : Slump test shall be carried out as often as demanded by the Engineer-in-Charge and invariably from the same batch of concrete from which the test cubes are made. Slump tests shall be done immediately after sampling.

4.7.6. Standard Deviation : Vide clause 4.4.2 of this specification.

4.8. ACCEPTANCE CRITERIA :

The concrete shall be deemed to comply with the strength requirements when both the following conditions are met:

(a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in column 2 of Table below

(b) Any individual test result complies with the appropriate limits in column of Table below.

Characteristic Compressive Strength Compliance Requirement:

Specified grade	Mean of the Group of 4 Non-overlapping consecutive	Individual test results in N/mm ²
(1)	(2)	(3)
M 15	$= / > f_{ck} + 0.825 \times \text{established}$ standard deviation (rounded off 0.5 N/mm ²	$= / > f_{ck} - 3 \text{ N/mm}^2$

	or $= / > f_{ck} + 3 \text{ N / mm}^2$ whichever is greater	
M 20 Or Above	$= / > f_{ck} + 0.825 \times$ established standard deviation (rounded off to nearest 0.5 N/ mm ² or $= / > f_{ck} + 4 \text{ N / mm}^2$,	$= / > f_{ck} - 4 \text{ N / mm}^2$

Note – In the absence of established value of standard deviation, the values given in (assumed standard deviation) may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.

Flexural Strength

When both the following conditions are met, the concrete complies with the specified flexural strength.

- The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm²
- The strength determined from any test result is not less than the specified characteristic strength less 0.3N/mm²

Quantity of Concrete Represented by Strength Test Results.

The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in column 2 of above table or in item (b) of flexural strength, only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60m³

If the concrete is deemed not to comply pursuant to above the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

Concrete of each grade shall be assessed separately

Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial

measures to the satisfaction of the Engineer-in-Charge.

4.9. ADMIXTURES :

Admixtures, if used shall comply with IS 9103. Previous experience with and data on such materials should be considered in relation to the likely standards of supervision & workmanship to the work being specified. Admixtures should not impair durability of the concrete not combined with the constituent to form harmful compounds nor increase the risk of corrosion of reinforcement.

The workability, compressive strength and the slump loss of concrete with & without the use of admixtures shall be established during the trial mixes before use of admixtures.

The relative density of liquid admixtures shall be checked for such drum containing admixtures and compared with the specified value before acceptance.

The chloride content of the admixtures shall be independently tested for each batch before acceptance. If two or more admixtures are used simultaneously in the same concrete mix data should be obtained to assess their interaction and to ensure their compatibility.

General :

Admixture may be used in concrete only with the approval of Engineer-in-charge based upon evidence that, with the passage of time neither the compressive strength nor its durability reduced. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturers instructions and in the manner and with the control specified by Engineer-in-Charge.

- i) **Calcium Chloride** : Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1 .5 percent of the weight of cement in each batch of concrete.
- ii) **Air Entraining Agents** : Where specified and approved by Engineer-in-charge, neutralized vinsol resin or any other approved air entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6.260, Air Entraining admixtures for concrete. The recommended total air content of the concrete is 4% (+/-) 1%. The method of measuring air content shall be as per I.S.1199.
- iii) **Retarding Admixtures** : Where specified and approved by Engineer-in-Charge, retarding agents shall be added to the concrete mix in quantities specified by Engineer-in-Charge.
- iv) **Water Reducing Admixtures** : Where specified and approved by Engineer-in-Charge,

water reducing lignosulfonate mixture shall be added in quantities specified by Engineer-in-Charge. The admixtures shall be added in the form of a solution.

- v) **Water Proofing Agents** : Where specified and approved by Engineer-in-Charge, chloride and sulphate free water proofing agents shall be added in quantities specified by Engineer-in-Charge.
- vi) **Other Admixtures** : Engineer-in-Charge may at his discretion, instruct contractor to use any other admixture in the concrete.

4.10. INSPECTION OF STRUCTURES :

Immediately after stripping the form work, all concrete shall be carefully inspected and any defective work or small defects, either removed or made good before concrete has thoroughly hardened, as instructed by Engineer-in-Charge.

In case of doubt regarding the grade of concrete used or results of cube strength are observed to be lower than the designed strength as per specifications at 28 days, compressive strength test of concrete based on core test, ultrasonic test and/or load test shall be carried out by the digital ultrasonic concrete tester by an approved agency as directed by the Engineer-in-Charge all at the cost of the contractor. In case these tests do not satisfy the requirements, the Department will be at liberty to reject the concrete, and the contractor, at his own cost, has to dismantle and re-do the same or carry out such remedial measures as approved by the Department.

4.11. TESTING OF STRUCTURES :

- 4.11.1. **Optional Tests** : Engineer-in-charge, if he so desires, may order for tests to be carried out on cement, sand, coarse aggregate, water etc. in accordance with the relevant Indian Standards.

Tests on cement will be carried out by Department and shall include (i) fineness test, (ii) test for normal consistency, (iii) test for setting time, (iv) test for soundness, (v) test for compressive strength, (vi) test for heat of hydration (by experiment and by calculations) in accordance with I.S.269.

Tests on sand shall include (i) sieve test, (ii) test for organic impurities, (iii) decantation test for determining clay and silt content, (iv) specific gravity test, (v) test for unit weight and bulkage factor, (vi) test for sieve analysis and fineness modulus.

Tests on coarse aggregate shall include (i) sieve analysis, (ii) specific gravity and unit weight of dry, loose and rodded aggregate, (iii) soundness and alkali aggregate reactivity, (iv) petrographic examination, (v) deleterious materials and organic impurities, (vi) test for aggregate crushing value.

The test on aggregates would normally be ordered to be carried out only if Engineer-in-charge

feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at an approved test laboratory. Contractor shall have to pay all the charges of optional tests. If the work cubes do not give the stipulated strengths, Engineer-in-Charge reserves the right to ask contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standards stipulated at contractors cost.

The unit rate for concrete shall be all inclusive including making preliminary mix design and test cubes, works cubes, testing them as per specifications, slump tests, optional tests etc. Complete. However, the Department will test the cubes departmentally. The contractor will have to make arrangements for transportation to the laboratory and testing charges will be borne by the contractor.

The contractor should also conduct **conclusive tests** such as ultrasonic pulse test, core test etc. to prove the suitability of concrete, in case cube tests give unsatisfactory results. The cost of the conclusive test should be borne by the contractor.

- 4.11.2. Core Test :** The points from which cores are to be taken and the number of cores required, shall be at the discretion of the Engineer-in-Charge and shall be representative of the whole of concrete concerned.

In no case, however, shall fewer than three cores be tested. Cores shall be prepared and tested as described in I.S. 516

- 4.11.3.** Concrete in the member represented by a core test shall be considered acceptable if the average equivalent cube strength of the cores is equal to at least 85% of the cube strength of the grade of concrete specified for the corresponding age and no individual core has a strength less than 75%.

In case the core test results do not satisfy the requirements as above or where such tests have not been done, load test (see 4:11:3) may be resorted to.

4.11.4. LOAD TESTS ON PARTS OF STRUCTURE :

Load tests should be carried out as soon as possible after expiry of 28 days from the time of placing of concrete.

The structure should be subjected to a load equal to full dead load of the structure plus 1.25 times the imposed load for a period of 24 hours and then the imposed load shall be removed.

Note: Dead load includes weight of the structural members plus weight of finishes and walls or partitions, if any, as considered in the design.

The deflection due to imposed load only shall be recorded. If within 24 hours of removal of the imposed load, the structure does not recover at least 75% of the deflection under super

imposed load, the test may be repeated after a lapse of 72 hours. If the recovery is less than 80%, the structure shall be deemed to be unacceptable.

If the maximum deflection in mm. shown during 24 hours under load is less than $40L^2/D$, where L is the effective span in M. and D the overall depth of the section in mm, it is not necessary for recovery to be measured and the recovery provision as above will not apply.

- 4.11.5.** Other non-destructive test methods may be adopted, in which case the acceptance criteria shall be agreed upon between the Engineer-in-Charge and the Contractor and the test shall be done under expert guidance.

MEMBERS OTHER THAN FLEXURAL MEMBERS:

Members other than flexural members should be preferably investigated by analysis.

Non – destructive tests:

Non-destructive tests are used to obtain estimation of properties of concrete in the structure. The methods adopted include ultrasonic pulse velocity [see IS 13311 (Part 1)] and rebound hammer [IS 13311 (Part 2)], probe penetration, pull out and maturity. Non destructive tests provide alternatives to core tests for estimating the strength of concrete in a structure, or can supplement the data obtained from a limited number of cores. These methods are based on measuring a concrete property that bears some relationship to strength/ the accuracy of these methods, in part is determined by the degree of correlation between strength and the physical quality measured by the non-destructive tests.

Any of these methods may be adopted, in which case the acceptance criteria shall be agreed upon prior to testing.

4.11.6. TESTING OF UNDERGROUND WATER TANK/SEPTIC TANK/UNDERGROUND STRUCTURES :

The tank will be tested after the completion according to the procedure laid down here:

The middle compartment shall be filled first to its full height and the leakage if any shall be checked on its outer surfaces and if found, the same shall be examined carefully and defects rectified/grouted if necessary. The drop in level of surface of water shall also be recorded for 48 hours. If this drop in level exceeds 20 mm. and shows any leakage in the said walls, necessary steps shall be taken in consultation with the Engineer-in-Charge.

After this compartment is tested to the satisfaction of the Engineer-in-Charge, all water from middle compartment shall be pumped into side compartment to the full height and checked for water leakages from the outer surfaces of the tank as well as inner surface of the middle compartment. The drop in level of surface of water shall also be checked as stated above and defects rectified.

The external surface of the tank shall then be plastered and cured as per the specifications

and back filling shall be taken up thereafter. The water from the compartments shall then be pumped out and the inner surface of the tank in all compartments then be checked and defects rectified.

After satisfactory completion of checks, internal plaster shall be taken up as specified in the specifications.

The contractor shall be responsible for carrying out the complete test, rectifying the leakages if any. The cost of providing all equipments, labour for carrying out tests shall be borne by the contractor. The rates quoted for concreting items for constructing under ground water tank shall be inclusive of testing of RCC tank for water tightness as per above specifications. The contractor shall make his own arrangement to tap the water from the departmental supply line for filling the tank, if supply of water stipulated under Schedule 'A'. If supply of water not stipulated under Schedule 'A', the contractor shall make his own arrangement as per contract conditions at his own cost.

4.11.7. UNSATISFACTORY TESTS :

Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction, contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by Engineer-in-Charge. Contractor shall bear the cost of so doing, unless the failure of the member or members to fulfill the test conditions is proved to be solely due to faulty design. The cost of load and other tests shall be borne by Contractor if the tests show unsatisfactory results; otherwise such costs will be borne by the Department.

4.12. CONCRETE IN ALKALI SOILS WATER & AGGREGATES:

Some aggregates containing particular varieties of silica may be susceptible to attack by alkalis (Na₂O and K₂O) originating from cement and other sources, producing an expansive reaction which can cause cracking and disruption of concrete. Damage to concrete from this reaction will normally only occur when all the following are present together.

- a) A high moisture level, within the concrete.
- b) A cement with high alkali content, or another source of alkali;
- c) Aggregate containing an alkali reactive constituent.

Where the service records of particular cement / aggregate combination are well established, and do not include any instances of cracking due to alkali-aggregate reaction, no further precautions should be necessary. When the materials are unfamiliar, precautions should take one or more of the following forms:

- a) Use of non-reactive aggregate from alternate sources
- b) Use of low alkali ordinary Portland cement having total alkali content not more than 0.6

percent (as Na₂O equivalent).

Further advantage can be obtained by use of fly ash (Grade I) conforming to IS 381 2or granulated blast furnace slag conforming to IS 12089 as part replacement of ordinary Portland cement (having total alkali content as Na₂O equivalent not more than 0.6 percent) provided fly ash content is at least 20 % or slag content is at least 50 percent.

- a) Measures to reduce the degree of saturation of the concrete during service such as use of impermeable membranes
- b) Limiting the cement content in the concrete mix and thereby limiting total alkali content in the concrete mix as per approval of Engineer- in-charge.

Chlorides in the concrete

Whenever there is chlorides in concrete there is an increased risk of corrosion of embedded metal. The higher the chloride content or if subsequently exposed to warm moist conditions, the greater the risk of corrosion. All constituents may contain chlorides and concrete may be contaminated by chlorides from the external environment. To minimise the chance of deterioration of concrete from harmful chemical salts, the levels of such harmful salts in concrete materials, that is, cement, aggregates, water and admixtures, as well as by diffusion from the environment should be limited. The total amount of chloride content (as Cl) in the concrete at the time of placing shall be as given below in the table.

Limits of Chloride Content of Concrete

Sl. No	Type or Use of Concrete	Maximum Total Acid soluble Chloride Content Expressed as kg/m ³ of Concrete.
(1)	(2)	(3)
i)	Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete	0.4
ii)	Reinforced concrete or plain concrete containing	0.6
iii)	Concrete not containing embedded metal or any material requiring protection form chloride	3.0

The total acid soluble chloride content should be calculated from the mix proportions and the major chloride contents of each of the constituents. Whenever possible the total chloride content of the concrete should be determined as per the approval of the Engineer-in-Charge.

Sulphates in concrete:

Sulphates are present in most cements and in some aggregates; excessive amounts of

water-soluble sulphate from these or other mix constituents can cause expansion and disruption of concrete. To prevent this, the total water-soluble sulphate content of the concrete mix, expressed as SO₃, should not exceed 4 per cent by mass of the cement in the mix. The sulphate content should be calculated as the total from the various constituents of the mix as per the approval of the Engineer-in-Charge.

The 4 percent limit does not applied to concrete made with super sulphated cement complying with IS 6909 or as approved by the Engineer-in-Charge.

4.13. PREPARATION PRIOR TO CONCRETE PLACEMENT, FINAL INSPECTION & APPROVAL :

Before the concrete is actually placed in position, the inside of the form work shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wire, rubbish, dirt etc. Opening shall be placed or holes drilled so that these materials and water can be removed easily. Such openings / holes shall be later suitably plugged.

The various traders shall be permitted ample time to install drainage and plumbing lines, floor and trench drain, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the drawing or as necessary for the proper execution of the work. All such embedments shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer-in-Charge.

Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.

Prior to concrete placement, all works shall be inspected and approved by Engineer-in-Charge, and if found unsatisfactory, concrete shall not be poured until all defects have been corrected at contractors cost.

Approval by Engineer-in-Charge of any and all materials and work as required herein shall not relieve contractor from his obligations to produce finished concrete in accordance with the drawings and specifications.

4.13.1. RAIN OR WASH WATER :

No concrete shall be placed in wet weather or on a water covered surface. Any concrete that has been washed by heavy rain shall be entirely removed, if there is any sign of cement and sand having been washed from the concrete mixture. To guard against damage which may be caused by rain, the works shall be covered with tarpaulins immediately after the concrete

has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitable drains and sumps shall be provided.

4.13.2. BONDING MORTAR :

Immediately before concrete placement begins, prepared surfaces, except form work, which will come in contact with concrete to be placed, shall be covered with a bonding mortar of same strength of concrete.

4.13.3. TRANSPORTATION :

All buckets, containers or conveyers used for transporting concrete shall be mortar-tight. All means of conveyance shall be adopted to deliver concrete of the required consistency and plasticity without segregation or loss of slump whatever method of transportation is employed. Chute shall not be used to transport the concrete without the written permission of the Engineer-in-Charge and concrete shall not be rehandled before placing.

4.13.4. Retempered or Contaminated Concrete :

Concrete must be placed in its final position before it becomes too stiff to work. On no account water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials and which has not been placed within half an hour of mixing water with cement shall be rejected.

4.13.5. CLEANING OF EQUIPMENT :

All equipments used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipe lines and other equipments shall be thoroughly cleaned after each period of placement.

4.13.6. PROCEDURE FOR PLACING OF CONCRETE :

- 1. Engineers Approval of Equipment and Methods :** Before any concrete is placed, the entire placing programme, consisting of equipment, layout proposed procedures and methods shall be submitted to Engineer-in-Charge and no concrete shall be of such size and design to ensure a practically continuous flow of concrete during depositing without segregation of materials, considering the size of the job and placement location.
- 2. Time Interval Between Mixing and Placing :** Concrete shall be placed in its final position before the cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.
- 3. Avoiding Segregation :** Concrete shall in all the cases be deposited as nearly as practicable

directly in its final position and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable prop and Elephant Trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in columns and thin walls.

4. **Placing by Manual Labour** : Except when otherwise approved by Engineer-in-Charge, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height more than 1.0 m. or handle in a manner which will cause segregation.
5. **Placing by Mechanical Equipment** : The following specifications shall apply when placing of concrete by use of mechanical equipment is specially called for while inviting bids or is warranted, considering the nature of work involved.

The control of placing shall begin at the mixer discharge. Concrete shall be discharged by a vertical drop into the middle of the bucket of hopper and this principle of a vertical discharge of concrete shall be adhered-to through out all stages of delivery until the concrete comes to rest in its final position.

Type of buckets : All concrete shall be conveyed from the mixer to the place of final deposit in suitable buckets, dumpers, containers which shall be leak-tight. All means of conveyance shall be adopted for delivering concrete to the required consistency/ workability and plasticity without segregation.

Central bottom dump buckets of a type that provides for positive regulation of the amount and rate deposition of concrete in all dumping position shall be employed.

Operation of Bucket : In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.0 m. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

6. **Placement in Restricted Forms** : Concrete placed in restricted forms by borrows, buggies, cars, short chutes or hand shovelling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.
7. **Chutting** : Where it is necessary to use transfer chutes, specific approval of Engineer-in-Charge must be obtained to type, length, slopes, baffles, vertical terminal and timing of operations. These shall be so arranged that almost continuous flow of concrete is obtained at the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the

waste water shall be kept clear of the forms. The concrete shall not be permitted to fall from the end of the chutes by more than 1.0 m. Chutes, when approved for use, shall have slopes not flatter than 1 vertical to 3 horizontal and not steeper than 1 vertical to 2 horizontal, chutes shall be of metal or metal line and of rounded cross section. The slopes of all chute sections shall be approximately same. The discharge end of the chutes shall be maintained above the surfaces of the concrete in the forms.

- 8. Placing by Pumping/ Pneumatic Placers :** Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers, only with the written permission of Engineer-in-Charge. The slump shall be held to the minimum, necessary for conveying concrete by this method.

When pumping is adopted, before pumping of concrete is started, the pipelines shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

When pneumatic placer is used, the manufacturers advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at the end.

Manufacturers advice shall be followed regarding concrete quality and all other related matters when pumping/ pneumatic placing equipments are used.

- 9. Concrete in Layers :** Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm. to 90 cm. as directed by Engineer-in-Charge. These shall be placed as rapidly as practicable to prevent the formation of cold joints or planes of weakness between each succeeding layers within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit, shall spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shovelling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer-in-Charge.

Bedding of Layers : The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed.

COMPACTION :

- 4.13.7. COMPACTION :** Concrete shall be compacted during placing, with approved vibrating equipment, until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate and fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the form faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix

and caution is to be exercised not to over vibrate the concrete to the point of segregation.

1. **Type of Vibrators** : Vibrators shall conform to I.S. specifications. Type of vibrators to be used shall depend upon the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the form work which must be sufficiently rigid to transmit the vibrations and strong enough not to be damaged by it. Immersion vibrators shall have No load frequency amplitude and acceleration as per I.S.2505 depending on the size of the vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.
 2. **Use of Vibrators** : The exact manner application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm. apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of lift, e.g. in a column or wall.
 3. **Melding successive batches** : When placing concrete in layers, which are advancing horizontally as the work progress, great care shall be exercised to ensure adequate vibration, blending and melding of the concrete between the successive layers.
 4. **Penetration of vibrators** : The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below while the under layer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.
 5. **Vibrating against reinforcement** : Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.
 6. **Use of Form Attached Vibrators** : Form attached vibrators shall be used only with specific authorisation of Engineer-in-Charge.
 7. **Use of surface vibrators** : The use of surface vibrators will not be permitted under normal conditions. However, for thin slabs, such as highways, runways and similar construction, surface vibrations by specifically designed vibrators may be permitted, upon approval of Engineer-in-Charge.
- 4.13.8. **STONE POCKETS AND MORTAR PONDAGES** : Formation of stone pockets or mortar pondages in corners and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to a sufficient depth and shape for thorough bounding as directed by Engineer-in-Charge.
- 4.13.9. **PLACEMENT INTERVAL** : Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for at least 24 hours after the final set of concrete

and before the start of a subsequent placement.

1. Special Provision in Placing : When placing concrete in walls with openings, in floors of integral slab and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slabs as the case may be. Placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by Engineer-in-charge.

2. Placing Concrete Through Reinforcing Steel : While placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregate. Where the congregation of steel make placing difficult, it may be necessary to temporarily move the top steel aside to get proper placement and restore reinforcing steel to design position.

4.13.10. BLEEDING : Bleeding or free water on top of concrete being deposited in to the forms, shall be caused to stop the concrete pour and the conditions causing this defect corrected before any further concreting is resumed.

4.14. CONSTRUCTION JOINTS AND KEYS :

Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints, as specified therein after. Time lapse between the pouring of adjoining units shall be as specified in the drawings or as directed by Engineer-in-Charge.

Construction joints and cold joints:

Joints are a common source of weakness and therefore it is desirable to avoid them. If this is not possible, their number shall be minimized . Concreting shall be carried out continuously up to construction joints the position and arrangement of which shall be indicated by the designer. Construction joints should comply with IS 11817.

Construction joints shall be placed at accessible locations to permit cleaning out of laitance, cement slurry and unsound concrete, in order to create rough/uneven surface . It is recommended to clean out laitance and cement slurry by using wire brush on the surface of joint immediately after initial setting of concrete and to clean at the same immediately thereafter. The prepared surface should be in a clean saturated surface dry condition when fresh concrete is placed, against it. In the case of construction joints at locations where the previous pour has been cast against shuttering the recommended method of obtaining a rough surface for the previously poured concrete is to expose the aggregate with a high pressure water jet or any other appropriate means.

Fresh concrete should be thoroughly vibrated near construction joints so that mortar from the new concrete flows between large aggregates and develop proper bond with old concrete.

Where high shear resistance is required at the construction joints, shear keys may be provided.

Sprayed curing membranes and release agents should be thoroughly removed from joint surfaces.

If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made where the work is stopped. Joints shall be either vertical or horizontal, unless shown otherwise in drawing. In case of an inclined or curved member, the joints shall be at right angles to the axis of the member. Vertical joints in walls shall be kept to a minimum. Vertical joints shall be formed against a stop board, horizontal joints shall be level and wherever possible, arranged, so that the joint lines coincide with the architectural features of the finished work. Battens, shall be nailed to the form work to ensure a horizontal line and if directed, shall also be used to form a grooved joint. For tank walls, similar work joints shall be formed as per I.S. 3370. Concrete that is in the process of setting shall not be disturbed or shaken by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform in detail to the requirements of the plans unless otherwise directed by Engineer-in-Charge. Where not described, the joints shall be in accordance with the following:

1. **Column Joints** : In a column, the joint shall be formed 75 mm. below the lowest soffit of the beams including haunches if any. In flat slab construction the joint shall be 75 mm. below the soffit of column capital. At least 2 hours shall elapse after depositing concrete in column, piers or walls, before depositing in beams, girders or slabs supported thereon.
2. **Beam and Slab Joints** : Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable, the joint shall be vertical and at the centre or within the middle third of the span unless otherwise shown in drawing. Where a beam intersects a girder, the joints in the girder shall be offset a distance equal to twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidable at right angles to the principle reinforcement, the joint shall be vertical and at the middle of span.
3. **Joints in Liquid Retaining Structures** : Vertical construction joints in watertight construction will not be permitted unless indicated on the drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of its construction to ensure maximum watertightness.
4. **Dowels** : Dowels for concrete work, not likely to be taken up in the near future, shall be wrapped in tar paper and burlap.
5. **Mass Foundations** : Mass foundations shall be poured in lifts not exceeding 1.5 m. in height unless, otherwise indicated on the drawings and approved by Engineer-in-Charge.
6. **Treatment of Construction Joints on Resuming Concreting** : Drier shall be used for the top lift or horizontal pours to avoid a laitance. All laitance and loose stones shall be thoroughly and carefully removed by wire brushing/ hacking and surface washed.

Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and loose matter removed and then treated with a thin layer of cement grout of proportion specified by Engineer-in-Charge and worked well into the surface. The new concrete shall be well worked specially against the prepared face before the grout mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the joint plane.

4.15. CURING, PROTECTING, REPAIRING, AND FINISHING:

1. **Curing** : All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water, continuously saturated covering of sacking, canvas, hessain or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment may be required for specific concrete surface finish.

Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer-in-Charge.

1. **Curing with Water** : Fresh concrete shall be kept continuously wet for a minimum period of 14 days from the date of placing of concrete, following a lapse of 12 to 24 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to unformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.
2. **Continuous Spraying** : Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliances of hose sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer-in-Charge.
3. **Alternate Curing Methods** : Whenever in the judgment of Engineer-in-Charge, it may be necessary to omit the continuous spray method, covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. Any type of covering which would stain or damage the concrete during or after the curing period, will not be permitted. Covering shall be kept continuously wet during the curing period.

For curing of concrete in pavements, side-walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer-in-Charge. Special attention shall be given to edges and corners of

the slab to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.

4. **Curing Compounds** : Surface coating type curing compound shall be used only on special permission of Engineer-in-Charge. Curing compounds shall be liquid type while pigmented, conforming to U.S. Bureau of Reclamation Specification. No curing compound shall be used on surface where future blending with concrete, water or acid proof membrane or painting is specified.
5. **Curing Equipment** : All equipments and materials required for curing shall be on hand and ready for use before concrete is placed.
6. **Moist Curing**: Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking , canvas, hassian or similar materials and kept constantly wet for at least seven days from the date of placing concrete. In case of ordinary Portland cement and at least ten days where mineral admixtures or blended cement are used. The period of curing shall not be less than ten days of concrete exposed to dry and hot wheather conditions. In the case of concrete the mineral admixtures or blended cement are used, it is recommended that the above minimum periods may be extended to fourteen days as per the approval of the Engineer-in-Charge.
7. **Membrane Curing**: Approved curing compounds may be used in lieu of moist curing with the permission of Engineer-in-charge. Such compounds shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set. Impermeable membranes such as poly ethylene sheeting covering, closely the concrete surface may also be used to provide effective barrier against evaporation.

For the concrete containing Portland pozzolona cement, Portland slag cement or mineral admixtures increased period of curing may be decided by Engineer-in-charge.

The rate of strength development at early age of concrete made with super sulphated cement is significantly reduced at lower temperatures. Super sulphated cement concrete is seriously affected by inadequate curing and the surface has to be kept moist for at least seven days or more as per the approval of the Engineer-in-Charge.

4.16. PROTECTING FRESH CONCRETE :

Fresh concrete shall be protected from the elements, from defacements and damage due to construction operations by leaving forms in place for ample period as specified later in this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Engineer-in-Charge, shall also be taken to protect immature concrete from damage by debris, excessive loading, vibrations, abrasion or contact with other materials etc. that may be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Engineer-in-Charge may require that bridges be placed over the area.

4.17. REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE :

Immediately after the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of Engineer-in-Charge who may permit patching of the defective areas or else reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by Contractor at no additional expense to the Department. Holes left by form bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing through 2.36 mm. I.S. sieve after removing any loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surface shall be finished as described under the particular item of work.

Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of Engineer-in-Charge and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer-in-Charge, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities, care being taken to avoid damaging the surfaces. Surface irregularities shall be removed by grinding.

If reinforcement is exposed or the honey combing occurs at vulnerable position e.g. ends of beams or columns, it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer-in-Charge shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm.), the edges being cut perpendicular to the affected surface or with a small under cut if possible, anchors, tees or dowels shall be provided in slots whenever necessary to attach the new concrete securely in place. An area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

1. **Use of Epoxy :** The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer-in-Charge. Epoxies shall be applied in strict accordance with the instruction of the manufacturer.
2. **Method of Repair :** Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows:

The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

A 5 mm. thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly proud of the surrounding surface. The concrete patch shall be built up in 10 mm. thick layers. After an hour or more, depending upon

weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian. Steel trowel shall not be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

Mortar filling by air pressure (guniting) shall be used for repair of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineering-in-Charge, to match the shade of the patch with the original concrete.

3. **Curing of Patched Work** : The patched area shall be covered immediately with an approved non-staining water-saturated material such as gunny bags, which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray of sprinkling water for not less than 10 days.
4. **Approval by Engineer-in-Charge** : All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Engineer-in-Charge. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

4.18. FINISHING :

This specification is intended to cover the treatment of concrete surfaces of all structures.

1. **Finish for Formed Surfaces** : The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified by the Engineer in charge:

For surfaces against which backfill or concrete is to be placed, no treatment is required except repair of defective areas.

For surfaces below grade, which will receive waterproofing treatment, the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing materials which is specified for use.

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods and clean up of loose or adhering debris.

Surfaces which will be exposed to the weather and which would normally be levelled, shall be sloped for drainage. Unless the drawing specifies a horizontal surface or shows the slope required, the tops of narrow surfaces such as staircase treads, walls, curbs and parapets shall be sloped across the width approx. as 1 in 30. Broader surfaces such as walkways,

roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, sub floors to be covered with concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth, screeded and leveled to produce even surfaces. Surface irregularities shall not exceed 6mm. Surfaces which will not be covered by backfill, concrete or tile topping such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks, floors and slabs shall be consolidated, screeded and floated.

Excess water and laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screeded surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints and edges shall be tooled as called for on the drawings or as directed By Engineer-in-Charge.

2. **Standard Finish for Exposed Concrete** : Exposed concrete shall mean any concrete other than floors or slabs exposed to view upon completion of the job. Unless otherwise specified on the drawings, the standard finish for exposed concrete shall be of smooth finish.

A smooth finish shall be obtained with use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms, the joint marks shall be smoothed off and all blemishes, projections etc. removed, leaving the surfaces reasonably smooth and unmarred.

3. **Integral Cement Concrete Finish** : When specified on the drawings, an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified in the drawings and as per I.S.2571. The surface shall be compacted and then floated with a wooden float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.
4. **Rubbed Finish** : A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off sets leveled and voids and/ or damaged sections immediately saturated with water and repaired by filling with concrete or mortar of the same composition as was used in the surfaces. The surfaces shall then be thoroughly wetted and rubbed with carborandum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

4.19. PROTECTION :

All concrete shall be protected against damage until final acceptance by Engineer-in-Charge.

4.20. FOUNDATION BEDDING, BONDING AND JOINTING :

All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering as may be indicated in the plans or as Engineer-in-Charge may direct to meet the various situations encountered in the work.

Soft or spongy areas shall be cleaned out and back filled with either a soil cement mixture, lean concrete or clean sand fill compacted to minimum density of 90% Modified Proctor, unless otherwise mentioned in schedule of quantities.

Prior to construction of form work for any item where soil will not act as bottom form, approval shall be obtained from Engineer-in-Charge as to the suitability of the soil.

4.21. PREPARATION OF ROCK STRATA OF FOUNDATIONS :

To provide tight bond with rock foundations, the rock surface shall be prepared and the following general requirements shall be observed:

Concrete shall not be deposited on large sloping rock surface. Where required by Engineer-in-Charge or as indicated on the plans, the rock shall be cut to form rough steps or benches to provide roughness or a more suitable bearing surface.

Rock foundation stratum shall be prepared by picking, barring, wedging and similar methods which will leave the rock in an entirely sound and unshattered condition.

Shortly before concrete is placed, the rock surface shall be cleaned with high pressure water and air jet even though it may have been previously cleaned in that manner.

Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Engineer-in-Charge.

Before placing concrete on rock surfaces, all water shall be removed from depressions to permit thorough inspection and proper bonding of the concrete to the rock.

4.22. PREPARATION OF EARTH STRATA OF FOUNDATIONS :

All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft, yielding soils shall be removed and replaced with suitable earth and well compacted as directed by the Engineer-in-Charge. Where specified, lean concrete shall be provided in the earth stratum for receiving concrete. The surface of absorptive soil against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete and later shall help to cure the concrete.

4.23. PREPARATION OF CONCRETE SURFACES :

Preparation of concrete surface upon which additional concrete is to be placed later, shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the

surface with picks and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer-in-charge. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate. When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

4.24. BONDING TREATMENT (MORTAR) :

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, it shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement sand mortar. The mortar shall have the same cement-sand proportion as the concrete which shall be placed on it. The water cement ratio shall be determined by placing conditions and as approved by Engineer-in-Charge.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm. thick for rock surface and about 5 mm. thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree as determined by Engineer-in-Charge.

Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar takes place. The amount of mortar that will be permitted to be placed at any one-time, or the area which is to cover, shall be in accordance with Engineer-in-Charge.

4.25. CLEANING AND BONDING OF FORMED CONSTRUCTION JOINTS :

Vertical construction joints shall be cleaned as specified above or by other methods approved by Engineer-in-Charge. In placing concrete against formed construction joints, the surfaces of the joints, where accessible, shall be coated thoroughly with the specified bed-joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms, dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by carefully puddling and spading with aid of vibrators and suitable tools.

4.26. EXPANSION AND CONTRACTION :

Provision shall be made for expansion and contraction in concrete by use of special type

joints located as shown in the drawings. Construction joint surfaces shall be treated as specified in the specifications, shown in the drawings or as directed by Engineer-in-Charge.

4.27. HOT WEATHER REQUIREMENTS :

All concrete work performed in hot weather shall be in accordance with I.S. 456, except as herein modified.

Admixtures may be used only when approved by Engineer-in-Charge.

Adequate provision shall be made to lower concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyers to direct sunlight and the use of reflective paint, on mixers etc. The temperature of the freshly placed concrete shall not be permitted to exceed 300C.

Consideration shall be given to shading aggregate stock piles from direct rays of the sun and spraying stock piles with water, use of cold water available and burying, insulation, shading and/ or painting white the pipe lines and water storage tanks and conveyances.

In order to reduce loss of mixing water, the aggregates, wooden forms, subgrade, adjacent concrete and other moisture absorbing surfaces, shall be well wetted prior to concreting. Placement and finishing shall be done as quickly as possible.

Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot wind for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

4.28. PLACING CONCRETE UNDER WATER :

Under all ordinary conditions all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary, all work shall conform to I.S.456 and procedure shall be as follows:

Method of Placement : Concrete shall be deposited under water by means of tremies or drop bottom buckets of approved type.

4.29. DIRECTION, INSPECTION AND APPROVAL :

All work requiring placement of concrete underwater shall be designed, directed and inspected with regard to the local circumstances and purposes. All under water concrete shall be placed according to the plans or specifications and as directed and approved by Engineer-in-Charge.

4.30. PRECAST CONCRETE & 4.31 PRECAST REINFORCED CONCRETE

Precast concrete & precast reinforced concrete shall comply with I.S. 456, and with the

following requirements:

- 4.31.1. General requirements :** Precast reinforced concrete units such as columns, fencing posts, door and window frames, lintels, chajjas, copings, sills, shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms / moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. Precast concrete shall be cast on suitable bed or platform with firm foundation and free from wind. The contractor may precast the units on a cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in the forms. Each unit shall be cast in one operation. Contractor shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.
- 4.31.2.** Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honeycombing.
- 4.31.3.** Precast articles shall have a dense surface finish showing no coarse aggregate and shall have no cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angles of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogenous appearance.
- 4.31.4.** The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

4.31.5. CURING

After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

- 4.31.6.** The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled. Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected at the time of lifting.

4.31.7. MARKING

Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

- 4.31.8.** Precast units shall be stored, transported and placed in position in such a manner that they will not be overstressed or damaged. The lifting and removal of precast units shall be undertaken without causing shocks, vibration or under bending stresses to or in the units. Before lifting and removal takes place, contractor shall satisfy Engineer-in-Charge or his representative that the methods he proposes to adopt for these operations will not over-stress or otherwise affect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

4.32. PRECAST CEMENT CONCRETE JALI :

- 4.32.1.** The Jali shall be of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 6 mm nominal size) reinforced with 1 .6 mm thick mild steel wire, unless otherwise specified.
- 4.32.2. Fixing :** The Jali shall be set in position true to plumb and level before the joints, sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement : 3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.
- 4.32.3. Measurement :** The Jali shall be measured for its gross superficial area. The length and breadth shall be measured correct to a cm. The thickness shall not be less than that specified.
- 4.32.4. Rate :** The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sill and soffits, which will be paid for under relevant items of plastering.

4.33. CURING :

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each units shall be kept constantly watered or preferably by completely immersed in water if the size of unit so permits. Otherwise curing practices as given in clauses stated earlier shall be followed.

4.34. SLOTS, OPENINGS ETC. :

Slots, openings or holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by the Engineer-in-Charge. Any deviation from the approved drawings shall be made good by contractor at his own expenses without damaging any other work. Sleeves, bolts, inserts etc. shall also be provided in concrete work where so specified.

4.35. GROUTING :

- 4.35.1. Standard Grout :** Grout shall be provided as specified in the drawing.

The proportions of grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. The grout proportions shall be limited as follows:

Use	Grout thickness	Mix. proportions	W/C. Ratio in (Max.)
a) Fluid mix	Under 25 mm.	One part Portland cement to one part sand.	0.44
b) General	25 mm. and over but less than 50 mm.	One part Portland cement to 2 parts of sand.	0.53
c) Stiff mix.	50 mm. and over	One part Portland cement to	0.53

Sand shall be such as to produce a flowable grout without any tendency to segregate. Sand, for general grouting purposes, shall be graded within the following limits:

Passing I.S. sieve 2.36 mm.	95 to 100%
Passing I.S. sieve 1.18 mm.	65 to 95%
Passing I.S. sieve 300 micron above	10 to 30%
Passing I.S. sieve 150 micron above	3 to 10%

Sand for fluid grouts shall have the fine material passing the 300 and 150 micron sieves at the upper limits specified above.

Sand for stiff grouts, shall meet the usual grading specifications and concrete.

Surface to be grouted shall be thoroughly roughened and cleaned of all foreign matter and laitance.

Anchor bolts, anchor bolt holes and bottom of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot, strong, caustic solution for this purpose will be permitted.

Prior to grouting, the hardened concrete surfaces to be grouted, shall be saturated with water. Water in anchor bolt holes shall be removed before grouting is started.

Forms around base plates shall be, reasonably, tightened to prevent leakage of the grout.

Adequate clearance shall be provided between forms and base plate to permit grout to be worked properly into place.

Grouting, once started shall be done quickly and continuously to prevent segregation, bleeding and breakdown of initial set. Grout shall be worked from one side of one end to the other to prevent entrapment of air. To distribute the grout and to ensure more release from entrapped air, link chains can be used to work the grout into place.

Grouting through holes in base plate shall be by pressure grouting.

Variations in grout mixes and procedures shall be permitted if approved by the Engineer-in-

Charge.

4.35.2. Special Grout : Special grout where specified on the drawing shall be provided in strict accordance with the manufacturers instructions/ specifications on the drawings.

4.36. INSPECTION :

All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of Engineer-in-Charge.

All rejected materials supplied by contractor and all rejected work or construction performed by contractor, as is not in conformance with the specifications and drawings, shall immediately be replaced at no additional expense to the Department.

Approval of any preliminary material or phase of work shall in no way relieve the contractor from the responsibility of supplying concrete and/ or producing finished concrete in accordance with the specifications and drawings.

All concrete shall be protected against damage until final acceptance by the Department or its representatives.

4.37. CLEAN UP :

Upon the completion of concrete work, all forms, equipments, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.

All debris i.e. empty containers, scrap wood etc. shall be removed to dump daily or as directed by the Engineer-in-Charge.

The finished concrete surfaces shall be left in a clean condition to the satisfaction of the Engineer-in-Charge.

4.38. PLAIN CEMENT CONCRETE FOR GENERAL WORK :

For plain cement concrete work, the specification for materials viz. cement, sand, fine and coarse aggregates and water shall be the same as that specified in reinforced concrete work specification.

But the proportion of mix will be nominal and the ratio of fine and coarse aggregate may be slightly adjusted within limits, keeping the total value of aggregates to a given volumes of cement constant to suit the sieve analysis of both the aggregates. Cement shall on no account be measured by volume, but it shall always be used directly from the bags (i.e. 50 kg/bag).

The proportion of cement, sand, aggregate and water for concrete of proportion 1:5:10, 1:4:8, 1:3:6 & 1:2:4 by volume shall generally consist of quantities as given below :

Proportion of Ingredients	Cement	Quantity of materials used per bag of cement			Water
		Fine aggregate (sand)	Coarse aggregate	Total of fine sand coarse aggregates	
1:5:10	1	175 ltrs.	350 ltrs.	800 kgs.	60 ltrs.
1:4:8	1	140 ltrs.	280 ltrs.	625 kgs.	45 ltrs.
1:3:6	1	105 ltrs.	210 ltrs.	480 kgs.	34 ltrs.
1:2:4	1	70 ltrs.	140 ltrs.	330 kgs.	32 ltrs.

The quantity of water used shall be such as to produce concrete of consistency required by the particular class of work and shall be decided by the use of a slump cone. Sufficient care should be taken to see that no excess quantity of water is used. The final proportion of the aggregate and quantity of water shall be decided by the Engineer-in-charge on the basis of test in each case.

Mix proportion	Cement in bags	Sand in cum	Coarse Aggregate in CUM			Water
			40 mm	20 mm	12 mm	
1:5:10	2.60	0.475	0.6623	0.2583	-	156
1:4:8	3.40	0.500	0.6883	0.6883	-	153
1:3:6 (with 40mm)	4.4	0.485	0.672	0.672	0.262	176
1:3:6 (with 20 mm)	4.4	0.485	-	0.727	0.242	162.5
1:2:4 (with 20 mm)	6.4	0.47	-	0.705	0.235	205
1:2:4 (with 40 mm)	6.4	0.47	0.544	0.241	0.126	235
1:1.5:3	8.0	0.441	-	0.6615	0.2205	240
1:1:2	12.20	0.45	-	0.675	0.225	330

The slump shall be specified for each class of work and shall in general be as follows:

Type of concrete	Max. slump (in)
Mass concrete	50
Concrete below water proofing treatment	50
Coping	25
Floor paving	50

All plain concrete should be preferably mixed in a drum type powder driven machine with a loading hopper which will permit the accurate measure of various ingredients. If hand mixing is authorised, it should be done on a water tight platform.

The mixing of each batch in the concrete mixer shall continue for not less than 1.5 minutes after the materials and water are in the mixer. The volume is mixed materials per batch shall not exceed the manufacturers rated capacity of the mixer. The mixer shall rotate at a peripheral speed of about 60 metres per minute.

Concrete shall be poured and consolidated in its final position within half an hour of mixing.

The retempering of concrete which has partially hardened, that is remixing with or without additional cement aggregate or water shall not be permitted. Concrete of mix 1:3:6 and 1:2:4 will be required to be vibrated if specified and directed by the Engineer. In case of the thickness of concrete is more than 150 mm., it may be vibrated as directed by the Engineer.

The concrete shall be cured for 10 days in ordinary weather and 15 days in hot weather.

Measurements for the work done shall be exact length, breadth and depth shown in figures on the drawings or as directed by the Engineer and after the concrete is consolidated. No extra shall be paid for excess quantity resulting from faulty workmanship.

4.39. SPECIFIC REQUIREMENTS FOR CONCRETE AND ALLIED WORKS :

The following specific requirements shall be met within addition to those provided in the clause of specification for Concrete and allied works.

4.39.1. General : If so specified in Schedule 'A' for the work, the Department shall supply with specification for "Concrete and allied works" and the contractor shall be solely responsible for supplying mixed concrete in accordance with the specification for concrete and allied works and also this specification. The rates for the reinforced concrete work shall be based on the issue rates of cement and steel as given in the schedule 'A'.

4.39.2. Water : Clean water in pipes under pressure shall be provided by the contractor with all necessary equipment for giving a nozzle pressure of not less than 2.0 kg/ sqcm. for the convenient and effective jetting of rock foundations and concrete surfaces, for cooling aggregate required for concrete, for curing concrete and other requirements.

4.39.3. Fire Protection System : The contractor shall provide and maintain at all times in adequate fire protection system to protect his equipment, materials and construction. In case of an emergency, the contractor shall permit the Engineer-in-Charge to use the system for protecting equipment, works etc. on the project.

4.39.4. Concrete : The rates for all concrete work should be based as per specifications and taking into consideration the guidelines indicated in special instruction under relevant clause.

4.39.5. The Placement Intervals : Each placement of concrete shall be allowed to set for a period of 48 hours and longer when required, before the start of subsequent placement. A time gap between the two adjoining pours in the horizontal plane and the two adjacent pours in the vertical plane shall be 7 days and 3 days respectively.

4.39.6. FINISHING OF CONCRETE :

1. General : Unless otherwise specified, concrete finishes shall conform to the following specifications: Finish F1, F2 and F3 shall describe formed surface.

Finish U1, U2 and U3 shall describe un-formed surface.

Off sets or fins caused by disposed or misplaced form sheathing lining or form sections or by defective form lumber shall be referred to as abrupt irregularities. All other irregularities shall be referred to as gradual irregularities. Gradual irregularities shall be measured as deviation from a plane surface with a template 1.5 m. long for formed surface and 3 m. long for unformed surfaces.

2. Formed Surfaces :

Finish F1—shall apply to all formed surfaces for which finish F2, F3 or any other special finish is not specified and shall include filling up all form tie holes.

Finish F2—shall apply to all formed surfaces so shown on the drawings or specified by the Engineer-in-Charge. This shall include filling all form tie-holes, repair of gradual irregularities exceeding 6 mm., removal of ridges and abrupt irregularities by grinding.

Finish F3—shall apply to all formed surfaces exposed to view or where shown in the drawings or specified by the Engineer-in-Charge. Finish F3 - shall include all measures specified for Finish-F2 and in addition, Filling air holes with mortar and treatment of the entire surface with sack rubbed finish. It shall also include clean up of loose and adhering debris. Where a sack rubbed finish is specified, the surfaces shall be prepared within two days after removal of the forms.

The surface shall be wetted and allowed to dry slightly before mortar is applied by sack rubbing. The mortar used shall consist of one part cement to one and half parts by volume of fine (minus No. 16 mesh) sand. Only sufficient mixing water to give the mortar a workable consistency shall be used. The mortar shall then be rubbed over the surface with a fine burlap or linen cloth so as to fill all the surface voids. The mortar rubbed in the voids shall be allowed to stiffen and solidify after which the whole surface shall be wiped clean so that the surface presents a uniform appearance without air holes, irregularities etc.

Curing of the surface shall be continued for a period of ten (10) days.

3. Unformed Surfaces :

Finish U1—shall apply to all unformed surfaces for which the finish U2, U3 or any other special finish is not specified and shall include screeding the surface of the concrete to the required slope and grade. Unless the drawing specifies a horizontal surface or shows the slope required, the tops of narrow surfaces such as stair, treads, walls, curbs and parapets shall be sloped approximately 10 mm. per 300 mm. width. Surfaces to be covered by backfill or concrete sub-floors to be covered with concrete topping, terrazzo and similar surfaces shall be smooth screeded and leveled to produce even surface, irregularities not exceeding 6 mm.

Finish U2—shall apply to all unformed surfaces as shown in the drawing or specified by the Engineer-in-Charge and shall include screeding and applying a wood float finish to the surface of the concrete to the required slopes and grade.

Repair of abrupt irregularities unless a roughened texture is specified. Repair of gradual irregularities exceeding 6 mm.

Finish U3—shall apply to unformed surfaces for which a high degree of surface smoothness is required, where shown on the drawing or specified by the Engineer-in-Charge. This shall include screeding, floating and applying a steel trowel finish to the surface of the concrete to the required slopes and grade.

Repair of abrupt irregularities.

Repair of gradual irregularities exceeding 6 mm., finishing joints and edges of concrete with edging tools.

4.40. MODE OF MEASUREMENT FOR CONCRETE WORK :

General : Concrete as actually done shall be measured for payment, subject to the following tolerances, unless otherwise stated hereinafter. Any work done extra over the specified dimensions shall not be measured for payment.

- a) Linear dimensions shall be measured in full centimetres except for the thickness of slab which shall be measured to the nearest half centimetre.
- b) Areas shall be worked out to the nearest 0.01 sqm.
- c) Cubic contents shall be worked out to the nearest 0.001 cum.
- d) The concrete shall be measured for its length, breadth and height/ depth limiting dimensions to those specified on drawings or as directed by the Engineer-in-Charge.

NOTE : The sizes of RCC members as assumed in the estimate are based on preliminary drawings and are likely to be changed. The contractor is not entitled to any extra claim due to such changes.

Deductions:

No deductions shall be made for the following :

- a) Ends of dissimilar materials e.g. joists, beams, posts, girders, rafters, purlins, trusses, corbels, steps etc. upto 500 sq cm. in cross section.
- b) Opening upto 0.1 sqm. (1000 sq cm)
- c) Volume occupied by reinforcement.
- d) Volume occupied by pipes, conduits, sheathing etc. not exceeding 25 sq cm. each in cross sectional area. Nothing extra shall be paid for leaving and finishing such cavities and holes.

i. COLUMN FOOTING :

R.C.C. in foundation and footings shall be measured for its length, breadth and depths limiting dimensions to those specified in drawing or as ordered in writing by the Engineer-in-Charge. In case of tapering portions of column footings, the quantities shall be calculated by the Formula : **Volume V = H/3 x [A1 + A2 + sqrt {A1 x A2}]** ; where A1 = Area at top of footing, A2 = Area at bottom of footing and H = Height of footing.

ii. COLUMN :

Column shall be measured from top of footings to the plinth level and from plinth level to the structural slab level and to the subsequent structural slab levels. Measurements for higher grade concrete in columns at its junction with lower grade concrete beams shall be restricted to the column section supporting the beam in question.

iii. WALL

All walls shall be measured from top of the wall footing to the plinth level and from plinth level to the top of structural first floor and to subsequent floors.

iv. BEAM AND LINTEL :

Beam shall be measured from face to face of the columns, walls, cross beams including haunches if any. The depth of the beams shall be measured from the top of the slab to the bottom of the beam except in the case of inverted beam where it shall be measured from top of slab to top of beams. The beams and lintels with narrow width even though acting as fascia in elevation in some cases, will be measured as beams and lintels only.

v. SLAB :

The length and breadth of slab laid to correct thickness as shown in the detailed drawings or as ordered by the Engineer-in-Charge shall be measured between beams, walls and columns.

vi. CHAJJAS, FACIAS, FINS AND MULLIONS:

- a) Chajjas shall be measured net from supporting faces upto the edges of chajjas without any fascia.
- b) Facia shall be measured full excluding chajja thickness.
- c) End fins shall be measured full.
- d) Intermediate fins, mullions shall be measured between chajjas or other supporting structural members.
- e) Parapets shall be measured from top of slab/ chajja.

vii. STAIRCASE :

The concrete in all members of staircase like waist slabs, steps, cantilever steps, stringer beams etc. shall be measured for their length, breadth and depth, limiting dimensions to those specified on drawings. No deductions shall be made for embedded plugs, pockets.

Rates: The rate for P.C.C/ R.C.C. shall include the cost of all materials, labour, transport, tools and plants and all the operations mentioned hitherto, including or excluding the cost of form work and/ or reinforcement as mentioned in the schedule of quantities. The rates also shall include the cost of testing materials, mix design, cube test and allied incidental expenses.

* * *

5. FORM WORK :

5.0. GENERAL :

The form work shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. The false work shall be so constructed that up and down vertical adjustment can be made smoothly. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of form work.

5.1. DESIGN OF FORM WORK :

The design and engineering of form work as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and calculations for the design of the form work shall be submitted well in advance to the Engineer-in-Charge for approval before proceeding with work, at no extra cost to the Department. Engineer-in-Charges approval shall not however, relieve Contractor of the full responsibility for the design and construction of the form work. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration loadings.

5.2. TOLERANCES :

Tolerances are a specified permissible variation from lines, grade or dimensions given in drawings. No tolerances specified for horizontal or vertical building lines or footings shall be constructed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted:

5.2.1. TOLERANCES FOR R.C. BUILDINGS :

i. Variation from the plumb:

- a. In the line and surfaces of columns, piers, walls and in buttresses: 5 mm. per 2.5 m., but not more than 25 mm
- b. For exposed corner columns and other conspicuous lines.
In any bay or 5 m. maximum: (+/-) 5 mm.
In 10 m. or more: (+/-) 10 mm.

ii. Variation from the level or from the grades indicated on the drawings.

- a. In slab soffits, ceilings, beam soffits and in arrises.
In 2.5 m.: (+/-) 5 mm.
In any bay or 5 m. maximum: (+/-) 8 mm.
In 10 m. or more: (+/-) 15 mm.
- b. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.
In any bay or 5 m. maximum: (+/-) 15 mm.
In 10 m or more: (+/-) 10 mm.

iii. Variation of the linear building lines from established position in plan and related position of columns, walls and partitions.

- In any bay or 5 m. maximum: (+/-) 10 mm.
- In 10 m or more: (+/-) 20 mm.

- iv. Variations in the sizes and locations of sleeves, openings in walls and floors except in the case of and for anchor bolts: (+/-) 5 mm.

- v. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls: (+) 10 mm./(-) 5 mm.

vi. Footings:

- a) Variation in dimensions in plan: (+) 50 mm./(-) 5 mm.
- b) Misplacement or eccentricity: 2% of footing within the direction of misplacement but not more than 50 mm.
- c) Reduction in thickness: (-) 5% of specified thickness subject to maximum of 50 mm.

vii. Variation in steps.

- a) In a flight of stairs.
Rise:
Tread:
- b) In consecutive steps. (+/-) 3.0 mm. (+/-) 5.0 mm.

Rise: (+/-) 1.5 mm.
Tread: (+/-) 3 mm.

5.2.2. TOLERANCES IN OTHER CONCRETE STRUCTURE :

A) All structures:

- i) Variation of the constructed linear outline from established position in plan.
In 5 m.: (+/-) 10 mm.
In 10 m. or more: (+/-) 15 mm.
- ii) Variation of dimensions to individual structure features from established positions in plan.
In 20 m. or more: (+/-) 25 mm.
In buried constructions: (+/-) 150 mm.
- iii) Variation from plumb, from specified batter or from curved surfaces of all structures.
In 2.5 m.: (+/-) 10 mm.
In 5.0 m.: (+/-) 15 mm.
In 10.0 m. or more: (+/-) 25 mm.
In buried constructions: (+/-) Twice the above limits
- iv) Variation from level or grade indicated on drawings in slabs, beams, soffits, horizontal grooves and visible arises.

In 2.5 m.: (+/-) 5 mm.
In 7.5 m. or more: (+/-) 10 mm.
In buried constructions: (+/-) Twice the above limits.
- v) Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members. (+)12 mm./(-) 6 mm.
- vi) Variation in the thickness of slabs, walls, arch sections and similar members. : (+)12 mm./(-) 6 mm.

B) Footings for columns, piers, walls, buttresses and similar members:

- i) Variation of dimensions in plan: (+)50 mm./(-)12 mm.
- ii) Misplacement or eccentricity: 2% of footing within the direction of misplacement but not more than 50 mm.
- iii) Reduction in thickness: 5% of specified thickness subject to a maximum of 50 mm.

Tolerances in other types of structures shall generally conform to those given in Clause 2.4

of Recommended Practice for concrete form work (ACI 347)

5.3. TYPE OF FORMWORK :

Form work may be of timber, plywood, metal, plastic or concrete. For special finishes, the formwork may be lined with plywood, steel sheets, oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Engineer-in- Charge.

5.4. FORMWORK REQUIREMENTS :

Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for in the drawings. Ample studs, waler braces, straps, shores etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases, from vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.

Plywood shall be used for exposed concrete surfaces, where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planed to remove irregularities or unevenness in the face. Form work with lining will be permitted.

All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Engineer-in-Charge shall be removed from the site.

Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundation.

Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be entirely removed and the formwork corrected prior to placing new concrete.

Excessive construction camber to compensate for shrinkage settlement etc. that may impair the structural strength of members will not be permitted.

Forms for substructure concrete may be omitted when, in the opinion of Engineer-in-Charge, the open excavation is firm enough to act as the form. Such excavations shall be slightly

larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirement.

Forms shall be so designed and constructed that they can be stripped in the order required and their removal do not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conforming to the architectural features of the structure as to location of joints and be as directed by Engineer-in-Charge.

Where exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the desired concrete surfaces could be obtained which require a minimum finish.

BRACINGS, STRUTS AND PROPS :

Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bracings.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of beams and under the soffit of slab can be removed without disturbing the beam bottoms.

Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering.

If the shuttering for a column is erected for the full height of the column, one side shall be left open and built upon sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m. or as directed by Engineer-in-Charge.

5.5. INSPECTION OF FORM WORK :

Following points shall be borne in mind while checking during erection of form work and form work got approved by the Engineer-in-charge before placing of reinforcement bars :

- a. Any member which is to remain in position after the general dismantling is done, should be clearly marked.
- b. Material used should be checked to ensure that, wrong items / rejects are not used.
- c. If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.
- d.
- i. The bearing soil must be sound and well prepared and the sole plates shall bear well on

the ground.

- ii. Sole plates shall be properly seated on their bearing pads or sleepers.
- iii. The bearing plates of steel props shall not be distorted.
- iv. The steel parts on the bearing members shall have adequate bearing areas.
- e. Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.
- f. Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.
- g. The stacked materials shall be placed as catered for, in the design.
- h. When adjustable steel props are used, they should :
 - i) be undamaged and not visibly bent.
 - ii) have the steel pins provided by the manufacturers for use.
 - iii) be restrained laterally near each end.
 - iv) have means for centralising beams placed in the forkheads.
- i. Screw adjustment of adjustable props shall not be over extended.
- j. Double wedges shall be provided for adjustment of the form to the required position wherever any settlement / elastic shortening of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened / clamped down after adjustment to prevent their shifting.
- k. No member shall be eccentric upon vertical member.
- l. The number of nuts and bolts shall be adequate.
- m. All provisions of the design and / or drawings shall be complied with.
- n. Cantilever supports shall be adequate.
- o. Props shall be directly under one another in multistage constructions as far as possible.
- p. Guy ropes or stays shall be tensioned properly.
- q. There shall be adequate provision for the movement and operation of vibrators and other construction plant and equipment.

- r. Required camber shall be provided over long spans.
- s. Supports shall be adequate, and in plumb within the specified tolerances.

5.6. FORM OIL :

Use of form oil shall not be permitted on the surface which require painting. If the contractor desire to use form oil on the inside of formwork of the other concrete structures, a non staining mineral oil or other approved oil CEMOL-35 of Ms. Hindustan Petroleum Co. Ltd. may be used, provided it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed. Before treatment with oil, forms shall be thoroughly cleared of dried splatter of concrete from placement of previous lift.

5.7. CHAMFERS AND FILLERS :

All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillers on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 x 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

5.8. VERTICAL CONSTRUCTION JOINT CHAMFERS :

Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not permitted by Engineer-in-Charge for structural or hydraulic reasons.

5.9. WALL TIES :

Wire ties passing through the walls, shall not be allowed. Also through bolts shall not be permitted. For fixing of formwork, alternate arrangements such as coil nuts shall be adopted at the contractors cost.

5.10. REUSE OF FORMS :

Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer-in-charge. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

5.11. REMOVAL OF FORMS :

Contractors shall record on the drawings or a special register, the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

In no circumstances shall forms be struck until the concrete reaches a strength of the at least twice the stress due to self weight and any construction erection loading to which the concrete may be subjected at the time of striking formwork.

In normal circumstances (generally where temperatures are above 15 °C.) forms may be struck after expiry of the following periods :

Stripping time:

Sl.No.	Type of form work	Minimum period before striking form work
a)	Vertical form work to columns, walls	16 – 24 h
b)	Soffit form work to slabs (Props to be refixed immediately after removal of formwork)	3 days
c)	Soffit form work to beams (Props to be refixed immediately after removal of formwork)	7 days
d)	Props to slabs: 1) Spanning up to 4.5 m 2) Spanning over 4.5 m	7 days 14 days
e)	Props to beams and arches; 1) spanning up to 6 m 2) spanning over 6 m	14 days 21 days

For other cements and lower temperature, the stripping time recommended above may be suitably modified.

The number of props left under the sizes and the position shall be such as to able to safely carry the full dead load of the slab, beam or arch., as the case may be together with any live load likely to occur during curing or further constructions.

Where the shape of the element is such that the form work has the reentrant angles the form work shall be removed as soon as possible. After the concrete has set, to avoid shrinkage cracking occurring due to the restraint imposed.

Striking shall be done slowly with utmost care to avoid damage to arise and projection and without shock or vibration, by gently easing the wedges. If after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided, as directed by Engineer-in-Charge, to facilitate removal of formwork which otherwise may be in-accessible.

Tie rods, clamps, form bolts etc. which must be entirely removed from walls or similar

structures shall be loosened not sooner than 24 hours nor later than 40 hours after concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the faces of walls and grade beams will not be permitted. Work damaged due to premature or careless removal of forms shall be re-constructed at contractors cost.

5.12. MODE OF MEASUREMENT :

In case the items of concreting are inclusive of cost of form work, no separate measurements shall be taken for form work. However, if the form work is to be paid separately and the item exists in the Schedule of Quantities for various types of form work, the net area of exposed surface of concrete members as shown in drawings coming in contact with form work shall be measured under item of formwork in square meters.

All temporary formwork such as bulk heads, stop boards provided at construction joints which are not shown in the drawings shall not be measured.

No deductions shall be made for openings/ obstructions upto an area of 0.1 sqm. and nothing extra shall be paid for forming such openings.

The rate shall include the cost of erecting, centering, shuttering materials, transport, deshuttering and removal of materials from site and labour required for all such operations etc.

6 . STEEL FOR CONCRETE REINFORCEMENT :

6.1.SCOPE OF MATERIAL:

The contractor shall make his own arrangement for procurement of Reinforcement steel bars and wires for use in Reinforced Cement Concrete works. Unless otherwise specified in drawings / Schedule of quantities, the steel bars shall be of "High strength deformed steel bars and wires" conforming to the IS 1786 (latest revision), in the following strength grades:

- a) Fe 415, Fe 415D;
- b) Fe 500, Fe 500D;
- c) Fe 550, Fe 550D; and
- d) Fe 600.

Where "Fe" stands for specified minimum 0.2% proof / yield stress in N/mm² and "D" stands for same specified minimum 0.2% proof / yield stress but with enhanced specified minimum percentage elongation.

6.2.TERMINOLOGY:

Elongation: The increase in length of a tensile test piece under stress, expressed as a percentage of the original gauge of a standard piece.

Longitudinal Rib -A uniform continuous protrusion, parallel to the axis of the bar/wire (before cold-working, if any).

Nominal Diameter or Size- The diameter of a plain round bar/wire having the same mass per metre length as the deformed bar/wire.

Nominal Mass -The mass of the bar/wire of nominal diameter and of density 0.00785 kg/cumm per meter.

Nominal Perimeter - 3.14 times the nominal diameter of a deformed bar/Wire.

Percent Proof Stress -The stress at which a non-proportional elongation equal to 0.2% of the original gauge length takes place.

Uniform elongation - The elongation corresponding to the maximum load reached in a tensile test (also termed as percentage total elongation at maximum force).

Tensile Strength - The maximum load reached in a tensile test divided by the effective cross-sectional area of the gauge length portion of the test piece (also termed as ultimate tensile stress).

Transverse Rib - Any rib on the surface of a bar/wire other than a longitudinal rib.

Yield Stress - Stress (that is, load per unit cross sectional area) at which elongation first occurs in the test piece without increasing the load during the tensile test. In the case of steels with no such definite yield point, proof stress shall be applicable.

The high strength deformed steel bars and wires for concrete reinforcement shall be hot rolled steel without subsequent treatment or hot rolled steel with controlled cooling and tempering and cold worked steel, and reinforcing bars and wires which may be subsequently coated.

Reinforcement steel shall be procured from any vendors who have the license for at least last 5 years for manufacture of BIS or Tor allies, subject to prior written approval of the EIC. The contractor shall supply copy of Documentary evidence of purchase of steel from the specified manufacturers.

6.3.TESTS:

The contractor shall submit the test certificate of manufacturer. Regular tests on steel supplied by the contractor shall be performed by the contractor at the approved lab, in presence of the Departmental Engineers as per relevant Indian Standards. Engineer-in-charge may require Contractor to perform necessary tests of samples at random as per relevant B.I.S. All cost of such tests and incidentals to such tests shall be borne by the Contractor. The quality, grade,

colour coding embossing marks etc. all shall be to the entire satisfaction of the Engineer-in-Charge. Steel not conforming to above test criteria shall be rejected.

The Chemical, Physical & Mechanical properties of the steel reinforcement bars shall be as per IS 1786. Unless otherwise specified, Selection and Preparation of Test Sample shall be as per the requirements of IS 2062.

All test pieces shall be selected either from the cuttings of bars / wires; or from any bar/wire after it has been cut to the required or specified size and the test piece taken from any part of it. In neither case, the test piece shall be detached from the bar/wire except in the presence of the EIC or his authorized representative.

The test pieces shall be full sections of the bars/wires and shall be subjected to physical tests without any further modifications. No reduction in size by machining or otherwise shall be permissible, except in case of bars of size 28 mm and above. No test piece shall be annealed or otherwise subjected to heat treatment. Any straightening which a test piece may require shall be done cold.

For the purpose of carrying out tests for tensile strength, proof stress, percentage elongation and percentage elongation at maximum force for bars 28 mm in diameter and above, deformations of the bars only may be machined. For such bars, the physical properties shall be calculated using the actual area obtained after machining. The following IS codes shall be referred for test methods:

SN	Title	IS No	ISO No.
i	Mechanical testing of metals -Tensile testing	1608	6892
ii	Methods for bend test	1599 7438 & 1786	15630-1
iii	Method for re-bend test for metallic wires & bars	1786	15630-1

THE PROPERTIES AS PER IS 1786 – 2008 ARE REPRODUCED BELOW:

Chemical Composition of the bars shall conform to the following requirement:

Constituents	Maximum Permissible Percent							Permissible max. Variation
	Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600	
Carbon	0.300	0.250	0.300	0.250	0.300	0.250	0.300	0.020%
Sulphur	0.060	0.045	0.055	0.040	0.055	0.040	0.040	0.005%
Phosphorus	0.060	0.045	0.055	0.040	0.050	0.040	0.040	0.005%
Sulphur & Phosphorus	0.110	0.085	0.105	0.075	0.100	0.075	0.075	0.010%

Notes:

1. For welding of deformed bars, the recommendations of IS 9417 shall be followed.
2. In case of deviations from the specified maximum, two additional test samples shall be taken from the same batch and subjected to the test or tests in which the original sample failed. Should both additional test samples pass the test, the batch from which they were taken shall be deemed to comply with this standard. Should either of them fail, the batch shall be deemed not to comply with this standard

Mechanical Properties of High Strength Deformed Bars and Wires

Sl. No.	Property	Maximum Permissible						
		Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600
1	2	3	4	5	6	7	8	9
i	0.2 Percent proof stress / yield stress,	415.0	415.0		500.0	550.0	550.0	600.0
ii	Elongation, Percent, Min. on gauge length 5.65 ; A, where A is the Cross –	14.5	18.0	12.0	16.0	10.0	14.5	10.0
iii	Tensile strength, Min	10% more than the actual 0.2% proof stress/yield stress but not less than 485.0 N/mm ²	12% more than the actual 0.2% proof stress/yield stress but not less than 500.0	8% more than the actual 0.2% proof stress/yield stress but not less than 545.0 N/mm ²	10% more than the actual 0.2% proof stress/yield stress but not less than 565.0 N/mm ²	6% more than the actual 0.2% proof stress/yield stress but not less than 585.0	8% more than the actual 0.2% proof stress/yield stress but not less than 600.0	6% more than the actual 0.2% proof stress/yield stress but not less than 660.0
iv	Total elongation at maximum force, Percent, Min of gauge length 5.65 ; A, where A is the cross sectional	-	5	-	5	-	5	-

Note: To satisfy Clause 26 of IS 456 -2000, no mixing of different types of grades of bars shall

be allowed in the same structural members as main reinforcement, without prior written approval of the Engineer-in-Charge.

6.4.STACKING & STORAGE :

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. The steel for reinforcement shall not be kept in direct contact with ground. Fresh / Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deteriorations. Care shall be taken to protect steel from exposure to saline atmosphere during storage, fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods. Bars of different classifications, sizes and lengths shall be stored separately to facilitate issue in such sizes and lengths to cause minimum wastage in cutting from standard length.

6.5.QUALITY :

Steel not conforming to specifications shall be rejected. All reinforcement shall be clean, free from grease, oil, paint, dirt, loose mill, scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer-in-Charge. If welding is approved, the work shall be carried as per I.S. 2751, according to best modern practices and as directed by the Engineer-in-Charge. In all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Substitution of reinforcement will not be permitted except upon written approval from Engineer-in-charge.

6.6.NOMINAL SIZES

The nominal sizes of bars/wires shall be 4mrn, 5mrn, 6mrn, 8mrn, 10mrn, 12mrn, 16mrn, 20mrn, 25 mm, 28mrn, 32mrn, 36mrn, 40 mm. (Other sizes viz. 7mrn, 18mrn, 22 mm, 45 mm and 50 mm may be procured on specific stipulations).

6.7.NOMINAL MASS

For the purpose of checking the nominal mass, the density of steel shall be taken as 0.00785 kg/mm³ of the cross-sectional area per metre. Unless otherwise specified, the tolerances on nominal mass shall be as per following Table.

Tolerances on Nominal Mass

SN	Nominal Size in mm	Tolerance on the nominal mass in Percent		
		Batch	Individual sample	Individual sample for coils only

1	2	3	4	5
i)	Up to and including 10	± 7	- 8	± 8
ii)	Over 10 up to and including 16	± 5	- 6	± 6
iii)	Over 16	± 3	- 4	± 4

6.8.LAPS :

Laps and splices for reinforcement shall be shown on the drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the drawings, shall be approved by the Engineer-in-Charge. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

6.9.BENDING :

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawing / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the materials. Bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25 mm. in diameter which may be bent hot if specifically approved by the Engineer-in-Charge. Bars that depend for their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 645°C) and after bending shall be allowed to cool slowly with out quenching. Bars incorrectly bent shall be used only after straightening and re-bending be such as shall not, in the opinion of the Engineer-in-Charge, injure the material. No reinforcement bar shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

BENDING AT CONSTRUCTION JOINTS :

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameters for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

6.10. FIXING / PLACING AND TOLERANCE ON PLACING :

Reinforcement shall be accurately fixed by any approved means maintained in the correct position as shown in the drawings by the use of blocks, spacers and chairs as per I.S. 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing point shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of

bars in beams or similar members shall be maintained by the provision of spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

TOLERANCE ON PLACING OF REINFORCEMENT :

Unless otherwise specified, reinforcement shall be placed within the following tolerances :

	Tolerance in spacing
a) For effective depth, 200 mm or less	+ /- 10 mm
b) For effective depth, more than 200 mm	+ /- 10 mm

6.11. COVER TO REINFORCEMENT :

Nominal cover is the design depth of concrete cover to all steel reinforcements, including links. It is the dimension used in design and indicated in the drawings. It shall be not less than the diameter of the bar. Unless otherwise specified, cover to reinforcement shall be provided generally as per guidelines of IS 456.

Nominal cover to meet durability requirement:

Minimum values for the nominal cover of normal weight aggregate concrete which should be provided to all reinforcement, including links depending on the condition of exposure described in 4.4 above and as per (nominal cover to meet durability requirements).

However for a longitudinal reinforcing bar in a column nominal cover shall in any case not be less than 40 mm or less than the diameter of such bar. In the case of columns of minimum dimension of 200 mm or under, whose reinforcing bar do not exceed 12 mm , a nominal cover of 25 mm may be used.

For footings minimum cover shall be 50 mm.

Nominal cover to meet specified period of fire resistance

Minimum values of nominal cover of normal-weight aggregate concrete to be provided to all reinforcement including links to meet specified period of the resistance as per the tables given under clause 4.4.1 of this specifications.

The cover shall in no case be reduced by more than one third of specified cover or 5 mm whichever is less.

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish shall be as follows:

- At each end of reinforcing bar not less than 25mm., nor less than twice the diameter of such, bar.

- b) For a longitudinal reinforcing bar not less than 25 mm., nor more than 40 mm., nor less than the diameter of such bar. In the case of column of maximum dimensions of 200 mm. or under, whose reinforcing bars do not exceed 12 mm., a cover of 25 mm. may be used.
- c) For longitudinal reinforcing bar in a beam, not less than 25mm., nor less than diameter of such bar.
- d) For tensile, compressive, shear, or other reinforcement in a slab, not less than 25 mm, nor less than the diameter of such bar, and
- e) For any other reinforcement not less than 15 mm., nor less than the diameter of such bar.
- f) Increased cover thickness may be provided when surfaces of concrete members are exposed to the action of harmful chemicals (as in the case of concrete in contact with earth faces contaminated with such chemicals), acid, vapour, saline atmosphere, sulphurous smoke (as in the case of steam-operated railways) etc. and such increase of cover may be between 15 mm. and 50 mm. beyond the figures given in (a to e) above as may be specified by the Engineer-in-Charge.
- g) For reinforced concrete members, totally immersed in sea water, the cover shall be 40 mm. more than specified (a to e) above.
- h) For reinforced concrete members, periodically immersed in sea water or subject to sea spray, the cover of concrete shall be 50 mm. more than that specified (a to e) above.
- i) For concrete of grade M 25 and above, the additional thickness of cover specified in (f), (g) and (h) above may be reduced to half. In all such cases the cover should not exceed 75 mm.
- j) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing dense impermeable concrete with approved protective coating, as specified on the drawings. In such case the extra cover, mentioned in (h) and (i) above, may be reduced by the Engineer-in-Charge, to those shown on the drawing.
- k) The correct cover shall be maintained by cement mortar briquettes or other approved means. Reinforcement for footings, grade beams and slabs on subgrade shall be supported on precast concrete blocks as approved by the Engineer-in-Charge. The use of pebbles or stones shall not be permitted.
- l) The minimum clear distance between reinforcing bars shall be in accordance with I.S. 456 or as shown in drawing.

6.12. THE BARS SHALL BE KEPT IN CORRECT POSITION BY THE FOLLOWING METHODS.

- a) In case of beam and slab construction precast cover blocks in cement mortar 1:2 (1

cement : 2 coarse sand) about 4 x 4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcement.

- b) In case of cantilevered and doubly reinforced beams or slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 metre or at shorter spacing to avoid sagging.
- c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them; or with block of cement mortar 1:2 (1 cement : 2 coarse sand) of required size suitably tied to the reinforcement to ensure that they are in correct position during concreting.
- d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by Engineer-in-Charge.

6.13. INSPECTION :

Erected and secured reinforcement shall be inspected and approved by Engineer-in-Charge prior to placement of concrete.

6.14. MODE OF MEASUREMENT FOR REINFORCEMENT FOR R.C.C. WORKS :

Reinforcement as detailed in schedule of quantities shall be measured for payment lineally as per the cutting length nearest to a centimetre shown in bar bending schedule submitted by the contractor and approved by the Engineer-in-Charge and weight calculated based on the standard weights as per I.S.1786, as indicated in the following table:

Nominal size in mm	6	7	8	10	12	16	18	20
Cross Sectional area in	28.30	38.50	50.30	78.60	113.10	201.20	254. 60	314.30
Mass / Weight in Kg / RM	0.222	0.302	0.395	0.617	0.888	1.580	2 .000	2 .47
Nominal size in mm	22	25	28	32	36	40	45	50
Cross Sectional area in	380.30	491.10	614.00	804.60	1018.30	1257.20	1591.10	1964.30
Mass / Weight in Kg / RM	2 .980	3.850	4.830	6.310	7.990	9.850	12.500	15.420

No allowance shall be made/ be measured in the weight for rolling margin. If weight of bar(s) found to be more than the standard weights, the measurement / payment shall be restricted to the standard weights as above. However, if weight of bar(s) found to be less than the standard weights (but within the permissible limit), the measurements / payment for the same shall be as per standard weights.

Only authorized laps shall be measured. The cost of steel used by the contractor in the reinforcement of beams, slabs and columns etc. will be paid as per the rate of reinforcement only upto the extent shown in the drawings. As far as possible laps in bars shall be avoided. Any laps and hooks provided by the contractor other than authorised as per approved bar bending schedule will be considered to have been provided by the contractor for his own convenience and shall not be measured for payment. Pins, chairs, spacers shall be provided by the contractor wherever required as per drawing and bar bending schedule and as directed by the Engineer-in-Charge and shall be measured for payment. Fan hooks as required shall be provided by the contractor under this item and shall be measured for payment.

The rate shall include the cost of all materials and labour required for all above operations including transport, wastage, straightening, cutting, bending, binding and the binding wire required.

* * * *

7. PILE FOUNDATION

(TECHNICAL SPECIFICATIONS FOR BORED CAST-IN-SITU R.C.C. PILES)

7.0.SCOPE :

This specification covers the design and construction of load bearing concrete bored cast-in-situ piles of appropriate diameter which can transmit the load of the structure to the soil by both resistance developed at the tip by end bearing and along the surface of the pile shaft by friction.

This specification also covers the design and construction of R.C.C. pile caps and plinth beams appropriate for the piles offered and structure to be supported.

Tenderer shall be responsible for the construction of the entire pile foundation system as proposed by the Department in its tender drawing and schedule and shall guarantee the stability of the pile foundation system offered against the risks of settlement and other type of damage to the structure.

The Tenderer shall submit his offer as per Department's schedule of work, specifications and drawings.

7.1.EQUIPMENT & ACCESSORIES :

The equipment and accessories shall depend on the type of bored cast-in-situ piles chosen for the job and shall be selected giving due consideration to the sub-soil strata, ground water conditions, type of founding materials and the required penetration, manner of operation etc. For Bored cast-in-situ piles percussion boring by suitable drilling rigs using direct mud circulation (DMC) methods is to be adopted and the size of the cutting tool shall not be less than the diameter of the pile by more than 75mm Bentonite shall be used as drilling mud and its basic properties shall conform to Appendix - 'A' of I.S. 2911 (Part-I/Section-2) 1987. Tremie shall be used for placing concrete into the bore holes.

7.2.GENERAL CONSIDERATIONS :

The construction of pile foundation shall be in such a way that the load from the structure it supports, can be transmitted to the soil without causing any soil failure & without causing such settlement, differential or total under permanent transient loading as may result in structural damage and/or functional distress to the buildings.

When working near the existing structures, any damage to such structures shall be made good at no extra cost to the Department. The contractor shall, therefore, take adequate care to avoid any damage to the existing structures.

In case of deep excavations adjacent to piles proper shoring or other suitable arrangement shall be done at no extra cost to the Department to guard against the lateral movement of soil or releasing the confining soil stress.

As per loading details, piles will be required to withstand vertical load axial or otherwise and horizontal load associated with moments. Axial load from a pile should be transmitted to the soil through skin friction along the shaft and end-bearing at its tip. A horizontal load shall be transmitted to the sub-soil by horizontal sub-grade reaction generated in the upper part of the pile shaft.

Coarse Aggregate, Fine Aggregate & Water:

Coarse aggregate fine aggregate and water shall conforming to IS 456 (L.R) and I.S 383 (L.R)

Concrete : Concrete to be used for the pile shaft shall be M 20. Materials and method of manufacture for cement concrete shall, in general, be in accordance with the method of concrete under the condition of pile installation. Consistency of concrete mix for cast-in-situ piles shall be suitable to the method of installation of piles. Concrete mix shall be so designed as to have a homogeneous mix having a flowable character consistent with the method of concreting of pile. The slump of concrete shall range between 100 to 180 mm depending on the method/manner of concreting. Minimum cement content shall be 400 kg per cubic metre. In case of piles where concreting is done under water or drilling mud using methods other than tremie 10% extra cement over that required for the design grade of concrete at specified slump shall be used subject to a minimum quantities of cement specified above. Cost of excess cement over the minimum quantity specified shall be borne by the

contractor. For mix design, manufacture, placing etc. specification for cement concrete given hereinafter shall be referred.

7.3.WORKMANSHIP :

- a) **Control of piling installation:** Bored cast-in-situ piles shall be installed by employing suitable drilling rigs using a combination of bailer and a suitable chisel with DMC method. Bore hole shall be stabilised by bentonite as drilling mud and concreting shall be done by use of tremie.
- b) **Control of Alignment :** Piles shall be installed as accurately as possible as per the designs and drawings. Greater care should be exercised in respect of installation of single pile or piles in two pile groups. The piles shall be installed vertically with tolerance as stipulated by I.S 2911 (Part-I/Section-2) (Latest revision). Piles shall not deviate more than 75mm or D/6 whichever is less in case of piles having diameter less than 600mm, 75 mm or D/10 whichever is more in the case of piles having diameters more than 600mm from their designed positions at the working level. In the case of a single pile in a column, positional tolerance should not be more than 50mm or D/6 which ever is less (100 mm in case of piles having diameter more than 600 mm). In case of piles deviating beyond these limits, contractor shall carry out necessary remedial measures duly approved by the Department at no extra cost. Piles that are deviated to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap or plinth beams, the piles should be re-placed or supplemented by one or more additional piles at no extra cost to the Department.

A minimum length of two/three metres of temporary guide casing upto piling platform shall be inserted in each bored pile after completion of bailer driving. Additional length or temporary casing may be used depending on the condition of the strata, ground water level etc.

- c) **Founding Level :** The bore hole shall be advanced by chisel and direct mud circulation method after installation of guide casing till the required founding level is reached. The founding level shall be as per the drawings and as directed by the Engineer-in-Charge.

In case, drilling mud within the hole stabilizes a bored pile, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. The cleaning of the hole shall be ensured by careful operation of boring tool and/or flushing of the drilling mud through the bottom of the hole by tremie for half an hour minimum.

In case, a hole is bored by use of drilling mud, the specific gravity of the mud suspension near about the bottom of the hole shall, wherever practicable, be determined by suitable, slurry sampler and recorded. Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting operations in order to keep the hole stabilized as well as to avoid concrete getting mixed up with the thicker suspension of the mud. The concreting operations should not be taken up when the specific gravity of bentonite slurry

is more than 1 .2.

In addition to the normal precautions to be taken in tremie concreting, the following requirements shall be applicable to the use of tremie concrete in piles:

- i) The concrete should be coherent, rich in cement (not less than 400 kg/cum) & of slump not less than 150mm.
- ii) When concreting is carried out under water, a temporary casing should be installed to the full depth of the bore hole or 2 to 3 M into the top stratum, so that fragments of ground cannot drop from the sides of the hole into the concrete as it is placed.
- iii) The hopper & tremie should be a closed system embedded in the placed concrete, through which water can't pass.
- iv) The first charge of concrete should be placed with a sliding plug pushed down the tube ahead of it or with a steel plate of adequate charge to prevent mixing of concrete and water. However, the plug should not be left in the concrete as a lump.
- v) The tremie pipe should always penetrate well into the concrete with an adequate margin of safety against accidental withdrawal of the pipe is surged to discharge the concrete.
- vi) The pile should be concreted wholly by tremie and the method of deposition should not be changed part way up the pile, to prevent the laitance from being entrapped within the piles.
- vii) All tremie tubes should be scrupulously cleaned after use.

Normally concreting of the piles should be uninterrupted. In the exceptional case of interruption of concreting, but which can be resumed within 1 or 2 hours, the tremie shall not be taken out of the concrete. Instead it shall be raised and lowered slowly, from time to time to prevent the concrete around the tremie from setting. Concreting should be resumed by introducing a little richer concrete with a slump of about 200 mm for easy displacement of the partly set concrete.

If the concreting cannot be resumed before final set of concrete already placed, the pile so cast may be rejected.

In case of withdrawal of tremie out of the concrete either accidentally or to remove a choke in the tremie, the tremie may be reintroduced in the following manner to prevent impregnation of laitance or scum lying on the top of the concrete already deposited in the bore.

The tremie shall be gently lowered on to the old concrete with very little penetration initially. A vermiculite plug should be introduced in the tremie. Fresh concrete of slump between 150mm and 175 mm should be filled in the tremie, which will push the plug forward and will emerge out of the tremie displacing the laitance/scum. The tremie will be

pushed further in steps making fresh concrete sweep away laitance/scum in its way. When tremie is buried by about 60 to 100 cm, concreting may be resumed.

During installation bored cast-in-situ piles, the convenience of installation may be taken into account while determining the sequence of piling in a group.

The top of concrete in a pile shall generally be brought above the cut-off level, upto ground level to permit removal of all laitance and weak concrete before capping and to ensure good concrete at the cut-off level for proper embedment into the pile cap. When concrete is placed by tremie method, concrete shall be cast to the piling platform level at ground level to permit overflow of concrete for visual inspection.

- d) **Defective Pile** : In case defective piles are formed, they shall be removed or left in place whichever is convenient without affecting, performance of the adjacent piles or the cap as a whole without any extra cost to the Department. Additional piles shall be provided to replace them as directed.

Any deviation from the designed location alignment or load capacity of any pile shall be noted and adequate measures taken well before the concreting of the pile cap and plinth beam if the deviations are beyond the permissible limit.

During chipping of the pile top manual chipping maybe permitted after three days of pile casting, pneumatic tools for chipping shall not be used before seven days after pile casting.

After concreting the actual quantity of concrete shall be compared with the average obtained from observations actually made in the case of a few piles initially cast. If the actual quantity is found to be considerably less, special investigations shall be conducted and appropriate measures taken.

7.4.ROUTINE LOAD TEST :

The contractor shall be required to carry out routine load tests as directed by the Engineer-in-charge on an individual pile or on a group of piles or on both. The routine load tests shall be carried out generally as per IS 2911 (Part-IV) – 1985. Report on routine load tests shall be submitted in an approved format for Department's approval at no extra cost. In case the tests on the routine piles reveal safe capacity less than specified, the contractor shall, at his own cost, provide suitable modifications to the pile or other remedial measures after obtaining approval of the Engineer-in-Charge. In case of an unsatisfactory results being revealed on any routine tests it shall be the contractor's responsibility to carry out additional routine tests, at his own cost till the criteria laid down are fulfilled.

Rate for routine load test shall be inclusive of providing kentledges, making other arrangements for the test loading platforms, providing tools and plants, equipments like hydraulic jack, dial gauges etc. other measuring instruments and all labour involved in carrying out tests. Cost of pile shall, however, be paid for by the Department at the rates

accepted in the tender since the piles are working piles.

7.5.MODE OF MEASUREMENT OF PILES :

The piles shall be measured in running metres from the pile cut-off level to the founding level. The rates quoted for piling work shall include the cost of concrete, hire charges of tools and plants, bailing out of water, breaking of pile heads to required level and shape, breaking, cutting through and removing the boulders or any other obstructions, if met with before reaching the required founding level etc. completed.

7.6.GUARANTEE FOR THE PILE FOUNDATION SYSTEM :

The contractor shall guarantee the stability of the pile foundation system and shall indemnify the department against risks of settlement and against all damages caused to building erected on the pile foundation system for a period of 5(five) years from the certified date of completion. Certificate of completion shall be issued by the Engineer-in-Charge after the satisfactory completion of the job.

NOTE: Proforma for guarantee to be executed by contractors for stability of pile foundation system against risk of settlement & other type of distress to the building(s) is attached in this book as **Appendix – “D”**.

* * * *

8. READY MIX CONCRETE :

(SPECIFICATIONS FOR READY MIXED CONCRETE, CONFORMING TO IS 4926)

- 8.1. Ready mix Concrete shall conform to latest revision of IS : 4926 following are the requirement for supply of R.M.C
 - 8.1.A. Concrete delivered at site shall be in a plastic condition and requiring no further treatment before being placed in the position in which it is to set and harden
 - 8.1.B. The process of continuing the mixing of concrete at a reduced speed during transportation to prevent segregation.
 - 8.1.C. Truck mounted equipment designed to agitate concrete during transportation to the site of delivery.
 - 8.1.D. Concrete produced by completely mixing cement, aggregates, admixtures if any and water at a stationary central mixing plant and delivered in containers fitted with agitating devices. The concrete may also be transported without being agitated as a special case and as requested.
 - 8.1.E. Concrete produced by placing cement, aggregates and admixtures, if any other than those to be added with mixing water, in a truck mixer at the batching plant , the addition of water and admixtures to be added along with mixing water, and the mixing being carried out entirely in

the truck mixer either during the journey or on arrival at the site of delivery. No water shall be added to the aggregate and cement until the mixing of concrete commences.

8.2. MATERIALS :

- 8.2.A. **The cement** used shall be of specified grade ordinary Portland cement or low heat Portland cement conforming to IS: 269 or Portland slag cement conforming to IS: 455 or Portland-pozzolana cement conforming to IS: 1489 or rapid hardening. Portland cement conforming to IS: 8041 as may be specified at the time of placing the order. If the type is not specified, ordinary Portland cement shall be used.
- 8.2.B. **Fly ash** when used for partial replacement of cement, shall conform to the requirements of IS-3812 (Part I) and as specified by the users.
- 8.2.C. **The aggregate** shall conform to IS: 383. Fly ash when used as fine aggregate shall conform to the requirements of IS 3812 – (Part - II).
- 8.2.D. **Water** used for concrete shall conform to the requirement of IS 456-2000.
- 8.2.E. **The admixtures** shall conform to the requirements of IS : 456-2000 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS : 3812 (Part II) – 1981. However, partial replacement of cement by fly ash shall not be more than 15% of designed requirement.

In case if fly ash is used more than 15%, the same shall be guided under table 5.1 of the IS, and in which case specific care shall be taken in terms of curing, protecting, repairing, finishing, de-shuttering etc. as detailed in the Chapter “FLY ASH CONCRETE”, here in after.

8.3. SUPPLY :

The ready-mixed concrete shall be manufactured and supplied on either of the following basis :

- i) Specified strength based on 28-day compressive strength of 15 -cm cubes tested in accordance with IS : 456-2000.
- ii) Specified mix proportion.

NOTE : Under special circumstances and as specified the strength of concrete in (a) above may be based on 28-day or 7-day flexural strength of concrete instead of compressive strength of 15-cm cube tested in accordance with IS : 456-2000.

- 8.3.A. When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the manufacturer and the concrete shall conform to the requirements specified.
- 8.3.B. When the concrete is manufactured and supplied on the basis of specified mix proportions,

the responsibility for the design of the mix shall be that of the purchaser and the concrete shall conform to the requirements specified.

8.4. GENERAL REQUIREMENTS:

- 8.4.A. When a truck mixer or agitator is used for mixing or transportation concrete, no water from the truck-water system or from elsewhere shall added after the initial introduction of the mixing water for the batch, when no arrival at the site of the work, the slump of the concrete is less than specified, such additional water to bring the slump within limits shall be injected into the mixer under such pressure and direct flow that the requirements for uniformity specified.
- 8.4.B. Unless otherwise specified when a truck or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1 ½ hour (when the prevailing atmospheric temperature above 20°C) and within 2 hours (when the prevailing atmosphere temperature is at or below 20 °C) of adding the mixing water to the mix of cement and aggregate or adding the cement to the aggregate which ever is earlier.
- 8.4.C. The temperature of the concrete at the place and time of delivery shall be not less than 5°C. Unless otherwise required by the purchaser, the concrete shall be delivered when the site temperature is less than 2.5° C.
- 8.4.D. Adequate facilities shall be provided by the manufacturer/supplier to inspect the materials used the process of manufacture and methods of delivery of concrete. He shall also provide adequate facilities to take samples of the materials used.
- 8.4.E. The tests for consistency or workable shall be carried out in accordance with requirements of IS 1199 by such other method as may be agreed to between the purchaser and manufacturer.
- 8.4.F. The sampling and testing of concrete shall be done in accordance with the relevant requirements of IS 456, IS 1199 and IS 516.
- 8.4.G. The compressive strength and flexural strength tests shall be carried out in accordance with the requirement of IS: 516 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements and other related requirements of IS: 456 -2000.
- 8.4.H. The testing shall be carried out in accordance with the requirements and the cost shall be borne by the Contractor.
- 8.4.I. The manufacturer shall keep batch records of the quantities by mass all the solid materials, of the total amount of water used in mixing and of the results of all tests. If required insisted, the manufacturer shall furnish certificates, at agreed intervals, giving this information.
- 8.4.J. Mode of measurement for ready mixed concrete (RMC) will be the same as mode of measurement for concrete work already mentioned at page No. 42 & 43 of clause 4.40.

However, consumption of RMC shall be maintained at site. Wastage, spillover, wastage due to pump blockage etc. shall not be considered for payment.

* * * *

9. FLY ASH CONCRETE

NOTES:

- a) The fly ash should have consistent quality satisfying the requirements of Grade-1 FA of IS 3812 and Class-F of ASTM C-618.
- b) The source of fly ash should be so selected that test results of fly ash samples collected from these sources during last one year at frequency of maximum one month interval should satisfy the requirements of above codes.
- c) The characterization of fly ash which will be used should be done as per above two codes for each batch of fly ash.
- d) The fly ash should be stored in bins at the plant.
- e) All concrete should be manufactured at RMC plant.
- f) The mix proportion should be approved by competent authority. The information to be supplied for approval would be identified by the competent authority.
- g) Any change in mix proportion, after approval, should be concurred by appropriate authority.
- h) Samples to be taken, at each time of casting, for 7 days and 28 days.
- i) All ingredients of concrete should satisfy the requirements of relevant IS codes and specifications.

9.1.0. Curing, Protecting, Repairing and Finishing

- 9.1.1. **Curing:** All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or ponded water, continuously saturated covering of sacking, canvas, hessain or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter the quality of curing water shall be the same as that used for mixing concrete.

Certain types of finish or preparation for overlaying concrete must be done at certain stages of curing process and special treatment may be required for specific concrete surface finish.

Curing of concrete made of high alumina cement and super sulphated cement shall be carried out as directed by Engineer-in-charge.

- 9.1.2. Curing of concrete with low water binder ratios having partial replacement of cement by

pozzolanic materials.

9.1.3. The structural elements with concrete having water binder ratio less than or equal to 0.4 or partial replacement of cement by pozzolanic materials (5% or above replacement by silica fume or high reactivity metakaoline, or 15% or above by fly ash) shall be cured in two stages, initial curing and final curing.

- i) The initial curing should be started not later than 3 hours or initial setting time, whichever is lower, after placement of concrete. The concrete surface exposed to environment should be covered by plastic sheet or other type of impermeable covers. The initial curing should be continued upto a minimum period of 12 hours or 2 hours plus final setting time of concrete, whichever is higher.
- ii) Final curing should be done with water. It should commence immediately after initial curing and continue upto a minimum period of 14 days.

9.1.4. CURING WITH WATER

Fresh concrete shall be kept continuously wet for a minimum period of 14 days from the date of placing of concrete, following a lapse of 12 to 24 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied to uniformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms . Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

9.1.5. CONTINUOUS SPRAYING

Curing shall be assured by use of ample water supply under pressure in pipes, with all necessary appliances of hose sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer-in-charge.

9.1.6. ALTERNATE CURING METHODS:

Whenever in the judgement of Engineer-in-charge, it may be necessary to omit the continuous spray method, covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. Any type of covering which would slain or damage the concrete during or after the curing period, will not be permitted. Covering shall be kept continuously wet during the curing period.

For curing of concrete in pavements, side walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer-in-charge. Special attention shall be given to edge and corner of the slab to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.

9.1.7. CURING COMPOUNDS :

Surface coating type curing compound shall be used only on special permission of Engineer-in-charge. Curing compounds shall be liquid type while pigmented, conforming to U.S Bureau of Reclamation Specification. No curing compound shall be used on surface where future blending with concrete water or acid proof membrane or painting is specified.

9.1.8. Curing Equipment: All equipments and materials required for curing shall be on hand and ready for use before concrete is placed.

9.2.0. Form Work

9.2.1. General: The form work shall consist of shores, bracings, sides of beams and columns, bottom of slabs etc. including ties, anchors, hangers, inserts etc. complete which shall be properly designed and planned for the work. The false work shall be so constructed that up and down vertical adjustment can be made smoothly. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of form work.

9.2.2. Design of Form Work: The design and engineering of form work as well as its construction shall be the responsibility of Contractor. If so instructed the drawings and calculations for the design of the form work shall be submitted well in advance to the Engineer-in-charge for approval before proceeding with work, at no extra cost to the Department. Engineer-in-charge approval shall not however, relieve Contractor of the full responsibility for the design and construction of the form work. The design shall take into account all the loads vertical as well as lateral that the forms will be carrying including live and vibration loadings.

9.2.3. Type of Form Work: Form work may be of timber, plywood, metal, plastic or concrete. For special finishes, the form work may be lined with plywood, steel sheets, oil tempered hard board etc. Sliding forms and slip forms may be used with the approval of Engineer-in-charge.

9.2.4. Formwork Requirements: Forms shall conform to the shapes, lines grooves and dimensions including camber of the concrete as called for in the drawings. Ample studs, water braces, straps, shores etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases, form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, wraps or other surface defects in contact with concrete. Faces coming in contact with concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.

Ply wood shall be used for exposed concrete surfaces, where called for Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces

which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Form work with lining will be permitted.

All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water lightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and if rejected by Engineer-in-charge shall be removed from the site.

Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundation.

Form work, during any stage of construction showing signs of distortion of distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be entirely removed and the formwork corrected prior to placing new concrete.

Excessive construction camber to compensate for shrinkage settlement etc. that may impair the structural strength of members will not be permitted.

Forms for substructure concrete may be omitted when, in the opinion of Engineer-in-charge, the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the drawings to compensate for irregularities in excavation and to ensure the design requirement.

Forms shall be so designed and constructed that they can be stripped in the order required and their removal do not damage the concrete. Face form work shall provide true vertical and horizontal joints, conforming to the architectural features of the structure as to location of joints and be as directed by Engineer-in-charge.

Where exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the desired concrete surfaces could be obtained which require a minimum finish.

9.2.5. Bracings, Struts and Props: Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboos shall not be used as props or cross bracings.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of beams and under the soffits of slab can be removed without disturbing the beam bottoms.

Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently

lowered vertically while striking the shuttering.

If the shuttering for a column is erected for the full height of the column, one side shall be left open and built upon sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m or as directed by Engineer-in-charge.

9.2.6. Inspection of Form Work

Following points shall be borne in mind while checking during erection of form work and form work got approved by the Engineer-in-charge before placing of reinforcement bars.

- a) Any members which is to remain in position after the general dismantling is done, should be clearly marked.
- b) Material used should be checked to ensure that wrong items/rejects are not used.
- c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.
- d) i)The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground. ii)Sole plates shall be properly seated on their bearing pads or sleepers.

iii)The bearing plates of steel props shall not be distorted.

iv)The steel parts on the bearing members shall have adequate bearing areas.
- e) Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.
- f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.
- g) The stacked materials shall be placed as catered for, in the design.
- h) When adjustable steel props are used, they should
 - i) Be undamaged and not visibly bent.
 - ii) Have the steel pins provided by the manufacturers for used
 - iii) Be restrained laterally near each end.

- iv) Have means for centralising beams placed in the fork heads
- v) Screw adjustment of adjustable props shall not be over extended
- j) Double wedges shall be provided for adjustment of the form to the required position wherever any settlement/elastic shortening of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/clamped down after adjustment to prevent their shifting.
- k) No member shall be eccentric upon vertical member
- l) The number of nut and bolts shall be adequate.
- m) Provisions of the design and/or drawings shall be complied
- n) Cantilever supports shall be adequate
- o) Props shall be directly under one another in multistage constructions as far as possible.
- p) Guy ropes or stays shall be tensioned properly
- q) There shall be adequate provision for the movement and operation of vibrators and other construction plant and equipment.
- r) Required camber shall be provided over long spans
- s) Supports shall be adequate, and in plumb within the specified tolerances.

9.2.7. Form Oil : Use of form oil shall not be permitted on the surface, which require painting. If the contractor desire to use form oil on the inside of form work of the other concrete structures, a non staining mineral oil or other approved oil CEMOL-35 of M/s. Hindustan Petroleum Co. Ltd may be used, provided it is applied before placing reinforcing steel and embedded parts. All excess oil on the form surfaces and any oil on metal or other parts to be embedded in the concrete shall be carefully removed. Before treatment with oil, forms shall be thoroughly cleared of dried splatter of concrete from placement of previous lift.

Any loss of water through the shuttering should be strictly prevented from placement specially for concrete mix with low water binder ratio or having partial replacement of cement by pozzoonas. In case of wooden shutter approved quality of form oil or plastic sheet can be use for this purpose.

9.2.8. Chamfers and Fillers : All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillers on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 x 20mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaces to the same texture as the forms to which it is attached.

9.2.8.1.Vertical Construction Joint Chamfers: Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not, permitted by Engineer-in-charge for structural or hydraulic reasons.

9.2.8.2.Wall Ties : Wire ties passing through the walls, shall not be allowed. Also through bolts shall not be permitted. For fixing of form work, alternate arrangements such as coil nuts shall be adopted at the contractors cost.

9.2.8.3.Reuse of Forms : Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer-in-charge. Warped lumber shall be resized. Contractor shall equip himself with enough shuttering to complete the job in the stipulated time.

9.2.8.4.Removal of Forms : Contractors shall record on the drawings or a special register, the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from.

In no circumstances shall forms be struck until the concrete reaches a strength of the at least twice the stress due to self weight and any construction erection loading to which the concrete may be subjected at the time of striking form work.

In normal circumstances (generally where temperatures are above 200 C.) forms may be struck after expiry of the following periods.

S. N	Part of Structure	Earliest concrete age at stripping		
		Cement with low and having pozzolonas	Ordinary Portland cement concrete	Portland Pozzolana C.C Fly Ash Based
a)	Walls, columns and vertical sides of beams	3 days	24 to 48 hours as directed by the E-I-C.	3 days
b)	Slabs(Props left Under)	14 days	3 days	7 days
c)	Beam, soffits (Props left under)	14 days	7 days	10 days
d)	Removal of props			
	i)Spanning upto 4.5m	14 days	7 days	10 days
	ii) Spanning over 4.5m	14 days	14 days	14 days
e)	Removal of props in beams & arches			
	i) Spanning upto 6m	14 days	14 days	14 days
	ii) Spanning over 6m	14 days	21 days	21 days
f)	For perforated 120mm thick	14 days	14 days	14 days

Skirting shall be done slowly with utmost care to avoid damage to arise and application and without shock or vibration by gently easing the wedge etc. After removing the form work, if it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provide as directed by Engineer-in-charge, to facilitate removal of form work which otherwise may be in accessible.

Tie, rods, clamps form-bolts etc. which must be entirely removed from walls or similar structures shall be loosened not sooner that 24 hours not later than 40 hours after concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties withdrawn from walls and grade beams shall be pulled towards the inside face. Cutting ties back from the faces of walls and grade beams will not be permitted. Work damaged due to premature or careless removal of forms shall be re-constructed at contractor's cost.

* * *

10. DAMP PROOF COURSE :

10.1. SCOPE OF WORK : The work covered under this specifications consists supplying and laying plain cement concrete as damp proof course with or without waterproofing admixture in accordance with this specification and applicable drawings.

10.2. WORKMANSHIP : Surface to receive damp proof course shall be cleaned and carefully swept to remove all dust, laitance etc. and shall be approved by the Engineer-in-Charge. Damp proof course shown shall be cement concrete as per proportion indicated in the schedule. Approved water proofing compound @ 3% by weight of cement or as directed by the manufacturer shall be mixed in cement mortar for this concrete. The damp proof course shall be laid to the full width of the wall and the edges shall be straight, even and truly vertical. Wooden forms shall be used to obtain good edges. No masonry work shall be commenced on freshly laid damp proof course unless it is cured for 48 hours of its laying but the curing of cement concrete shall be continued along with the masonry work. Specifications for cement, sand, aggregate and water shall be as described herein before for concrete works.

10.3. MODE OF MEASUREMENT : The work shall be measured in Sqm. area actually laid limited to sizes as shown in drawing. The rate shall include cost of all the materials, labour etc.

* * *

11. PRECAST REINFORCED CEMENT CONCRETE JALI :

11.1. GENERAL :

The item refers to manufacturing, supplying and fixing in position reinforced cement concrete jalli with thickness, proportion, design and pattern as specified in the description of item of schedule of quantities.

11.2. MATERIALS :

The concrete shall consist of a mix as specified in the item and specifications for cement concrete shall be similar to that specified under cement concrete. Reinforcement shall be as specified in the item description or as shown in the drawing or as directed by the Engineer-in-charge.

11.3. MANUFACTURE :

Precast jalli of approved design and thickness as specified in description of item shall be cast at site and fixed in position at all floors and levels by the contractor. Steel moulds to manufacture approved size, design and thickness of reinforced jalli as per drawings shall be manufactured and got approved before starting large scale casting. Reinforced jalli shall be cast at site. M.S. reinforcement of 6 mm. dia. or as specified shall be bent to the exact shape of jalli to run vertically and horizontally along centre of all walls and suitably kept in position. Use of teak wood/shuttering plywood moulds can be allowed at the discretion of the Engineer-in-charge. Precast Jalli shall be made by filling the moulds of the approved design, pattern with complete batch of 1:2:2 (using 10 mm. down graded stone aggregate) cement concrete so that the entire work may set in one time. If one batch is sufficient to complete a unit, each succeeding batch should follow the preceding batch as quickly as possible. The specifications for reinforced cement concrete shall conform to I.S. 456-1964 and as specified earlier. The jalli shall be cast according to drawing, design and as approved by the Engineer-in-charge. Necessary holes and keys for M.S. dowels to house in the jalli shall be left for fixing. Jallies shall be cured in a curing tank for a minimum period of 14 days. All the imperfection in surfaces and edges shall be repaired with neat cement paste to finish with sharp and smooth edges. The jalli so manufactured shall be perfectly at right angles when checked with straight edge. Jallies which are not approved due to defective pattern, shape, finish etc. shall be removed forthwith from the site of work.

11.4. FIXING :

The jalli shall be fixed in position in cement mortar 1:2 in preformed opening true to line, level and plumb with 6 mm. M.S. pins, all as per drawing or as directed by the Engineer-in-charge. Jalli with damaged edges of surfaces shall not be fixed. The joints shall be cured for a minimum period of 7 days. After grouting the sides with cement mortar etc., the jalli shall be rechecked for its levels and alignment. Finally the jambs, sills and soffits shall be plastered embedding the jalli uniformly on sides. The jalli shall be cleaned off all the mortar splashes, dirt etc.

11.5. MODE OF MEASUREMENT:

The jalli shall be measured in square metre and shall be measured between the limiting dimensions of unplastered sides, base and top. Any portion of jalli embedded in the supporting wall shall not be measured for payment. Dimensions shall be measured correct upto two places of decimal of a metre and the area worked out upto two places of a decimal of square metre. No deduction shall be made for the openings in the jalli. The thickness shall not be less than that specified.

11.6. RATES :

Rate to include the cost of the following :

- i) Providing the precast jalli of approved design conforming to specifications detailed above including concrete reinforcement, moulds etc.
- ii) All materials, equipment, labour for handling, transporting, hoisting and fixing the jalli in position including scaffolding, forming grooves if necessary, touching up all sides wherever necessary as per drawing and specifications.

* * * *

12 . STRUCTURAL STEEL :

12.1. SCOPE OF WORK :

The work covered by this specification consists of furnishing and erecting of structural steel complete in strict accordance with this specifications and the applicable drawings.

12.2. MATERIALS :

12.2.1. All structural steel shall be of standard sections as marked on the drawings and shall be free of scale, blisters, laminations, cracked edges and defects of any sort. If the structural steel is not supplied by the Department and the Contractor is required to bring such steel, the Contractor shall furnish duplicate copies of all mill orders and/ or also the test report received from the mills, to satisfy the Engineer-in-Charge.

12.2.2. All structural steel and electrodes shall comply in all respects with I.S.S. for structural steel.

12.3. WORKMANSHIP :

All workmanship shall be of first class quality in every respect to the greatest accuracy being observed to ensure that all parts will fit together properly on erection.

All ends shall be cut true to planes. They must fit the abutting surfaces closely. All stiffeners shall be fit tightly at both ends.

All butt ends of compression members shall be in close contact through the area of the joints.

All holes in plates and section between 12 mm. and 20 mm. thick shall be punched to such

diameter that 3 mm. of metal is left all around the hole to be cleaned out to correct size by reamer.

The base connection shall be provided as shown on drawings and the greatest accuracy of workmanship shall be ensured to provide the best connections.

Figured dimensions on the drawings shall be taken.

12.4. ERECTION AND MARKING :

Erection and fabrication shall be according to I.S. 800-1984 section-11. During erection, the work shall be securely braced and fastened temporarily to provide safety for all erection stresses etc. No permanent welding shall be done until proper alignment has been obtained.

Any part which do not fit accurately or which are not in accordance with the drawings and specifications shall be liable to rejection and if rejected, shall be at once be made good.

Engineer-in-Charge shall have full liberty at all reasonable times to enter the contractors premises for the purpose of inspecting the work and no work shall be taken down, painted or despatched until it has been inspected and passed. The contractor shall supply free of charge all labour and tools required for testing of work.

12.5. DELIVERY AT SITE :

The contractor shall deliver the component parts of the steel work in an undamaged state at the site of the works and the Engineer-in-Charge shall be entitled to refuse acceptance of any portion which has been bent or other wise damaged before actual delivery on work.

12.6. SHOP DRAWINGS :

The shop drawings of structural steel based on contract drawings shall be submitted to the Engineer-in-Charge. The necessary information for fabrication, erection, painting of structure etc. must be furnished immediately after acceptance of the tender.

12.7. PAINTING :

Painting should be strictly according to I.S. 1477-1971 (Part I-Pretreatment) and I.S. 1477-1 971 (Part II-painting).

Painting should be carried out on dry surfaces free from dust, scale etc. The paint shall be approved by the Engineer-in-Charge.

One coat of shop paint (red lead) shall be applied on steel, except where it is to be encased in concrete or where surfaces are to be field welded.

12.8. WELDING :

Welding shall be in accordance with I.S. 816-1969, I.S. 819-1957, I.S. 1024-1979, I.S. 1261-

1959, I.S. 1323-1982 and I.S. 9595-1980 as appropriate. For welding of any particular type of joint, welders shall give evidence of having satisfactory completed appropriate tests as described in any of I.S. 817-1966, I.S. 1393-1961, I.S. 7307 (Part-I)-1 974, I.S. 7310 (Part-I)-1974 and I.S. 7318 (Part-I)-1 974 as relevant.

12.8.1. Welding Consumables : Covered electrodes shall conform to I.S. 814 (Part-I)-1974 and I.S.814 (Part-II)-1974 or I.S. 1395-1 982 as appropriate.

Filler rods and wires for gas welding shall conform to I.S. 1278-1972.

The bare wire electrodes for submerged arc welding shall conform to I.S. 7280-1 974. The combination of arc and flash shall satisfy the requirements of I.S. 3613-1 974.

The filler rods and bare electrodes for gas shielded metal, arc welding shall conform to I.S. 6419-1971 and I.S. 6560-1972 as appropriate.

12.8.2. Types of Welding: Arc welding (direct or alternating current) or Oxyacetylene welding may be used. Field welding may be used. Field welding shall be by D.C.

12.8.3. Size of Electrode Runs: The maximum gauge of the electrodes for welding any work and the size of run shall be based on the following tables.

Average thickness of plate or	Maximum gauge or diameter of electrodes to be
Less than 3/16"	10 S.W.G.
3/16" and above but less than 5/16"	8 S.W.G.
5/16" and above but less than 3/8"	6 S.W.G.
3/8" and above but less than 5/8"	4 S.W.G.
5/8" and above but less than 1"	5/1 6"dia.
1" and above thick section	3/8" dia.

Note : On any straight weld the first run shall not ordinarily be deposited with a larger gauge electrode than No. 8 S.W.G. For subsequent runs the electrode shall not be increased by more than two electrode size between consecutive runs.

12.8.4. Welding Contractors : The contractor shall ensure that each welding operator employed on fabrication or erection is an efficient and dependable welder, who has passed qualifying tests on the types of welds which will be called upon to make. Sample test shall have to be given by the contractor to the entire satisfaction of the Engineer-in-charge.

12.8.5. Welding Procedure :

- Welding should be done with the structural steel in flat position in a down hand manner wherever possible. Adequate steps shall be taken to maintain the correct arc length, rate of travel, current and polarity for the type of electrode and nature of work. Welding plant capacity shall be adequate to carry out the welding procedure laid down. Adequate

means of measuring the current shall be available either as a part of the welding plant or by the provision of a portable ammeter. In checking the welding current, a tolerance of 10% or 30 amperes from the specified value whichever is less shall be permitted.

- b) The welding procedure shall be such as to ensure that the weld metal can be fully and satisfactory deposited through the length and thickness of all joints so that distortion and shrinkage stresses are reduced to the minimum and thickness of welds meet the requirements of quality specified.

12.9. WORKMANSHIP :

12.9.1. Preparation of Fusion Faces : Fusion faces shall be cut by steaming machine or gas cutting and later dressed by filing or grinding so that they shall be free from irregularities such as would interfere with the deposition of the specified size of weld to cause the defects. Fusion faces and the surrounding surfaces shall be free from heavy slag, oil paint or any substance which might affect the quality of the weld or impede the progress of welding. The welding face shall be free of rust and shall have metal shine surfaces.

The parts to be welded shall be brought into as close contact as possible and the gap due to faulty workmanship or incorrect fit up shall not exceed 1/16". If separation of 1/16" or more occurs locally, the size of the fillet weld shall be increased at such position by an amount of equal to the width of the gap.

The parts to be welded shall be maintained to their correct position during welding. They shall be securely held in position by means of tack welds, service bolts, clamps or rings before commencing welding so as to prevent and relative movement due to distortion, wind or any other cause.

12.9.2. Step Back Method Should be Used to Avoid Distortion : The minimum leg length of a fillet weld as deposited should not be less than the specified size and the throat thickness as deposited should be not less than that tabulated below:

Throat Thickness of Fillet

Angle between fusion faces	60°-90°	91°-100°	101°-106°	107°-113°	114°-120°
Throat thickness in cms.	0.70	0.65	0.60	0.55	0.50

In no case should a concave weld be deposited without the specific approval of the Engineer-in-Charge unless the leg length is increased above the specified length so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat.

All welds shall be deposited in a pre-arranged order and sequence taking due account of the effects of distortion and shrinkage stresses.

After making each run of welding, all slag shall be removed and final run shall be protected

by clean boiled linseed oil till approved.

The weld metal, as deposited, shall be free from crack, slag, excessive porosity, cavities and other faults.

The weld metal shall be properly fused with the parent metal without overlapping or serious undercutting at the toes of the weld.

The surfaces of the weld shall have a uniform and consistent contour and regular appearance.

In welds containing crack, porosity or cavities in which the weld metal tends to overlap on the parent metal without proper fusion, the defective portions of the welds shall be cut out and re-welded. Where serious under cutting occurs, additional weld metal shall be deposited to make good reduction. Testing of welded joints shall be done as per relevant IS codes 3600, 3613, 4260, 7205, 7215, 7307, 7310, 7318.

12.10. MODE OF MEASUREMENT:

All structural steel shall be measured on weight basis in metric tonnes or quintals or kgs. as mentioned in the schedule of quantities. The length or areas of various members including gusset plates shall be measured correct to two places of decimals and the net weight worked out from the standard steel tables approved by Indian Standard Institution. No separate measurements shall be taken for welding, riveting, bolting, field connections etc. The rate shall include cost of all labour, materials, scaffolding, transport and also cost of welding, riveting and bolting, field connections if any all to complete the job as per specifications.

* * *

13. STONE MASONRY :

13.1. SCOPE OF WORK :

The work covered under this specifications consists of supplying and erecting stone masonry walls with available best quality of stone in strict compliance with this specifications and applicable drawings.

13.2. RANDOM RUBBLE MASONRY :

- 13.2.1. Material :** The rubble shall be of the best quality trap/granite/ballast stones obtained from the approved quarry. The sample of the stone, to be used shall be got approved from the Engineer-in-Charge. All stones shall, generally, be freshly quarried and shall be sound, dense, hard, free from segregation, cracks, weathered portions and other structural defects or imperfections, tending to off set soundness and strength. The percentage of water absorption shall generally not exceed 5% by weight. All stones shall be wetted before use. Stones shall be neatly worked to requisite sections and forms and shall have fully dressed beds and joints. At least 50% of the stones shall be 0.015 cum in content when reckoned individually. The length of stones for stone

masonry shall not exceed three times the height and the breadth or base shall not be greater than three fourth the thickness of wall, or not less than 15 cm. The height of stone may be upto 30 cm. Stones shall be laid on the natural beds and shall run sufficiently inside the wall thickness. No hollow space shall be left out and inter spaces of stones being filled with mortar and stone chips, driven hard & not with mortar only.

All mortar to be used shall be of the type and proportion mentioned in the item. Cement, sand and water to be used shall conform to their relevant specifications as described under cement concrete. The masonry shall be laid to plumb, lines levels, curves, shapes as shown in drawings. All required holes for passage of water or pipes are to be embedded during construction as specified.

All stones shall be wetted before laying in masonry. Concrete surfaces of columns, beams, lintels, chajjas etc. coming in contact with masonry shall be properly chipped, washed and wetted before start of masonry work. The concrete surface coming in contact of masonry shall be given a thick coat of cement slurry as the masonry work progresses in height. Clean chips and sprawls carefully selected to fit in the space shall be wedged into the mortar joints and beds wherever necessary to avoid thick beds or joints or mortar. However, proper shaping and dressing of stones shall be done prior to their laying in masonry and hammering shall not be resorted to often after the stones are laid in position. The bond stones shall be used in every square meter area of masonry wall and shall extend from front to back to thin walls having width of 600mm and shall overlap by at least 150mm in walls having thickness more than 600mm when laid from both sides. Engineer-in-Charge may permit cement concrete 1:2:4, in-situ / pre-cast, to act as bond stone, as required. When the work has to be started on the old or the one completed a long while ago or in the previous working seasons, care shall be taken to roughen and clean old surface satisfactorily without disturbing the masonry before laying the new. It shall be wetted before laying the bedding mortar.

When practicable, the whole masonry in any structure shall be carried out upto a uniform level throughout. But when breaks are unavoidable in carrying the work continuously in uniform level, sufficiently long steps shall be left. All junction of walls shall be formed at the time when walls are being built. Cross walls should be carefully bonded into the main walls. All masonry built in cement mortar shall be kept continuously wet for 14 days from the date of laying. Should the mortar perish i.e. becomes dry, white or powder through neglect of watering and if the masonry shows hollow joints or non adherence of mortar to the stones or if the work does not conform to drawings and specifications, the work shall be pulled down and rebuilt by the contractor at his own cost and risk. All masonry shall be thoroughly cleaned and washed down on completion and all stains, adhering mortar removed from the surface and raking of joints carried out as the scaffolding is being lowered and removed. Holes left in masonry for supporting scaffolding shall be filled and made good before pointing/ plastering.

13.3. KHANDKI FACING STONE MASONRY :

The specifications for Random rubble masonry as given in item No. 14.2 shall generally apply to these for quality of stones, workmanship etc. except for the following:

The face of the stones shall be square/ rectangular in shape and shall be so dressed around that those can be set on proper bases and shall render uniform joints. The stones may have bushing on the face but shall not project more than 40 mm. The external faces shall be laid in courses of about 200 mm. height or as specified and the internal face shall be finished with rubble backing.

The other specifications, mode of measurements etc. shall be same as per specifications for R.R. Masonry mentioned above.

13.4. MODE OF MEASUREMENT :

All stone masonry shall be measured in cubic metres as actually done. All openings for windows, doors, lintels etc. shall be deducted to get the net quantity of actual work done. Openings or chases required for P.H. and electrical inserts less than 0.1 sqm. and bearings of precast concrete members shall not be deducted. The rate shall also include cost of corner stones, bond stones, scaffolding ,labour, curing etc.

* * * *

14. PRECAST CEMENT CONCRETE SOLID BLOCK MASONRY:

14.1. Scope of Work : The work covered under this specifications pertains to procurement of best quality locally available or locally manufactured precast cement concrete solid block and workmanship in building walls of various thickness in strict compliance with the specifications and applicable drawings.

14.2. Material : Precast cement concrete solid blocks shall be of best quality locally available/ manufactured at site and should be approved by the Engineer-in-Charge before incorporation in the work. The ingredient and the cement concrete used shall confirm to relevant I.S. as stipulated in specification for cement concrete works herein before.

Minimum crushing strength of the solid blocks shall be 40 to 60 Kg/ sqcm. at 28th day after curing. The type of the bond to be adopted will be decided by the Engineer-in-Charge but vertical joints shall be staggered. The size of the blocks shall be 390 x 190 x 140 mm. and 390 x 190 x 100 mm. and the proportion used in making the blocks shall be 1:11 (1 cement : 11 fine and coarse aggregates). The blocks shall be cured well at least for 14 days before incorporation in to the work. The cement mortar for concrete blocks masonry shall be 1:4 and joints shall not be more than 10 mm. thick.

14.3. Workmanship and Mode of Measurement : The workmanship and mode of measurement shall be as stipulated in the specification for brick work as applicable stated earlier and concrete block masonry with 140 mm. thick block shall be measured in sqm. nearest to two places of decimals of a metre. The rate quoted shall include cost of all materials, labour including form work in casting the blocks, curing, transporting, handling, hoisting the blocks to proper level, curing masonry etc. complete.

* * *

16. CEMENT CONCRETE FLOORING (IPS) :

16.0. SCOPE OF WORK :

The work covered under this specification consists of providing and laying at all levels and floors, flooring of different types, strictly in accordance with these specifications and relevant drawings.

16.1. CEMENT CONCRETE FLOORING (INDIAN PATENT STONE) :

16.1.1. Materials : The specifications for materials, grading, mixing and the quantity of water to be added shall generally conform to their relevant specifications described under plain and reinforced concrete. The maximum size of coarse aggregate shall be 10 mm. The fine aggregate shall consist of properly graded sand. Concrete shall be mixed preferably by machine, and hand mixing shall be avoided as far as practicable.

16.1.2. Preparation of Base : The base concrete surface shall be thoroughly chipped to remove laitance, caked mortar, loose sand, dirt etc. cleaned with wire brush and washed clean and watered until no more water is absorbed. Where the base concrete has hardened so much that roughening the surface by wire brushes is not possible, the same shall be roughened by chipping or hacking at close intervals. The surface shall be soaked with water for at least 12 hours and surface water removed and dried before laying the topping. Before laying the concrete, cement slurry at 2.75 kg./ sqm. of surface shall be applied for better bond. Concrete flooring shall then be laid in alternate bays in pattern and joints, wide/ flush as per drawing. The edge of each panel into which the floor is divided shall be supported by wooden or metal strips duly oiled to prevent sticking. The panels shall be of uniform size and, unless otherwise specified, no dimension of panel shall exceed 2 m. and the area of a panel shall not be more than 2 sqm. However, the exact size of panel shall be decided by the Engineer-in-Charge to suit the size of the room. The joints in the floor finish shall extend through the borders and skirting/dado. The border shall have mitred joints at the corners of the room. Where glass/ aluminium dividing strips are proposed to be provided, the same shall be fixed in cement mortar 1:2 @ 600 mm. centres or as specified in the schedule for full depth of the finished floor.

The depth of dividing strips shall be the thickness as proposed for the finished floor in the item. In the case of flush joints, alternate panels only may be cast on same day. At least 48 hours shall elapse before the concreting of adjacent bay is commenced.

16.1.3. Mixing : The topping concrete shall be of mix of one part of cement, two parts of sand and 4 parts of well graded stone chips of 10 mm. maximum size. The ingredients shall be thoroughly mixed with just sufficient water to the required plasticity, having water cement ratio not more than 0.4.

16.1.4. Laying : The free water on the surface of the base shall be removed and a coat of cement slurry to the consistency of thick cream shall be brushed on the surface. On this fresh grouted base, the prepared cement concrete shall be laid immediately after mixing.

The concrete shall be spread evenly and laid immediately after mixing. The concrete shall be spread and levelled carefully. The concrete shall be completed and brought to the specified levels by means of a heavy straight edge resting on the side forms and down ahead with a sawing motion in combination with a series of lifts and drops alternatively with small lateral shifts, either mechanically or manually as directed by the Engineer-in-Charge.

While concreting the adjacent bays, care shall be taken to ensure that the edges of the previously laid bays are not broken by carelessness or hand tamping. Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete and whole surface is again levelled. When the layer is made even, the surface shall be completed by ramming or beating and then screed to a uniform line and level. Before the initial set commences, the surface shall be trowelled to smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly or empty gunny bags spread over the surface of the concrete to absorb excess water coming on top due to floating.

16.1.5. Finishing the Surface : After the concrete has been fully compacted, it shall be finished by trowelling or floating. Finishing operations shall start shortly after the compaction of concrete and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled intermittently at intervals for several times so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon the care with which trowelling is carried out. The object of trowelling is to produce as hard and close knit a surface as possible. The time interval allowed between successive trowelling is very important. Immediately after laying only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to work a layer rich in cement to the surface, some time. After the first trowelling, the duration depending upon the temperature, atmospheric conditions and the rate of setting of cement used, the surface shall be retrowelled many times at intervals to close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowelled back into the topping). The final trowelling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface. Trowelling of rich mix of dry cement and fine aggregate on to the surface shall not be permitted. Trowel marks should not be seen on the finished surface.

Where broom finish is specified, after the concrete has been thoroughly compacted, and when most of the surface water has disappeared, the surface shall be given broom finish with an approved type of brass or M.S. fiber. The broom shall be pulled gently over the surface from edge to edge in such a manner that corrugation shall be uniform in width and depth, the depth shall be not more than 1.5 mm. Brooming shall be done when the concrete is in such a condition that the surface will not be torn or unduly roughened

by the operation. Coarse or long bristles which cause irregularities or deep corrugation shall be trimmed out. Brooms which are worn or otherwise unsatisfactory shall be discarded.

After the concrete in the bays has set, the joints of the panels should be filled with cement cream and neatly floated smooth or jointed. Care should be taken that just the minimum quantity of cream for joint is used and excess spilling over the already finished surface shall be removed when the cream is still green.

In case of wide joints the same shall be filled with pigmented cement concrete (1:2:4) using approved pigment and the joint shall be finished in perfectly straight line.

16.1.6. Steel Trowel Finish : Areas where Marbled tiles are proposed to be used are required to have base concrete finished smooth by steel trowel.

16.1.7. Curing : The completed flooring shall be protected from sun, wind and rain for the first two days and movement of persons over the floor is prohibited during this period. The finished surface shall be covered and cured continuously from the next day after finishing, at least for a period of 7 days. Bunding with murrum for curing is prohibited as it will leave permanent stain on the finished floor.

Curing shall be done by spreading sand and kept damp throughout the curing period of seven days minimum. The surface shall be protected from any damage to it whatsoever. The surface shall then be allowed to dry slowly. All corners, junctions of floor with plastered wall surface shall be rounded off when required at no extra cost.

16.1.8. Mode of Measurement : The rate for flooring and skirting shall be in square metre of the area covered.

The length and width of the flooring shall be measured net between the faces of skirting or dado or plastered faces of walls which is the proudest.

All openings in flooring exceeding 0.1 sqm. in area where flooring is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment.

Nothing extra shall be paid for laying the floor at different levels in the same room.

The dimensions shall be measured upto two places of decimals of a metre and area worked out upto two places of decimal of a square metre.

* * * *

17. IRONITE (OR HARDONATE) FLOORING.

17.1. GENERAL :

To withstand heavy wear and tear, concrete flooring with metallic concrete hardening compound such as Ironite/ hardonate shall be laid as wearing layer as detailed below:

17.2. METALLIC CONCRETE HARDENING COMPOUND :

The metallic compound shall be Ironite/ Hardonate of approved quality consisting of uniformly graded iron particles, free from non-ferrous metal particles, oil, grease and soluble alkaline compound.

17.3. CEMENT CONCRETE UNDER LAYER :

Cement concrete flooring of specified thickness and mix shall be laid as specified and generally conforming to specifications laid down for cement concrete flooring. The top surface shall be roughened with brushes while the concrete is still green and the form shall be kept projecting up 12 mm. over the concrete surfaces, to receive the metallic hardening compound topping.

17.4. METALLIC CONCRETE HARDENER TOPPING :

This shall consist of 12mm. thick layer of mix 1:2 (1 part of cement mixed with hardener: 2 parts of stone aggregate of 6 mm. nominal size by volume). The metallic concrete hardener compound being mixed with cement in the ratio of 1:4 (1 metallic concrete hardener: 4 cement used by weight) or as specified by the manufacturer. Concrete hardener shall be dry mixed thoroughly with cement on a clean dry pucca platform. This dry mixture shall then mixed with stone aggregate 6mm. nominal size or as otherwise specified in the ratio of 1:2 (1 cement mixed with hardener: 2 stone aggregate) by volume, and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete, water cement ratio not exceeding 0.4.

The mixture so obtained shall be laid in 12mm. thickness, on cement concrete floor within 1 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. The concrete shall be compacted well mechanically. Manual compaction will not be permitted unless approved by the Engineer-in-charge. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

17.5. CURING, PRECAUTIONS, MEASUREMENTS ETC. :

Specifications for curing, precautions, quantity measurements etc. shall be same as specified for cement concrete flooring.

* * * *

18. CEMENT CONCRETE FLOORING WITH RED OXIDE TOPPING :

18.1. GENERAL :

Red oxide of iron when used, gives an improved appearance to concrete flooring. The specifications shall be as under.

18.2. RED OXIDE OF IRON :

Red oxide powder as the name indicates is a fine powder of iron oxide, red in colour normally available in market shall be obtained in adequate quantity and stores in clean dry place.

18.3. PREPARATION OF BASE :

The specifications for cement concrete flooring (I.P.S.) shall be followed for this work also.

18.4. UNDER LAYERS :

The under layer of flooring of specified thickness shall be of cement concrete 1:2:4 mix using 10mm. maximum size coarse aggregate. The dividing strips of aluminium or glass if required to be retained shall not be removed and kept in position properly. After the consolidation is over, the top surface shall be left rough by drawing diagonal lines 2 mm. deep at 75 mm. centres both ways.

18.5. TOP LAYER :

18.5.1. Mortar: The top layer shall consist of uniform and smooth layer of specified thickness and of mix 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement. The cement shall be mixed dry with red oxide powder in the proportion of 3.5 kg. of red oxide to 50kg. (1 bag) of cement. This mixture shall be used in both the cases i.e. for mixing mortar for top layer and also for floating coat. Full quantity of materials required for one room shall be mixed and kept ready to ensure uniform colour. Net mortar shall be prepared in usual manner.

18.5.2. Laying of Top Layer: The top plaster shall be done the following day after the under layer is laid. The plaster shall be done to specified thickness (normally 10 mm.) and finished smooth with cement and red oxide slurry at 2.2 kg. of cement red oxide mix per sqm. The surface shall be polished smooth with polishing stones.

Alternate panels shall then be taken in hand for laying under layers, top layers as process repeated. Rounding at the junction with the wall shall be done, if required, to a radius of 25 mm.

18.6. CURING: Similar to Cement concrete flooring (IPS)..

18.7. MODE OF MEASUREMENT: Similar to Cement concrete flooring (IPS).

* * * *

GENERAL NOTE FOR ALL TILING WORKS:

Where the size of flooring files and height of risers, skirting or dado does not admit full size of other finished size tiles, the tile(s) are to be cut / sawn to the required size and nothing extra shall be paid for the same.

18.8. TERRAZZO / CEMENT TILE SKIRTING :

Terrazzo tile in skirting shall be of size as specified in schedule of quantities or as directed by the Engineer-in-charge, hydraulically pressed and shall be obtained from the same source as for the terrazzo/ cement tiles for flooring. The design and shade of the skirting tiles shall be exactly similar to that of flooring tiles. The specifications for materials and workmanship shall be same as for flooring except that the skirting tile shall be laid against a 12 mm. thick backing of cement mortar 1:3 to the full height of skirting, thus allowing uniform projection beyond the plastered surfaces. In case of dado, the back of tiles shall be buttered with a coat of grey cement slurry/paste and edges with grey or white cement slurry/paste as the case may be, with or without pigment to match the shade of tiles and set in the backing/bedding mortar. Any cutting of brick work, concrete etc. required due to unevenness of brick surface shall be carried out at no extra cost to the Department to maintain this uniform projection beyond the plastered surfaces.

The skirting tiles shall be true in plane, line, level and plumb or in slope. The vertical lines of skirting tiles should be in line with that of flooring tile lines. The colour of the skirting tile and floor tile shall match. The undone portion of plaster work left above the terrazzo tile skirting work shall be finished round or as directed by the Engineer-in-charge in the matching plaster. The item of plastering shall be inclusive of this plaster finishing above the skirting tiles, required to be done after laying of skirting tiles. No additional payment will be admissible for this extra operation.

18.9. SAMPLING AND TEST:

Tiles required for carrying out tests described below shall be taken by "random sampling". Each tile samples shall be marked to identify the consignment from which it was selected. Minimum quantity of tiles for carrying out the test and frequency of test shall be as per IS : 13801. Cost of these tests shall be borne by the contractor.

Mandatory Tests	No. of Samples	Results
a) For conformity to requirements of shape and dimensions. wearing	12 tiles	Concavity & Convexity shall not exceed 1 mm. Perpendicularity shall not exceed 2% of the length of edge.

b) For wet transverse strength test	6 tiles	Strength shall not be less than 30 kgf/cm ²
c) For resistance to wear test	6 tiles	Average wear shall not exceed 3.50 mm and wear on individual specimen shall not exceed 4 mm.
d) For water absorption test	6 tiles	Shall not be more than 10%

18.10. MODE OF MEASUREMENT :

The length and / or width of the flooring / skirting / dado shall be measured net between the faces of skirting or dado or plaster faces of walls which is the proudest, and height of skirting / dado shall be measured from the finished level of floor. All openings exceeding 0.1 sqm. in area where tiling is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same room.

All dimensions shall be measured correct upto 2 places of decimal of a meter and area so worked out shall be correct upto two places of decimal of a sqm. for flooring, skirting, dado etc.

Note: Wastage in tile cutting to get the required dimension of rooms etc. as specified in drawing or as directed by the Engineer-in-charge shall have to be taken into consideration by contractor while quoting the rate for work to be measured as above. No extra claim on this account will be entertained.

18.11. PLAIN CEMENT TILE FLOORING & SKIRTING :

The specifications, mode of measurements etc. in respect of terrazzo tiles in flooring and skirting shall be applicable in general to plain cement tiles except that no marble chips & white cement shall be used in tile manufacture.

* * *

19. IN-SITU TERRAZZO FLOORS, SKIRTING, TREADS OF STAIRCASE, WINDOW SILLS ETC.

19.1. FLOORING :

In situ terrazzo flooring, the underlayer shall consists of cement concrete mix 1:2:4 (the maximum size of aggregate used shall not exceed 10 mm.) the thickness of which shall be as specified in item of schedule of quantities.

The terrazzo topping shall consist of white cement or grey cement wherever specified in the schedule of quantity with or without pigment and marble chips of best approved quality, shade and grade all mixed in proper proportion as provided in I.S. 2114 and/ or approved by the Engineer-in-charge. The total combined thickness of the underlayer and topping shall as provided in the I.S. Specification and as specified and approved by the Engineer-in-Charge.

The floor surface shall be thoroughly cleaned of all dirt, dust, laitance and loose material, thoroughly wet with water and then smeared with cement slurry. Cement concrete under layer immediately be laid in regular bays not exceeding 1.5 sqm. in area or as directed and allowed to harden. The surface of screed shall be well scratched whilst it is not sufficiently hard to form key for terrazzo topping. 25 x 1 .5 mm. aluminium dividing strips or 3mm. thick glass dividing strips whichever specified in the item of schedule of quantities shall be placed to form bays as directed. When the screed has sufficiently hardened but not later than 24 hours, it shall be thoroughly cleaned down, washed with water and brushed over with neat cement slurry of about the consistency of thick cream. Terrazzo top layer shall then be laid in alternative bays in plastic condition, well troweled into position. Surplus moisture and cement slurry from surface shall be removed and allowed to set sufficiently hard to stand machine or hand grinding, thoroughly cleaned to reveal surface voids, and grouted with neat cement of the same tint as used in terrazzo. When dry and hard, machine grinding with grit blocks as per specifications for terrazzo tiles shall be done with 3 to 5 days between successive grinding during which the terrazzo shall be cured and grouted with neat cement of same tint, if required. The entire surface shall then be kept wet for at least seven days. The edges of treads and window sills shall have straight edges and corners properly rounded up. In case of window sills, only top layers is covered under the relevant item and concrete base layer under RCC item. The window sills and treads of staircase shall be hand polished instead of machine polished.

Cleaning and applying oxalic acid shall be same as specified for terrazzo tile flooring.

19.2. IN-SITU SKIRTING & DADO ETC. :

In situ skirting and dado shall be as specified in the schedule of finishes.

The surface shall be prepared as per plastering work where required by the architects, the dado or skirting shall be sectionalised as for in situ floor. If shown and required, the junction of the floor and dado shall be rounded to a proper, neat and uniform round to the satisfaction of the Engineer-in-charge. After the work is complete, the surface shall be kept continuously wet for 7 days. Unless otherwise specified, skirting and dado shall match the floor.

Terrazzo skirting and dado shall consist of under coat of 1:4 cement- sand plaster of the thickness specified. This shall be laid simultaneously with the borders of the flooring and same joints as in the floor shall continue. The topping shall be terrazzo as per specifications for in-situ terrazzo flooring except that in-situ polishing shall be done by hand to the satisfaction of Engineer-in-charge. 1 .5 mm. thick aluminium strip joint (wherever mentioned 3mm. glass strips shall be fixed) shall be provided in situ terrazzo in both direction or as directed. Care shall be taken to see that the terrazzo in skirting and dado matches the floors. The dado work in columns shall be done in one operation for the full height of the column. The shape of the finished surface shall be uniform for all such columns treated and checked for its accuracy during the progress of work.

19.3. MODE OF MEASUREMENT :

Mode of measurement for cast-in-situ terrazzo flooring and dado shall be same as per terrazzo tile flooring and skirting.

The rate shall include all materials, curing, rounding of junctions, labour, scaffoldings etc..

* * *

20. KOTAH STONE FLOORING/ SKIRTING/ FACIA / SHELVES :

20.1 MATERIALS : . The stone shall be hard, sound, durable, homogeneous in texture and resistant to wear. These shall be without any soft veins, cracks or flaws and shall have uniform colour. They shall have natural surface free from broken flakes on top. Hand cut/ machine cut for exposed edges and machine polished. Kotah stone shall be of the best quality and of the specified thickness, size and the shade, which shall be got approved by the Engineer-in-charge.

The slabs / tiles shall be rectangular or square in shape or as per pattern shown in drawing and as directed by the Engineer-in-charge. The sizes given in schedule of quantities are tentative and can vary only slightly as per the availability in the market. The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the item. Tolerance of (+/-) 2 mm shall be allowed for the thickness. In respect of length & width, tolerance in length & width shall be permissible upto (+/-) 5 mm for hand cut slabs & (+/-) 2 mm for machine cut slabs. At its thinnest, no stone shall be thinner than the specified thickness.

Uniformity of size and colour / shade shall generally be maintained for the stones used in any one room. The exposed surface shall be machine polished to a smooth, even and true plane and the edges hand cut and dressed true and squares. The evenness of the surface of slabs and edges of the slab shall not be marred by careless dressing or handling and no patching up shall be allowed for the slab. The edges shall be quite straight. The under face may be left as required or rough dressed. Before taking up the work, samples of stone slabs to be used and their dressing and polishing shall be got approved by the Engineer-in-charge and kept in his office as approved sample and the stone slabs to be used shall conform to the same.

20.1 BEDDING/ BACKING COAT : In case of flooring / skirting / dado, the mortar bedding / backing shall be of cement mortar of thickness and mix specified in the schedule of work.

1. **CEMENT MORTAR:** Cement mortar bedding shall be as specified under relevant specification for terrazzo / plain cement tile flooring.
2. **CONSTRUCTION DETAILS:** Cement mortar as specified for bedding shall be uniformly mixed. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, the sub-floor or base shall be cleaned of all dirt, set mortar scum or laitance and of loose materials by hacking and brought to original levels and then well wetted without forming pool of water on surfaces.

3. **FIXING THE STONE SLAB/ TILE** : Before laying, the stone shall be thoroughly wetted with clean water, neat cement grout (2.75 kg/ sqm.) of honey like consistency shall be spread on the mortar bed over as much areas as could be covered with the slabs within half an hour. The specified type of stone shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each stone shall be gently tapped with wooden mallet till it is firmly and properly bedded.

There shall be no hollows left. If there is a hollow sound on gently tapping off the slab, such slab shall be removed and reset properly. The joints shall be grouted with matching cement slurry. Approved pigment shall be used in cement slurry to match with shade of stone. Pigment required to match the shade of stone shall be supplied by the contractor at no extra cost. The stone adjoining the wall shall go about 12mm. under the plaster, skirting or dado for the wall. All stone slabs, tiles shall be so laid as to have continuous lines from various rooms to the corridors. No change of lines shall be permitted at junction between rooms and corridors. Only one piece machine cut, Kotah stone shall be used for treads and risers, unless otherwise specified in the tender schedule..

4. **CURING** : The work shall be kept well wetted with damp sand or water for seven days.
5. **POLISHING AND CLEANING** : When the bedding and joints have completely set and attained required strength, the surface shall be machine polished to give smooth, even and true plane to the flooring. All flooring shall be thoroughly cleaned and handed over free from any mortar stains etc. Polishing shall be done as per relevant IS and IS-14223 (Specification for polished building stones).
6. **SKIRTING AND DADO/ FACIA** : The quality and type of stone shall be same as mentioned for flooring except of their height and thickness or backing coat which shall be as mentioned in item schedule. The backing shall conform to the specifications for cement mortar specified for item of terrazzo tiles. Contractor should take into consideration the fact that touching up of the plaster at the junction of skirting / dado is invariably done after the skirting/ dado/ facia work is completed and quote rates accordingly. Nothing extra for the same shall be entertained.

Fixing, curing, polishing and cleaning shall be as specified herein before under cement/ terrazzo tile skirting. Polishing may be done by hand, but a smooth surface and fine polishing shall be obtained. Joints shall be finished in neat matching cement slurry. The junction of plaster and the upper edges of the dado/ skirting shall be finished smoothly as directed by the Engineer-in-charge without any extra cost.

7. **MODE OF MEASUREMENTS** : Flooring, skirting and dado/ facia shall be measured same as that for terrazzo cement tile, flooring/ skirting/ dado. Unless otherwise specified, shelves shall be paid on area basis in sqm. calculated to two places of decimal, where length and breadth shall be measured inclusive of bearings correct to a cm. The permissible tolerance in the specified thickness shall be (+/-) 2 mm.

Note : Wastage in obtaining the required machine cut, hand cut sizes as specified from the

commercial sizes available in market shall be taken into consideration by contractor while quoting the rate for work and no extra claim on this account shall be entertained.

* * * *

21. WOODEN FLOORING

21.1 Seasoning and Preservation: All timber used for timber floors shall be thoroughly seasoned in accordance with IS : 1141. After seasoning, the timber shall be treated with preservative in accordance with IS : 401. Seasoning and preservative treatment shall not be paid for separately and the rate quoted for the item shall be inclusive of the same.

21.2 Supporting Joists: Main beams and joists of the class of wood sections specified in the description of the item for beams and joists, or as instructed by the Engineer-in-charge shall be fixed in position to dead levels. The width of the joints shall not be less than 50 mm. The arrangement and spacing of beams, joists etc. shall be as per design furnished.

21.3 Boards: It shall be of the class of timber and thickness specified in the description of the item. The timber shall be as specified in *preceding chapters for wood work*. Only selected boards of uniform width shall be used. Unless otherwise specified or shown in the drawings, the width of boards selected shall not be less than 100 mm nor more than 150 mm. The same width of boards shall be maintained throughout except where the width of the room is not an exact multiple of the boards. In the latter case, the difference shall be equally adjusted between the two end boards (adjacent to walls). The length of the boards shall not exceed 3 metre anywhere. Ordinarily, the minimum length of boards shall be such that the boards shall rest at least on three supports, except where otherwise required by the pattern specified in the drawings or as directed by the Engineer-in-charge.

The boards shall be planed true on the top face only unless otherwise specified in the description of the item. Where the bottom face is exposed and it is also required to be planed, then such planing shall be paid for extra. Unless otherwise described in the item, the longitudinal joints of planks shall be tongued and grooved to a minimum depth of 12 mm while the heading joints shall be of the square butt type and shall occur over the centre line of the supporting joists. Heading joints in adjacent boards shall be placed over the same joists.

21.4 Iron Screws: Iron screws shall be of the slotted counter sunk head type, of length not less than the thickness of planks plus 25 mm subject to a minimum of 40 mm, & of designation of No.9 conforming to IS :451.

21.5 Fixing: The joists on which the planks shall be fixed shall be checked and corrected to levels. The end boards shall be accurately fixed with the sides parallel and close to the walls. Each adjoining board shall be carefully joined and shall be tightened in position and screwed. For fixing the boards to the joists, two screws shall be used at each end of the boards and one screw at each of the intermediate joists in a zigzag manner. The screws shall be countersunk and screw holes filled with approved stopping.

The junction between timber flooring and adjacent flooring shall be formed by inserting a metal

strip (brass or aluminium) at the junction. The metal strip shall be fixed to the end of the planks by screws. The strips shall be paid for extra. The flooring shall be truly level and plane. The joints shall be truly parallel and or perpendicular to the walls, unless otherwise specified. The floor shall be planed in both directions and made perfectly even, true and smooth.

NOTE : No wood of any kind shall be placed within 60 cm of any fire place or flue. Provision shall be made for ventilating the space below the floor in case of ground floor and between and top of ceiling in the case of upper floors. Such arrangements shall be paid for separately.

- 21.6 **Finishing:** The surface of the floor shall be bees waxed or finished otherwise as directed by the Engineer-incharge. The lower face shall be painted or treated with wood preservative as directed. The finishing shall be paid separately unless specifically included in description of the flooring item.
- 21.7 **Measurements:** Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in sqm correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm.
- 21.8 **Rate:** The rate shall include the cost of labour and materials involved in all the operations described above, with the exceptions noted in the relevant sub paras.

* * *

22. WOOD WORK IN FRAMES, SHUTTERS AND PANELLING :

22.2 WOOD WORK :

All timber mentioned in the item in schedule of quantities shall be from the heart of a sound tree of nature growth entirely free from sap wood. It shall be uniform in texture, straight in fiber and shall be well and properly seasoned. It will be free from large, loose, dead or cluster knots, wedges, injuries, open shakes, borer holes, rot, decay date, discoloration, soft or spongy spot, hollow pockets, pith or centre bore and all other defects or any other damages of harmful nature which will affect the strength, durability, appearance and its usefulness for the purpose for which it is required. Only properly seasoned timber shall be used.

i. ROLLER BLINDS -

Providing and fixing Galeecha/ Hunter Douglas or approved equivalent make vertical blinds of approved shade. The blinds to be fixed and commissioned as per manufactures specification. Roller should be fixed horizontal in proper level. Two blinds should be overlapped to each other by 150mm. The work is to be completed as per satisfaction & approval of the EIC/ Architect.

23. ROLLER MECHANISM-

Installation –

Brackets shall be of ionized steel powder coated to give superior finish. Bracket shall accommodate overhead, side or face mounting with clutch assembly on either end of roller.

Roller Tube -

Roller tube shall be of extruded Aluminium alloy 32 mm O.D. with a minimum wall thickness of 1.0 mm duly anodized for long life.

Clutch-

Clutch shall be of warp spring design with high strength fiberglass reinforced polyester assembly and high carbon steel springs to transmit motion from driving to driven members of clutch mechanism. Clutch shall operate by directionally with the use of an endless beaded chain. Clutch mechanism shall be crash proof, prevent slippage and shall raise and lower smoothly to any desired height. Clutch shall never need adjustment.

Idler-

Idler shall be of high strength fiberglass reinforced polyester, consisting of an outside sleeve and center shaft. Sleeve shall provide bearing surface for roller tube and rotate freely on center shaft, providing smooth, quiet and long wearing operation.

Bottom Weight -

Bottom of the blind shall be provided with Aluminium tube powder coated in a colour matching to the fabric. The fabric shall be enclosed in the suitably created pocket along with the tube. The tube shall be closed from side with end caps to give a neat look.

Technical specifications –

Black out Roller Blinds Fabric-

- 1) Composition : PVC/ Glass Fiber
- 2) Weight : 470G/SQM
- 3) Thickness : 0.034 mm
- 4) Maximum Width : 27 meter
- 5) Moisture Resistance : Yes
- 6) Flame Retardant : CCC- C- 521E & NFPA No. 701
- 7) Cleaning- Easy to Maintain : Cleanable With Mild Detergent Water

Sunscreen Roller Blinds Fabric-

- 1) Standard Width : 63" and 98" (160.0cm and 248.9cm); 126" (320cm)
- 2) Standard Roll Length : 30 Linear Yards (27.4m)
- 3) Composition : 35% Fiberglass, 65% Vinyl on Fiberglass
- 4) Mesh Weight : 11.8 oz/yd² (403g/m²)
- 5) Fabric Thickness : 0.017 in (0.43mm)
- 6) Openness Factor : Approximately 5%
- 7) Fire Classification : NFPA 101 (Class A Rating), UBC (Class I), BS 5867 2008 Part2 Type B Performance, NFPA 701 TM#2

Rate to Include-

- 1) All Labour, material, use of tools and equipment for carrying out the items as specified above.
- 2) Necessary Hardware.
- 3) Drilling, cutting, Grinding
- 4) Aluminium roller mechanism with end brackets.
- 5) Approved Fabric.

Mode of Measurement –

Area of fabric shall be measured for billing.

MASONRY

Rate shall include for provision of:

Work at all heights, depth and in all situations and to all shapes and profile and all necessary works like staging, ladders, platforms, double staging etc. all are required for proper execution of works.

Hacking and roughening of concrete or other surfaces coming in contact with masonry for bondage, cutting bricks/blocks, wastage etc.

Raking out joints to specified depth either for plaster or pointing or finishing the joints flushes as the work proceeds, all as directed.

Bedding and pointing wall-plaster, lintels, sills etc. in or on walls, bedding and pointing doors, windows and like in cement mortar.

Making openings for pipes, conduits, ducts etc. and closing the same after completion of such works and finishing as directed.

Providing at exact locations and to exact sizes pre-designated openings.

Forming chases for edges for concrete floors or other units, for scaling in of waterproofing layers, etc.

Providing cement concrete blocks (1:2:4) at doorjambes where required to receive expansion bolts/holdfasts etc.

Building in holdfasts and or inserts, supplied by the engineer.

Keeping the work well wetted for 10 days.

Bricks/blocks to be wetted before use.

Bailing out, pumping out or otherwise removing all water, which may accumulate from all causes.

Sampling and testing of any other material during the course of work as and when directed.

PLASTER

Rates shall include for provision of:

Work at all levels, heights and to all situations and profiles.

Double scaffolding, working platforms etc.

A coat of neeru plaster soon after the curing period is over.

Work in narrow widths and small quantities unless special provision is made to the contrary.

Preparation to the surfaces by raking out joints in brick or by hacking the concrete surface and wetting the surface before plastering wherever required.

Thickness of plaster exclusive of the thickness of key i.e. grooves and open joints in brickwork, stone work etc.

Chamfers of any width, internal and external rounded angles and chases and forming sharp and clean

edges as shown.

Curing, protection and cleaning of all surfaces.

Keeping all plastered surfaces well wetted for at least 7 days.

PAINTING AND POLISHING

The rates shall include for provision of:

Works at all heights and use of all scaffolding quantities, ladders, cradles etc. necessary for execution work and for inspection.

Preparing surfaces to receive finishing coats, such as brushing to remove all extraneous materials and fungus growth, if any, preparing, scraping, washing and rubbing etc.

Puttying, sand papering and dusting of surfaces in between coats where applicable.

Work on cornices, narrow bands and widths, recesses grooves etc.

Finishing to approved matt texture and/or stipple finish etc. complete as directed.

Spreading and removing, covering to doors window. Floors, fittings, ducts, pipes etc. to protect them from splashes

Washing floors, cleaning glass, joinery, electrical fittings, ducts. Pipes etc. of drops and splashes and leaving premises clean and tidy.

FLOORING, DADO, SKIRTING AND WALL FINISHES

The rates shall include for provision of:

Use and waste of all temporary fillets, side-forms, templates, moulds, straight edges etc.

Washing of coarse and fine aggregates, wherever required by the consultants.

Final preparation of the base, sub-grade or sub-floor including minor trimming of the base to remove slight undulations if necessary.

Cleaning and watering the surfaces immediately before laying the floor.

Providing bedding layer of mortar as specified, in case of slabs, tiles etc. to correct levels of slopes as called for.

Cutting, rubbing and polishing surfaces and edges where applicable.

Rounding off corners, edges and junctions of floors with skirting or dado and also cutting recesses where required to accommodate recessed skirting.

Forming rounded recess in floor where called for.

Providing grooves where shown on drawings.

Work in narrow widths, bands, cornices, and strips and to profiles shown at all heights, levels, and locations and in small quantities, unless otherwise mentioned.

Curing, protecting and cleaning all finished surfaces as specified.

Work on any surface such as bricks, concrete, stone etc.

Providing grooves at the junction of plaster with other finishes as called for.

Scoring surfaces of plaster for key where the surface is not required to be finished fair.

All samples of finishing materials shall be got approved prior to use.

Keeping the work well wet for at least 7 days.

Cutting tiles/slabs to require size/shapes providing holes etc. before laying.

Hand polishing, machine polishing, cleaning tiles with acid.

All marble work e.g. flooring, cladding, skirting, dado etc. shall have white cement based mortar in bedding and grouts.

All ceramic tiles shall be of 1st quality.

All stone flooring to be protected by POP covering with plastic base.

CARPENTRY AND JOINERY

Rate shall include for provision of:

Unless otherwise specified, the quoted rates shall be for all joinery work with approved Indian Teakwood, Steam beech wood free from all defects and kiln seasoned and preservatives treated and shall be got tested in laboratory and approved before placing or applying primer coat. The rate shall also include for applying two coats of Solignum paint to the face of frames in contact with masonry or concrete and the like.

The rate quoted shall include for fixing on masonry/RCC members and for 300 x 40 mm x 6 mm finished MS holdfasts embedded in PCC (1:2:4) blocks of 230 x 150 mm size and of width to suit the thickness of masonry wall or for anchor fasteners, coach screws etc. of adequate size for fixing to RCC members, as

Care shall be taken to thoroughly clean the hardware, fittings, glass panes, doors, etc. of the waste cement marks, left over paint marks etc.

The rate shall include for providing temporary supports etc., for fixing of frames and shutters at all levels.

The rate quoted shall be inclusive of any chiseling work, raking of sides, sills, soffits, if required and

making good the surface.

The sizes mentioned are for finished items.

Also the rate quoted shall include for:

Planing and finishing smooth all faces of various faces as required.

All screws, nails, pins, key and such other fixing accessories.

Cutting rebates, Grooves etc. in frames/shutters as required or as directed.

Approved glue or adhesive for all joinery work.

Providing seasoned Burma T.W., beech wood best quality, beading, trimmings, beads, weather bars etc. as called for. Providing rough grounds as per drawings.

Providing as per schedule/drawings all hardware, fittings and fixture like, latches, hinges, tower bolts etc. locks and other items as indicated for fixing such items supplied by the Engineer-in-charge at no extra cost.

Solignum treatment to all hidden wooden members and all board or ply faces coming in contact with masonry or concrete faces where retarding treatment is not called for.

Providing and applying pink primer to all wooden surfaces till the same are painted/polished.

Filling and finishing neat gaps around frames, doors, windows etc. with approved mastic.

Work at all heights and locations.

Wherever painting is specified it includes painting the surfaces with three coats of first quality synthetic enamel paint of approved shade and make over a coat of wood pink primer.

Wherever polishing is specified it include polishing the surfaces with two or more layers of French spirit polish, with approved additives, stainers to get even shade over a coat of primer of approved chemicals.

All plywood and blackboard edges where exposed shall be finished with teakwood Lipping.

Unless otherwise specified, all door shutters specified are to be solid core flush door shutters, with topping bonded with phenol formaldehyde and confirming to relevant Indian Standards.

METAL WORK

The rates shall include for provision of:

All steelwork shall confirm to IS-800 and rolled steel to IS-226 and IS-1977. All pressed steel sections shall be heavy duty.

Supplying all materials, fabricating, hoisting and fixing in position complete with expansion fasteners, coach screws, hold fasts, screws etc. and for RCC(1:2:4) blocks of adequate size as directed.

Glazing of windows, ventilators, doors should be as approved by Architect/Consultant.

Supplying and fixing all hardware of specified and approved type and make, confirming to standard practices followed by approved manufacturer.

Door, windows, rolling shutters, fire doors shall be fabricated by approved manufacturer.

Member's joints shall be mechanically cut to length mitred and electrically welded with true corners.

Providing Silicon sealant in gaps between frames and masonry/concrete faces after erection.

Painting with a coat of zinc chromate's primer and three coats of synthetic enamel paint of approved make including supplying putty to obtain even and smooth finish.

Before fabrication, the contractor must take approval of the Architect/Consultant for type of sections, hardware, glass etc. to be utilized. He should take actual measurements at site and fabrication shall be done accordingly.

Providing necessary coupling, transoms and mullions wherever required as per relevant I.S. code (I.S. 1038).

WATER PROOFING OF WC AND BATH AREA

General :

The water proofing treatment for the Bath and W.C. shall be essentially of cement based water proofing treatment with admixture of proprietary water proofing compound similar to M/s India Water Proofing Company's treatment or any other equivalent approved cement based water proofing treatment. The waterproofing treatment shall consist of providing cement slurry mixed with proprietary water proofing compound after preparation of surfaces, providing water proofing treatment etc.

The following specification shall be followed unless otherwise stated in schedule of quantities : This shall be 15 mm. thick plaster including an under coat not exceeding 8 mm. thick. Approved water proofing compound like CICO No. 1 or other approved equivalent shall be added @ 3% by weight of cement in cement mortar or as per manufacturers specifications in both the coats. The workmanship and material shall be same as described in plaster work in general. All exposed surfaces shall be finished smooth with a coat of neat cement as directed, except areas where tiling work is to be done, where the plaster shall be left rough / float finish..

Finishing :

The surface of the exposed plaster shall be finished smooth with neat cement. The plaster surface where tiling is to be provided as well as brick bat coba filling where flooring to be provided, shall be finished to proper line, level, plane and plumb to receive the floor/dado finish. Curing of the waterproofing treatment shall be carried out for 14 days.

Testing and Guarantee:

The contractor shall test the surface where waterproofing treatment is provided for the bone dry condition by filling with water inside the depressed plastered portion. No wet patches or leaks shall appear on the surrounding plastered walls or at the underside of the slabs. The testing shall be carried out to the entire satisfaction of the Engineer.

The contractor shall furnish guarantee in the proforma for the waterproofing treatment for maintaining the underside of the waterproofed surface in bone dry condition for a period of minimum ten years. During this period, contractor shall attend to all leakages, defects etc. If noticed, free for cost, starting his work of checking up and rectification within a weeks time from the date of receipt of information about such leakages etc. by him. The contractor shall submit the guarantee bond appropriate stamp

paper and as per the enclosed proforma.

Mode of measurement :

1. Waterproof plaster shall be computed by taking the length and breadth of the area actually plastered corrected upto two decimal places of a metre. No deduction shall be made for W.C. pans, pipes etc. in the measurement.
2. The filling with waterproof brick bat coba shall be computed by noting the levels and dimensions of the filled up depression before and after the filling, upto two decimal places of a metre and also no deductions shall be made for W.C. pans, pipes etc.

Waterproofing work shall be guaranteed for a period of 10 years from the date of handing over completed building work in Performa approved by the Engineer on a stamp paper, where the work is carried out by an approved proprietary agency and according to their specifications, the guarantee shall be executed by the proprietary firm and submitted directly to the owner

The rates shall include for:

- All necessary labour, materials, tools and equipments for the satisfactory completion of the job.
- Preparing the surfaces and providing fillets.
- Treating down take pipes, floor traps or any other inserts etc. that may cause leakage.
- Work in narrow widths and all locations/situations as called for.
- Work at all heights and depths.
- Keeping the works well wet for at least 7 days.
- Laying to correct slope and level as shown on drawing.
- Protecting waterproof layer over which other materials, fittings, fixtures are to be laid/installed and to prevent damage from other construction operations.
- The waterproofed surface shall be bone dry and there shall not be any moisture or wet patches.
- The contractor to supply full details, with the bid of waterproofing he proposes to adopt for various item.
- Measurements shall be on the basis of finished dimensions.
- Bailing out, pumping out or otherwise removing all water, which may accumulate from all causes.

FALSE CEILING

Introduction:

Providing and fixing in position 12.5 mm thick gypsum board false ceiling for dry areas or 12.5 mm thick calcium silicate board false ceiling for wet areas. Screw fixed to the underside or suspended from the main true ceiling as per manufacturer's instructions and specifications.

Method:

G. I. Grid should consist of 80 mm ceiling sections (0.5 mm thick, 26mm width made of G.I. steel) at maximum distance of 457 mm c/c. 20mm Perimeter channel (0.5 mm thick having one flange of 27mm and another flange of 30mm made of G.I. Steel). The ceiling section should be fixed to 45mm intermediate channels (0.91mm thick having equal flanges of 15mm made of G.I. steel) at maximum distance of 1220mm c/c with connection clips. G. I. Grid should be fixed to R.C.C. slab above with the help of 25mm ceiling angle (0.5mm thick and 10mm width made of G.I. steel) & soffit cleat. The joints between soffit cleat, ceiling angles and G.I. grid should be fixed with 6.4X12.7mm nut bolts. Soffit cleats

should be fixed to R.C.C. ceiling with W.E. type 12mm dia. 3" long steel rawl plug and fastener maximum c/c distance (both ways) of strap hangers should be 1200mm.

Finishing:

The board should be 12.5mm thick tapered edge screw fixed to the ceiling sections. The board should be taped and filled from underside to give smooth, seamless ceiling to be complete as per manufacturer's specification & instructions. It should include necessary channel ceiling sections & intermediate channel opening for light fixtures, AC duct opening to provide linear grill(as per drawing), vertical drops offset and cutout for spotlights with GI frame out to out of fittings. The item shall include all grooves, kanis, pattas etc. complete

Trap doors, modular trap doors, pelments :

Wooden or modular aluminum trap doors and wooden pelmet to be provided as per detail specification in the BOQ, in line and level. Trap doors to be flushed with the ceiling, finished with approved matching color paint as rest of the ceiling with all edges properly grooved and leveled with the false ceiling. Including scaffolding, ladders, etc.

The rates shall include for:

- All necessary labour, materials and use of tools and equipments for the satisfactory completion of the job.
- Work at all heights.
- Work in narrow widths and all locations as called for and working to specified patterns and profiles.
- Carrying out work to correct line and level.
- Providing necessary cutouts and framework for lights, fittings, AC grills, trap doors, sprinkler heads, smoke detectors and similar including supports from ceiling where directed for these.
- No deductions for openings less than 0.1 sqm. in area.
- Necessary precautions to prevent damage to the flooring and other works.

SPECIFICATIONS GENERAL

These specifications are for work to be done, items to be supplied and materials to be used in the works as shown and defined on the drawings and described herein all under supervision and to the entire satisfaction of the Architect/Consultant & owner.

The workmanship is to be the best available and of a very high standard, use must be made of specialist tradesmen in all types of work and necessary allowance must be made for the same in the rates quoted.

The materials and items to be provided by the contractor shall be the best of their respective kinds as specified in the tender and in accordance with the samples approved, where materials or products are specified in these specifications and/or Bill of Quantities by the name of the manufacturer of the brand name, trade name or catalogue reference, the contractor will require to obtain prior approval of the Architect/Consultant and owner for using substitute material or product. The contractor shall produce all

invoices, vouchers or receipted accounts for any materials if called upon to do so by the Architect/Consultant and owner.

Samples of all materials are to be submitted to the Architect/Consultant/owner for his approval before the contractor orders or delivers in bulk in the site. Samples together with their packing are to be provided by the Contractor free of charge and approved samples will be retained by the owner and designer for comparison with the materials which will be delivered to the site.

Should any materials be rejected by the Architect/Consultant/owner, they will be removed from the site at the Contractor's expense. Also the contractor will be required to submit specimen finishes of colours, fabrics, etc. for approval of Architect/Consultants/ owner before proceeding with the works. Should it be necessary to prepare shop drawings, and then four copies of such drawings shall be submitted for approval of the Architect/Consultant who will retain two copies, all at the Contractor's expenses.

Timber generally is to be the best of its kind, well and properly seasoned, of natural growth, free from work holes, large loose or dead knots or other defects and sawn die square and not to suffer from warping, splitting or other defects through handling.

The hardwood is to be Hollock or red maranti with moisture contents not more than 20%.

Teak is to be the best quality from Dandeli free from soft heart, worm and bee holes, and weighing not less than 50 lbs. per cubic foot with maximum moisture contents of 12%. Teak veneers and flitches shall match each other throughout and, where possible, shall match existing flitches in the building.

The particleboard shall be of high density, equal or superior quality to that laid in the I.S. 3478 and as approved by the Architect/Consultant.

The blackboard shall be of Mysore, Anchor or P.G.Brand, one of the following I.S. Specification or such approved adhesives shall be used: -

I.S. 851 - 1957: Synthetic Resin adhesive for construction work in wood.

I.S. 849 - 1957: Cold setting case in glue for wood. where glued joinery and carpentry work is likely to come into contact with moisture, the glue shall be waterproof. The use of animal glues will not be permitted.

Flush doors of hollow framed core insulated construction shall be constructed with 4" wide stiles, top and bottom rail, one 4" wide horizontal intermediate rail and two 4" wide diagonal braces, filled in solid with approved rigid type polyurethane doors shall be constructed with one 3" wide and one 5" wide stile, 4" wide top and bottom rail, one 4" wide horizontal intermediate rail and 2" wide diagonal braces; filled in as described before.

Flush doors of hollow framed core construction shall be constructed with 3" wide stiles and top rails, 5" wide bottom rail, two 6" wide horizontal intermediate rails with beehive core of 1" wide filling pieces at 4" centers both ways and blocked out as necessary for lock and hinges. All horizontal members shall have 1/4 dia. borings.

All doors shall consist of selected hardwood properly jointed together and they shall be covered on both sides with 3/16" teak veneered plywood or as specified. Each door is to be lipped all around with 1/2" teak twice-rebated edging tongued to the stiles and rails and mitered. The doors are to be the full

thickness as specified. The lipping on the meeting stiles of folding doors shall be increased to take the rebate as specified.

Frames to doors, windows, etc. shall be of hardwood or teak as specified and to the required sizes with all necessary mouldings with mortise and tennon joint, lead and teak pins and secured in position as specified.

Shelves generally shall be constructed of plywood with edgings of 1" teak tongued on.

Timber is to be cut to the required sizes and length as soon as practicable after the works are begun and stored under cover so that the air will circulate freely around it. Joinery is to be prepared immediately after the finalisation of the contract, framed up (but not boned) and stored until required for fixing in position, when it is to be bonded and wedged up. Any portion that warps or develop shakes or other defects are to be replaced before wedging up. The whole work is to be framed and finished in a proper workman like manner, in accordance with the detailed drawings, and fitted with all necessary metal ties, straps, bolts, screws, etc.

Turning bonded joints are to be cross-tongued with teak tongues and where over 1/2" thick, to be double cross tongued. Joiner's work generally is to be finished with fine sand papered surfaces unless otherwise specified.

Templates, boxes and moulds shall be accurately set out and rigidly constructed so as to remain accurate during the time they are in use.

Grounds are to be clean sawn, free from large knots, splayed as required and plugged and fixed to walls, etc. at 1'-6" centers unless otherwise specified.

Wood plugs are to be cut on the twist. Patent wall plugs or plastic fillings may be used in lieu of wood plugs with the prior approval of the Architect/Consultant.

All unexpected surfaces of timber, e.g. false ceilings, backing fillets, backs of door frames, cupboard framing, grounds, etc. are to be treated with two coats of Atlas 'A' or other equal and approved timber preservative before fixing or bedding

The service stations, bar counters, shelving, etc. shall be generally constructed of plywood as described and specified properly housed, grooved tongued, glued, blocked and screwed together and entirely to the satisfaction of the Architect/Consultant.

The banquettes, chairs, tables, etc. shall be generally constructed of teak, foam rubber and fabric as described and specified, properly housed, grooved, tennoned, tongued, glued, blocked and screwed together in the manner of good quality furniture and entirely to the satisfaction of the Architect/Consultant & owner. A prototype sample of all custom made pieces must be prepared and submitted to the Architect/Consultant for his owner's approval before proceeding with the work in quantity.

HARDWARE & METAL:

The hardware throughout shall be of approved manufacture and supply, well made and equal in every respect to the approved samples to be deposited with the owner and Architect/Consultant. For the purpose of approval of samples, the contractor may be required to produce and provide to the

Architect/Consultant, samples from many different sources and should allow in his rates for the same.

Fittings generally shall have satin chrome or anodised finish unless otherwise stated and shall be suitable for their intended purpose of use.

Screws are to match the finish of the article to be fixed and to be round or flat headed or counter sunk as required.

The bronze and brass surfaces shall be covered with thick grease or other suitable protective material renew as necessary and subsequently clean off and clear away on completion.

Aluminium and stainless steel shall be of approved manufacture and suitable for its particular application Generally, the surfaces of all aluminium shall have an anodised finish and the quality and finish both shall comply with the samples approved by the Architect/Consultant & owner.

All steel, brass, bronze, aluminium and stainless steel articles shall be submitted for test for strength, if so, required by the Architect/Consultant & owner, at the contractor's expenses.

All brazing and welds are to be executed in a clean and smooth manner, rubbed down and left in the flattest and tidiest way, particularly where exposed.

Chromium plating shall be in accordance with B.S. 1224 or as per approved specifications for "normal outdoor conditions", and shall be on a base material of copper or brass.

FIBRE GLASS

The fiberglass decorative panels shall be constructed or 30% glass fibre chopped strand mat reinforced with 70% polyester resin; the fibreglass and resin to be either pigmented or sprayed with and fired with tarred paint. The panels shall be made in moulds to the approved design as per drawings and to the thickness required by the Architect/Consultant. The fibreglass panels are also obtainable from the approved suppliers.

GLAZING

All glass to be approved manufacture complying with is: 3548-1966, or as per approved quality and sample, to be of the quality specified and free from bubbles, smoke wanes, air holes and other defects.

The compound for glazing to metal is to be a special non-hardening compound manufactured for the purpose and of a brand and quality approved by the Architect/Consultant & owner.

In cutting glass, proper allowance shall be made for expansion each square of glazing to be in whole sheet. On completion, clean all glass inside and out, replace all cracked, scratched or broken panes and leave in good condition to the satisfaction of the Architect/Consultant & owner.

PAINT & POLISHING

All materials required for the works shall be of specified and approved manufacture, delivered to the site in the manufacture's containers with the seals, etc. unbroken and clearly marked with manufacturer's name or trade-mark with a description of the contents and colour. All materials are to be stored on the site of the works.

Spray painting with approved machines will be permitted only if prior written approval has been obtained from the Architect/Consultant. No spraying will be permitted in the case of priming neither coats nor where the soiling of adjacent surface is likely to occur. The nozzle and pressure to be so operated as to give an even coating throughout to the satisfaction of the Architect/Consultant. The paint used for spraying is to comply generally with the specification concerned which is to be specifically prepared by the manufacturer for spraying. Thinning of paint made for brushing will not be allowed.

Wood preservation shall be Solignum or other equal and approved impregnating wood preservative, and all concealed woodwork shall be so treated.

All brushes, tools, pots, kettles, etc. used in carrying out the work shall be clean and free from foreign matter, and are to be thoroughly cleaned out before being used with a different type of class of material.

All iron or steel surfaces shall be thoroughly scrapped and rubbed down with wire brushes and shall be entirely free from rust, mill scale, etc. before applying the priming coat.

Surfaces of new woodwork, which are to be painted, are to be rubbed down, knotted and stopped to the approval of the Architect/Consultant & owner.

Surfaces of previously painted woodwork which are to be repainted shall be cleaned with soap and water, detergent solution or approved solvent to remove dirt, grease, etc. whilst wet the surfaces shall be flatted down with a suitable abrasive and then rinsed down and allowed to dry. Minor areas of defective paint shall be removed by scrapping back to a firm edge and the exposed surface touched in with primer as described and stopped with putty. Where woodwork has been previously painted or polished and is to be newly polished, the same shall be prepared with scrapping, burning off or rubbing down.

Surfaces of previously painted metal which are to be repainted shall be cleaned down and flatted down as described in surfaces of previously painted woodwork. Minor areas of defective paint and any rust and loose scale shall be removed completely by chipping, scrapping and wire brushing back to the bare metal and touched in with primer as described.

PLASTER

Cement/lime plaster for internal surfaces shall be applied in two coats, as follows:

Undercoat 3/8" thick composed of 1 part cement, 4 parts lime putty, 12 parts clean washed sand, measured by volume, the whole laid evenly, straightened with a rule and scratched to form key.

Finishing coat 3/8" thick composed of 1 part cement, 3 parts lime putty, 6 parts clean washed sand, measured by volume, trowelled with a steel trowel to a smooth or textured finish in accordance with samples approved by the Architect/Consultant.

A minimum period of 7 days must elapse between the application of undercoat and finishing coat. The total thickness of the plaster must not exceed 3/4".

Rough rendering shall be composed of cement and sand (1:4) floated to the thickness required to fill in voids behind facings, dubbing out to uneven surfaces, etc. Dubbing out must not under any circumstance exceed 1" in thickness at any point.

Screeds and backings shall be composed of cement and granite fine or sand (1:3) and shall be properly laid to rules and floated to a surface suitable to receive the finishings specified.

Mixing of lime/cement plaster, cement rendering and screeds shall be carried out with machine driven roller-pan mixers of a type and size approved by the Architect/Consultant. For smaller quantities, or in exceptional circumstances, the Architect/Consultant may require or approve mixing by hand on a clean dry floor or platform. Measurement of all constituents is to be made by means of gauge boxes. Gypsum plaster shall be of approved manufacture, delivered to the site in the manufacturer's sealed bags or drums, bearing the name of the manufacturer and the brand of plaster are to be in accordance with B.S.1191 for the following types -

Undercoat plasters are to be borrowing or "slow setting browning" of class "B", type a - retarded semi-hydrates.

Finishing plaster used on undercoats is to be of Class 'B' type b - retarded semi-hydrates or class "B" type c - dual-purpose plaster.

Finishing plaster used or plasterboard is to be of "Board finish" type, Class "B", type b - retarded semi-hydrates.

Keepe's Cement is to be dual-purpose type in accordance with class "B", type c.

Plaster of Paris to be in accordance with class "B".

Joints of brickwork, etc. are to be thoroughly raked out and loose particles of mortar, etc. brushed out to form key for plaster. Concrete work generally is to have a coat of "spatterdash" applied to form key for plaster, etc. The concrete shall be dampened immediately after removal of formwork and "spatterdash" consisting of 1 part of cement and 2 1/2 parts coarse sand (by volume) mixed to the consistency of a thick slurry, thrown on with a hand trowel to thickness not exceeding 1/4". The "spatterdash" shall be waited one hour after application and left to harden.

All pavings, wall linings, etc. are to be adequately covered up and protected until the completion of the works. The whole of the finished work to be cleaned off and left in a sound and perfect condition to the satisfaction of the Architect/Consultant & owner. Where particularly, required, pavings will not be laid until completion of all other work.

Gypsum plaster to surface of concrete or brickwork is to be two-coat as follows:

Undercoat composed of one part "browning" or slow setting browning plaster as described above with two parts of sand, the whole laid on evenly, straightened with a rule and scratched to form a key.

Finishing coat to be as described above, applied neat of with an admixture of not more than 25% volume by lime putty, trowelled with a steel trowel to smooth even surfaces.

The total thickness of two-coat work must not exceed 1/2".

Gypsum plasterboard shall be of approved manufacture and in accordance with B.S. 1230. Consisting of a core of set gypsum plaster in accordance with B.S. 1191 sandwiched between two sheets of heavy paper to a nominal thickness of 3/8". Plasterboard is to be nailed to timber bearers with 1 1/4" * 12 S.W.G. galvanized screws with 3/8" dis. heads, spaced about 6 inches apart and not less than 3/4"

from the edges and ends. Nailing is to commence at the centre of the board. Boards are to be spaced 1/8" to 1/4" apart at the joints and end joints are to be staggered to break bond. The boards are to be fixed and cleaned at least 24 hrs. before the application of plaster and in no circumstances should it be wetted before plastering.

Gypsum plasterboard is to be prepared for plastering by filling the joints with 'board finish' gypsum plaster as described above and pressing into the plaster, dry reinforcing jute scrim cloth 3 1/2" wide trowelled as flat as possible. When the plaster to the scrimed joints has set, thin coat of neat gypsum plaster is to be applied over the whole surface to level up followed immediately by a finish coat to a total thickness of 3/16". The finish coat when almost set is to be trowelled to a smooth surface using as little water as possible applied with a brush. The admixture of lime with gypsum plaster will not be permitted.

Internal wall tiling is to be of a quality and equal to samples approved by the Designer as suitable for the standard of work required. Tiles are to be of 'A' Grade. Indian manufacture size 4 1/4" * 4 1/4" * 6mm thick cushion edge coloured egg shell glazed tiles fixed complete with rounded nosing tiles to external angles or as specified. The tiles are to be soaked in clean water and brushed on the underside with cement slurry before bedding on a cement and sand (1:3) and painted in neat white or coloured cement.

Pavings composed of cement and sand (1:3) are to be trowelled smooth with steel trowel or floated with a wooden hand float as required.

Dividing strips of brass, stainless steel or plastic as specified and on approval, shall be provided and bedded to, finished flush with finished floor levels between different types of pavings or where abutting wood floors.

Stone flooring and cladding should be of dimensions, quality and colour as specified and shall conform to the relevant I.S. specification samples of stone materials should be got approved by the Designer/Client prior to installation allowed without extra charge, unless such variations are made after conduits, cables, etc. are fixed.

All cables shall be of 1st quality manufacturer and the Main Contractor will be required to submit a samples of wiring materials to the Designer & owner, for their approval before commencing the installation.

GENERAL SPECIFICATIONS FOR "UPHOLSTERED" FURNITURE :

TIMBER : All timbers used are to be of top quality, free from knots, shakes, and worm holes, and with a moisture content of not more than 12% depending on the climatic conditions prevailing at the site.

Timbers which are completely hidden, that is when covered by upholstery material, can be of local hardwood, except where this interfaces with the strength of the product, as in the case of a leg or arm which is part covered and part finished.

JOINTS : All joints shall be standard, mortise and tenon, dowel, dovetail, and crosshalved. Nailed or glued butt joints will not be permitted. Screws, nails, etc. will be of standard iron or wire unless stated otherwise on drawing. Where mortise and tenon joints are used, tenons should fit the mortise exactly. Where screws show on a finished surface, these will be sunk, and the hole plugged with a wood plug of the same wood and grain of the finished surfaces, unless otherwise. Nails on finished surface will be neatly punched and the hole filled with wood filler to match the colour.

UPHOLSTERY : This will be of first class standard workmanship with webbing, no sag springs, coiled springs, padding and filling as specified on drawing. Covering fabrics will be sewn, tufted, and corded as shown on the drawing.

CUSHION VENTS : Brass or Aluminium "cushion vents" should be installed at the back or under side of seat cushions (especially those covered in leather, vinyl plastic or very tightly woven fabric) to allow air to escape easily and to prevent torn seams.

MATERIALS : Finished timber shall be of the type specified, furnishing fabrics, colour, pattern, substance to be as specified, no variation of this will be permitted unless with prior approval of the Designer & owner.

FINISH : This will be as specified on the drawing and colour scheme chart where timber is finished in natural colour, care must be taken to "match" each separate piece of colour, before assembly. Where timber is stained, the stain or colour on each member must match.

Only first class workmanship will be accepted. All legs to furniture will be fitted with nylon glides or castors as specified on the drawing. Full size drawings or prototype samples are to be submitted to the Designer for prior approval if requested.

FABRIC AND WALL COVERINGS :

The fabrics or wall coverings shall be supplied by the owner in conformity with the details shown on colour scheme charts. The wall paper or fabric shall be applied with an approved method or adhesive after necessary preparation of surfaces and in accordance with the manufacturer's recommendations and to the approval of the Architect/Consultant. The lengths of wall covering are to be hung with an overlap of at least 1" and cut flush as recommended by the manufacturer. A sample of the colour and style shall be produced for the Architect/Consultant's / owner approval.

ELECTRICAL INSTALLATION :

The whole of the electrical installation shall be carried out by a major registered licensed Electrical Contractor's firm.

The electrical installation shall includes for the supply of the whole of the materials and the work of fixing, necessary for the complete installation. The work shall be carried out in strict accordance with the latest edition of the Regulations for the Electrical Equipment of Buildings issued by the Institute of Electrical Engineers I.E. rules and to the satisfaction of and in accordance with rules, regulations, and requirements of the supply company and the Fire department all to the entire satisfaction of the Architect/Consultant & owner.

The positions of all points and equipment shown on the drawings shall be assumed to be correct for the purposes of tendering, but it is the main contractors responsibility to check the exact positions on the site before commencing the works.

NOTE : This specification is of the general type only and must be used in conjunction with the drawing of the particular item being made. Anything shown on the drawing and not in the specification must be compiled with, and vice versa.

GENERAL SPECIFICATION FOR CASE OF "CABINET" FURNITURE.

TIMBER : All timbers used are to be of top quality free from knots, shakes, wormholes, and with a moisture content of not more than 12% depending on the climatic conditions prevailing at the site.

JOINTS : All joints will be standard, mortise and tenon, dovetail, duel, cross halved, mitred, tongued and grooved and rebated. Nailed and glued butt joints will not be accepted.

FASTENINGS : Screws, nails, bolts, will generally be iron or wire, except in the following examples. "Outdoor Furniture" fastenings will be of brass or other non-corrosive metal. In hardware, they will match the finish of the hardware item.

Nails, in a finished surface shall be neatly punched and the hole filled with wood filler matching the finish. Screws in a finished surface will be round head, raised or sunk beneath the surface, and the hole plugged with a wood plug with matching colour and grain of the wood surface, unless specially detailed.

PLYWOOD : Used mainly for the body-work of this furniture, shall be Green ply, century or multi ply suitable for veneering, painting or bonding plastic laminate. It shall be a resin bonded, specification, "marine", brand or equivalent. Exposed edges will be finished with a piece of solid wood, tongued, grooved and glued, or as detailed.

HARDWARE : Hinges, locks, latches, door tracks, etc. shall be as specified, and as far as is possible of specified manufacture. In any variation of this the quality of the substitute shall be equal to or better than the originally specified, and the sample should be submitted to the designer/owner for prior approval.

METAL : Where metal lags, frames, sheets, etc. are used, these shall be welded, brazed, bolted or revetted as required and on finished surfaces welding, brazing and revetting shall be neatly smoothened so that no evidence of this is apparent on the final finish of the metal which will be as specified on drawing.

On all legs wood or metal, nylon glides or heavy duty castors as indicated, are to be installed.

FINISH : This will be as indicated on the drawing and colour scheme charts, and materials (timber, plastic, laminates, lacquer, paints, etc.) must be as specified. No variation will be accepted unless with the prior approval of the Designer & owner. "Backs" of cabinets, etc., where wall hung shall be treated with an approved brand or wood preservative. Full size drawings or prototypes are to be submitted for approval if requested.

NOTE : This specification is of a general type only and must be used in conjunction with the drawings of the particular item being made. Anything showing on the drawing, but not in the specification must be complied with and vice versa.

APPENDIX “B”
THEORETICAL STANDARD REQUIREMENT OF CEMENT FOR VARIOUS ITEMS OF WORK

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
1	Cement Concrete 1:5:10	Cum	2.60
2	Cement Concrete 1:4:8	Cum	3.40
3	Cement Concrete 1:3:6	Cum.	4.40*
4	Cement Concrete 1:2:4	Cum	6.40*
5	Reinforced Cement Concrete 1:2:4	Cum	6.40*
6	Reinforced Cement Concrete 1:1.5:3	Cum.	8.00*
7	Reinforced Cement Concrete 1:1:2	Cum	12.20*
* Note : For controlled concrete items like M-10, M-15, M-20, M-25 etc., the consumption of cement will have to be assessed by the Engr-in-Charge on the basis of design mixes approved for individual work.			
8	Brick masonry in C.M. 1:4	Cum.	1.90
9	Brick masonry in C.M. 1:6	Cum	1.25
10	Half brick masonry in C.M. 1:4 with RCC 1:2:4 stiffeners	Sqm.	0.27
11	Half brick masonry in C.M. 1:4	Sqm	0.21
12.(a)	R.R. Masonry in C.M. 1:6	Cum.	1.65
12.(b)	C.R. Masonry in C.M. 1:6	Cum.	1.56
13.	IPS Flooring (C.C. 1:2:4, finished smooth)		
(a)	30mm. thick	Sqm	0.23
(b)	40mm. thick (smooth/broom finish)	Sqm	0.30
(c)	50mm. thick	Sqm	0.36
(+)	20mm. thick skirting/dado in cm.1 :3	Sqm	0.30
14	Hardonate flooring -50mm. thick (C.C. 1:2:4, finished smooth)	Sqm.	0.41
15	Kota stone:		
(a)	Flooring (with lime mortar bedding pointed with matching cement slurry)	Sqm	0.13
(b)	Skirting with 20mm. thick C.M. 1:3 backing	Sqm	0.27
(c)	Coping	Sqm.	0.13
16	Terrazzo tile :		
(a)	Flooring (with lime mortar bedding & pointed with cement slurry).	Sqm	0.18
(b)	Skirting with 20mm. thick C.M. 1:3	Sqm	0.28
(c)	Treads, hydraulically pressed with C.M. 1:3 bedding	Sqm.	0.37
(d)	Treads in one piece	Sqm	0.28
(e)	Risers, hydraulically pressed with C.M. 1:3 backing	Sqm.	0.28
(f)	Risers in one piece	Sqm	0.23

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
17.	Cast-in-situ terrazzo		
(a)	Flooring, 40mm. th. (28mm C.C. 1:2:4 + 12mm with marble chips & powder)	Sqm	0.26
(b)	Skirting, 20mm. thick (12mm CM1:3+ 8mm marble chips with cement & marble powder)	Sqm	0.25
18.	White glazed tile flooring and dado over 20mm. C.M.1 :3 bedding	Sqm	0.31
19.	Cement tile :		
(a)	flooring (lime mortar bedding).	Sqm	0.18
(b)	skirting with 20mm thick C.M. 1:3	Sqm	0.28
20	Plaster skirting, 20mm. thick in C.M.1 :3.	Sqm	0.30
21.	Cuddapah stone kitchen platform over 20mm. thick C.M. 1:4	Sqm	0.30
22	Cuddapah stone window sill over 20mm. thick C.M. 1:4	Sqm	0.27
23	Fixing hold fasts in CC 1:3:6 of size 300x100x150 mm. for doors & windows	100 Nos	2.20
24.	Cement Plaster in C.M. 1:4/1:5 with neeru finish		
(A)	Cement Mortar 1:4		
(a)	12 mm. thick	Sqm	0.11
(b)	15 mm. thick	Sqm	0.13
(c)	20 mm. thick.	Sqm	0.17
(B)	Cement Mortar 1:5		
(a)	12 mm. thick	Sqm	0.09
(b)	15 mm. thick	Sqm	0.11
(c)	20 mm. thick	Sqm	0.14
25.	Cement plaster in C.M. 1:4 in two coats with neat cement punning		
a)	15 mm. thick.10mm + 5mm (for ceiling	Sqm	0.18
(b)	20 mm. thick.15mm + 5mm (for internal walls	Sqm	0.22
26	Cement plaster in C.M. 1:4, 20mm. thick rough finish (for external brick/concrete surfaces)	Sqm.	0.17
27.	Sand faced plaster, 20mm. thick (12mm C.M. 1:4 + 8 mm C.M. 1:3)	Sqm	0.21
28.	Rough cast plaster, 25 mm thick (12mm C.M. 1:4 + 13 mm C.M.1 :3)	Sqm	0.27
(+)	(+) 10 mm wide & 18 mm thick plain or moulded cement mortar band in CM 1:4	100 R.M	0.152
29.	Cement plaster in C.M. 1:3 with water proofing compound finished smooth with neat cement		
(a)	12mm. thick	Sqm	0.19
(b)	20mm. thick	Sqm	0.27
30.	Cement pointing in C.M. 1:3		
(a)	Ruled pointing (groove pointing)	Sqm	0.02
(b)	Raised & cut pointing	Sqm	0.04

S.NO.	BRIEF DESCRIPTION OF ITEM	UNIT	CEMENT IN BAGS
31.	Cement based waterproofing works (Through the agency approved by the Department)		
(a)	Terrace type average 115 mm. thick	Sqm	0.45
(b)	Basement type (Box type).	Sqm	0.70
(c)	Basement type (surface).	Sqm	0.60
(d)	In sunken floor of toilets, chajjas, parapets	Sqm	0.30
(e)	Brickbat coba in toilets, extra in roof terrace	Cum	3.00
(f)	O.H. Water tanks	Sqm	0.50
(g)	Expansion joints.	R.M	0.50
32.	Damp proof course in C.C. 1:2:4		
(a)	25mm. thick	Sqm	0.16
(b)	38mm. thick	Sqm	0.24
33.	Laying R.C.C. spun pipes in C.M. 1:1/1:2		
(a)	100 mm dia.	10m	0.10
(b)	150 mm dia	10m	0.12
(c)	250 mm dia.	10m	0.18
(d)	300 mm dia	10m	0.22
(e)	450 mm dia	10m	0.48
(f)	600 mm dia	10m	0.64
34.	Cement mortar 1:4 screed		
(a)	20mm. thick	Sqm	0.16
(b)	50mm. thick	Sqm	0.38
35.	Chain link fencing/barbed wire fencing - C.C. 1:2:4 pockets of 450x450x600 mm.:		
(a)	Angle iron posts	m	0.21
(b)	Cement Concrete 1:2:4 posts	m	0.37
36	Kerb stone in CC 1:3:6 of size 125x375mm	m.	0.21
37.	Shahabad stone paving, pointed in C.M.1 :3, 15x10 mm groove.	Sqm	0.02
38	Pointing & grouting stone pitching in C.M. 1:3	Sqm	0.14

APPENDIX – “C-1”

CONSUMPTION OF PAINT FOR SOME PAINTING ITEMS : (PARA 47.7.1 OF PAINTING)

Coverage Achieved Per Litre or Per Kg of Paint / Material				
Sl. No.	Name of Paint	Area coverage For one coat (Old work)	Area coverage For two coats (New Work)	Area coverage Per addl. coat
1	Synthetic enamel paint	1 4m ² per Ltr.	8.5m ² per Ltr.	1 8m ² per Ltr.
2	Plastic emulsion paint	14m ² per Ltr.	8.5m ² per Ltr.	18m ² per Ltr.
3	Oil Bound distemper	10m ² per Ltr.	6.0m ² per Ltr.	12m ² per Ltr.
4	Dry Distemper	10m ² per kg	6.5 m ² per kg	12 m ² per kg
5	White wash	5m ² /kg of lime	3.5m ² / kg of lime	10 m ² /kg of lime
	Note : Following things to be added in lime (i) Adhesive (DDL/SDL) – 5% of lime (ii) Neel (Blue) – 3 gm per kg of lime (iii) Water – 5 kg of water per kg of lime			
6	Cement based paint	4.5 m ² per kg	2 m ² per kg	6 m ² per kg
7	Aluminium paint	20m ² per Ltr.	12.5 m ² / Ltr.	28 m ² per Ltr.
8	Bitumen Paint/Black Japan	14 m ² per Ltr.	14 m ² per Ltr.	28 m ² per Ltr.
9	Neeru (or lime punning with slacked lime) over plaster	0.5 m ² per kg of slacked lime		
10	Red oxide metal primer	16 m ² per Ltr.		
11	Cement primer	12 m ² per Ltr.		
12	Wood primer	13 m ² per Ltr.		
13	Wax polishing of new wood work with ready made polish	20m ² per kg	20m ² per kg	20m ² per kg
14	French or spirit polish	10.5 m ² / Ltr.		

Sl. No.	Name of Paint	Area coverage For one coat (Old work)	Area coverage For two coats (New Work)	Area coverage Per addl. coat
15	Varnish	14 m ² per Ltr.	8.5 m ² per Ltr.	18 m ² per Ltr.
16	Requirement of paint per coat in Structural steel work on tonnage basis. (i) Truss and Lattice girder work – 4.5 litres per tonne. (ii) Plane Beam/plane girder work – 2.5 litres per tonne			

APPENDIX – “C-2”
CO-EFFICIENT FOR EQUIVALENT PLAIN AREAS FOR PAINTING ITEMS :
(PARA REFERRED TO CHAPTER 47 - PAINTING)

SN	DESCRIPTION OF WORK	MULTIPLYING CO-EFFICIENTS
I.	WOOD WORK : DOORS, WINDOWS ETC.	
1	Panelled or framed and braced doors, windows etc.	
2	Ledged & battened or ledged, battened & braced doors, windows etc.	1.30 (for each side)
3	Flush doors etc	1.20 (for each side)
4	Part panelled and part glazed or gauzed doors, windows etc.	1.00 (for each side)
5	Fully glazed or gauzed doors, windows etc.	0.80 (for each side)
6	Fully venetioned or louvered doors, windows etc.	1.80 (for each side)
7	Trellis (or Jaffri) work one way or two way.	2.00 (for painting all over)
8	Carved or enriched work:	2.00 (for each side)
9	Weather boarding:	1.20 (for each side)
10	Wood shingle roofing:	1.10 (for each side)
11	Boarding with cover fillets and match boarding.	1.05 (for each side)
12	Tile and slate battening:	0.80 (for painting all over)
II.	STEEL WORK: DOORS, WINDOWS ETC.	
13	Plain sheeted steel door or windows:	1.10 (for each side)
14	Fully glazed or gauzed steel doors and windows	0.50 (for each side)
15	Partly panelled and partly gauzed or glazed doors and windows.	0.80 (for each side)
16	Corrugated sheeted steel doors or windows.	1.25 (for each side)
17	Collapsible gates	1.50 (for painting all over)
18	Rolling shutters of inter locked laths.	1.10 (for each side)
III.	GENERAL WORKS :	
19	Expanded metal, hard drawn steel wire fabric of approved quality, grill work and gratings in guard bars, balusters, railings, partitions and m.s. bars in window frames.	1.00 (for painting all over)
20	Open palisade fencing and gates including standards, braces, rails, stays etc. in timber or steel.	1.00 (for painting all over)
NOTE: The height shall be taken from the bottom of the lowest rail, if the palisades do not go below it (or from the lower end of palisades, if they project below the lowest rail) upto the top of palisades but not upto the top of standards, if they are higher than the palisades.		

SN	DESCRIPTION OF WORK	MULTIPLYING CO-EFFICIENTS
21	Corrugated iron sheeting in roofs, side cladding etc.	1.14 (for each side)
22	A.C. Corrugated sheeting in roofs, side cladding etc.	1.20 (for each side)
23	A.C. Semi-corrugated sheeting in roofs, side cladding etc. or Nainital pattern using plain sheets.	1.10 (for each side)
24	Wire gauze shutters including painting of wire gauze.	1 .00 (for each side).

APPENDIX – “D”

PROFORMA FOR GUARANTEE TO BE EXECUTED BY CONTRACTORS FOR STABILITY OF PILE FOUNDATION SYSTEM AGAINST RISK OF SETTLEMENT & OTHER TYPE OF DISTRESS TO THE BUILDING(S).

(PARA 7.7 OF PILE FOUNDATION)

This Agreement made this day of Two thousand between M/s. (hereinafter called the Guarantor of the one part) and the INDIAN INSTITUTE OF TECHNOLOGY, BOMBAY (hereinafter called the Employer of the other part).

Whereas this Agreement is supplementary to a contract (hereinafter called the Contract) dated..... and made between the Guarantor of the one part and the Employer of the other part whereby the contractor interalia undertook to render the damages caused to the buildings and structure to the satisfaction of the Department.

AND WHEREAS THE GUARANTOR agreed to give a guarantee for the stability of pile foundation system against the risk of settlement and against all damages caused to the buildings erected on pile foundation system for a period of five (5) years from the certified date of completion.

NOW THE GUARANTOR hereby guarantees that the stability of the pile foundation system provided by him will render the structures completely free from settlement and any other type of distress for a period of five (5) years to be reckoned from the certified date of completion of the work.

During this period of guarantee, if the Guarantor fails to execute necessary rendering work due to damages/distress caused to the buildings and structures for settlement of pile foundation system or commits breach thereunder, then the Guarantor will indemnify the principal and successors against all loss, damage, cost, expense or otherwise which may be incurred by the Department by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Employer, the decision of the Engineer-in-charge shall be final and binding on the contractors.

IN WITNESS WHEREOF these presents have been executed by the
Obligator..... and
by.....and for and on behalf of the Indian Institute of
Technology, Bombay on the day, month and year first above written.

SIGNED, sealed and delivered by (OBLIGATOR) in the presence of :

(1)

(2)

SIGNED FOR AND ON BEHALF OF THE IITB

BY.....in the presence of :

(1)

(2)