

SCOPE & SPECIFIC TECHNICAL REQUIREMENTS

1.1.0 SCOPE

1.1.1 The scope of work under this specification is Civil Works of 400kV Substation at Koradi in Maharashtra, being executed by BHEL on turnkey basis. The Customer is Maharashtra State Electricity Transmission Corporation Limited (MSETCL).

1.1.2 The Civil Works shall generally include, *but not limited to*, construction of following:

- (i) Compound Wall with anticlimbing barbed wire fencing gate, etc.
- (ii) Watchman Cabin.
- (iii) Store Shed.
- (iv) Control Room Building.
- (v) Bay Control Rooms.
- (vi) Other miscellaneous works as required for project.

1.1.3 The works to be performed in the above constructions include preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labour, supervision, materials, scaffolding, power, fuel, construction equipments, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall generally involve excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures disposal of surplus soil, concreting including reinforcement and formwork, rubble masonry, providing necessary steel embedments and other inserts, building works including all finishing, etc., all complete as per detailed specification, drawings and directions of Engineer-in-charge.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

1.2.1 The specific technical requirements for the execution of civil works shall be as per Customer's Detailed Technical Specifications enclosed with the tender.

1.2.2 All source of sand and metal shall be got approved by Customer.

1.2.3 The steel shall be as per relevant IS & grade 415. The steel shall be procured from the approved manufacturer only after sample testing of the steel from the factory for chemical composition as well as mechanical properties.

1.2.4 Cement shall be ISI mark with requisite properties & make and grade shall be approved by Customer.

1.2.5 Exhaustive specifications for the work are given, however as per general principle all PWD specifications shall be applicable for all works. Where no such specifications are available, description of the item shall prevail.

1.3.0 BILL OF QUANTITY

1.3.1 The quantities indicated in the Bill of Quantity are indicative and can vary to any extent. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.2 The provision of Bill of Quantity, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

**MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO.
LTD.**

The detailed specifications for various items described below are to be taken as guide lines. The work is to be carried out in accordance with the description mentioned in the wording of the item and the relevant drawings issued with the tender. Generally, description in Schedule 'B' will prevail. However, in case of difference in the opinion between the contractor and the Engineer-In-Charge and in case there is any difference between the drawing, detailed specifications and wording of the item, the decision of the Chief Engineer, Transmission Projects, M.S.E.T.C.L., Mumbai shall be final, conclusive and binding on the contractor.

The works are to be executed in accordance with the specifications mentioned in the "Standard Specification (Red) Book" published by the Government of Maharashtra together with the relevant Indian standard specification referred therein. Whether there is difference in the size, quality and quantity of materials to be used in wording of standard specification book and the description of the item in schedule of this tender, the sizes quality and quantity of the material to be used shall be as per the wording of the item in schedules of this tender.

Samples of all materials proposed to be utilized in the works shall be got approved well in advance.

The works include clearing of the site before the commencement of works, setting out the works, establishment of centre lines and the bench marks firmly, clearing and cleaning of the works and surrounding area and clearing the construction debris laying at site after completion without any extra cost to the department.

The various rates quoted in the tender shall be treated as inclusive of all labour, material, transport charges, lifts, taxes, duties, royalties etc. to give a completed and finished item. Nothing extra on any account is payable. Extra lift above or below ground level is also not payable.

The various item numbers given in schedule 'B' are to be co-related for respective items of detailed specifications since the item numbers mentioned in Schedule 'B' are different than those mentioned in detailed specifications. No complaint/difference of opinion shall be entertained only on the ground that detailed specification for any particular item does not appear together with the respective item of Schedule 'B'.

Signature of Contractor

Name :

Address :

MAHARASHTRA STATE ELECTRICITY TRANSMISSION CO. LTD.

GENERAL SPECIFICATIONS FOR MATERIALS

A.2. CEMENT

Cement :- Cement shall conform to I.S. 8112-1989.

The type of cement as to whether it shall be Ordinary, Rapid Hardening or Low Heat shall be specified. When no type is specified, Ordinary Portland cement shall be used.

- A.2.1** The weight of Ordinary Portland cement shall be taken as 1442 kg. per cum. The measurement of proportion of cement should normally on the basis of weight and bags, each undisturbed and sealed 50 kg. bag being considered equivalent to 35 litres in volume. When part bag is required, cement shall be taken by weight. When the basis of mix is by volume, cement will be taken by weight, assuming 35 litres to be equal to 50 kg. Care should be taken to see that each bag contains full quantity of cement.
- A.2.2 Test :-** When tests are considered necessary, those shall be carried out as indicated in I.S. 8112-1989. The contractor should ensure that the cement is of sound and required quality before using it.
- A.2.3 Storage :-** Cement required for use shall be as fresh as possible and on planks raised 15 to 20 cm. above the floor and stacked 30 cm. away from the walls in suitable closed weather- proof buildings at the work site or at the selected approved site, in such a manner as to prevent deterioration by dampness or moist atmosphere or intrusion of foreign matter, cement shall be stored in such a way as to allow the removal and use of cement in chronological receipt of cement i.e. first received being first used. Not more than 15 bags shall be stacked vertically in one pile and maximum width of the piles should not be more than 3 meters. Any cement which has deteriorated, caked or which has been damaged shall not be used. Cement concerning which there is doubt, shall not be used pending testing and satisfactory results. Cement that is condemned shall be immediately removed from the work site. When temporarily stored in the open or use within 48 hours, it shall be kept on a platform of planks about 15 cm. to 20 cm. above ground and covered with a tarpaulin. Ordinary cement stored for more than 2 months from the date of receipt from the factory shall be subjected to test and used only if found satisfactory. The cost of tests shall be borne by the agency responsible for the storage after two months from receipt. Different kinds or brands of cement or cement of the same brand from different mills should be stored in separate groups and should not be mixed during use except when writing by the Engineer. Cement shall be kept in store under double allocating arrangement of the Department. A board indicating stock and daily transactions of cement shall be kept in each room of the cement store. Daily account of receipt and use of cement bags shall be maintained by the Contractor in the proforma approved by the Engineer. This shall be kept in the store for verification by the supervising Department staff. Copies of the records shall be supplied to the

Engineer regularly.

A.2.4 The cement shall not be stored for unduly long periods. It should not be handled in such a way as to impair its strength or useful characteristics.

A.2.5 Measurement - When required to be measured, measurement shall be by on the basis of weight with Metric ton as a unit.

A.4. NEERU

A.4.1 General : These specifications cover neeru to be used for plasterfinishes in building work.

A.4.2 Materials : 1) Lime - Class C lime (i.e. pure fat lime) as mentioned in I. S. 712-1973 shall be used. Lime shall comply with specification No. A-1 in all respects.

2) Water - Water shall conform to specification No. A.5

3) Sand - Sand shall conform to specification No. A.6

All sand shall pass through I. S. sieve No. 50 (0.599 mm.).

A.4.3 Preparation : Lime shall be slaked and mixed with sufficient water to form a thick paste. It shall be reduced to a fine paste by grinding. It shall then be passed through a fine sieve (3 mm. mesh) to remove all unslaked particles and foreign matter and allowed to mellow under water for at least 10 days in large slaking tanks. The surplus water on the top shall be allowed to run off. The slaked lime paste thus formed shall be used for preparing neeru.

The neeru shall be prepared by mixing together 4 parts of this lime paste and 1 part of fine sieved sand by volume. Jute fibre finely chopped shall be added to the above mortar at the rate of 4 kg. of jute to every cu. metre of lime-sand mixture (or 1 lb. of jute for every 4 c. ft. of lime sand mixture). The mixture shall then be properly ground to a fine paste between two stones or a mill.

The neeru thus prepared shall be kept moist until used and no more than what can be consumed in 15 days shall be prepared at a time.

A.4.4 Measurement : When required to be measured, measurement shall be by volume with cu. metre as the unit.

A.5. WATER

A.5.1 Water for mixing cement/lime mortar or cement/lime concrete : Water for mixing cement/lime mortar or concrete shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and traces of oil, acid and injurious alkali, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence or attack the steel in R.C.C. water shall be obtained from sources approved by the engineer sources of water shall be maintained at such a depth and the water shall be withdrawn in such a manner as to exclude silt, mud, grass or other foreign materials. Containers for transport, storage and handling of water shall be clean.

If required by the Engineer, it shall be tested by compression with distilled

water. Comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength as specified in I.S. 8112-1989. Any indication of unsoundness, change in time of setting by 30 minutes or more, or decrease of more than 10 per cent in strength of mortar prepared with distilled water shall be sufficient cause for rejection of water tested. sea water shall not be used.

Water fit for drinking will generally be found suitable for mixing cement/lime mortar or concrete.

- A.5.2 Water for curing cement/lime mortar or concrete :** Water for curing mortar or concrete should not be too acidic or too alkaline. It should have a pH value ranging between 4.55 to 8.5. It shall be free of elements which significantly affect the hydration reaction or otherwise interfere with the hardening of mortar or concrete during curing or those which produce objectionable stains or other unsightly deposits on concrete or mortar surfaces. Hard and bitter water containing more than 100 p.p.m. of sulphates shall not be used for curing purpose.

Sea water and water containing over 3 per cent of chloride salts should not be used for curing reinforced concrete work.

Potable water will generally be found suitable for curing cement/lime mortar or concrete.

A.6. FINE AGGREGATE

- A.6.1 General** - All fine aggregate shall conform to I.S. 383-1963 and relevant portion of I.S. 515-1959 as directed by the Engineer.
- A.6.2** Sand for use in concrete work shall be natural sand or crushed stone screenings. Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay, kankar nodules, soft or flaky particles, shale, alkali, salts, organic matter, loam, mica or other deleterious substances and shall be approved by the Engineer. The maximum size of particles shall be limited to 5 mm. where best trap sand available in the region contains murum or laterite particles, such particles may be allowed upto 5 percent. Zeolite crystals may also be permitted upto 4 percent. If the fine aggregate contains more than 4 percent of clay, dust or silt it shall be washed. When the quality of fine aggregate is doubtful, it shall be tested for clay, organic impurities and other deleterious substances as laid down in I.S. 383-1963. It shall not contain deleterious materials in such quantity as to reduce the strength or durability of the mortar or concrete or to attack the reinforcement in the case of reinforced concrete work. sea sand shall not be used.
- A.6.3** The fine aggregate for concrete shall be graded within limits given in table III or table IV in paragraph 5-2 of the I.S. 383-1963. The fineness modules may range between 2.6 to 3.6. If substitution of a certain quantity of stone screenings will improve the quality of concrete, the Engineer may allow it.
- A.6.4** The fine aggregate for cement mortar for masonry and first coat of plaster

should generally satisfy the following gradings :

I.S. Sieve	Percentage by weight passing sieve
480	100
240	80 - 95
120	70 - 90
60	40 - 85
30	5 - 50
15	0 - 10

The fineness modulus shall not exceed 3.0.

- A.6.5** The fine aggregate for cement mortar for fine joints of Ashlar masonry, pointing and second coat of plaster may have the following grading :

I.S.Sieve	Percentage by weight Passing sieve
480	100
240	100
120	75 - 100
60	40 - 85
30	5 - 50
15	0 - 10

The fineness modulus shall not exceed 1.6.

I.S. 1542-1960 shall generally apply for sand for plaster.

- A.6.6 Gradation** : The gradation of materials from any one source shall not vary in composition beyond the range of values that governs, in selecting source of supply. For determining the degree of uniformity, determination of fineness modulus shall be made upon representative samples furnished by the contractor from such source as he proposes to use. Fine aggregate from any one source having a variation in fineness modulus greater than ± 0.20 from average fineness modulus of the representative samples submitted by the contractor shall be rejected or may be accepted subject to such changes in the proportion of aggregate as the Engineer may direct

- A.6.7 Storage** : The fine aggregate should be stacked carefully on a clean, hard surface so that it will not get mixed up with deleterious foreign material.

Sand shall not be stacked in high conical heaps so that segregation of heavier particles by sliding down may be prevented. It shall be placed in layers not thicker than those resulting from lorry loads dumped on the same plane.

- A.6.8 Tests** : The aggregate shall satisfy the tests referred to in I.S. 383- 1963. Samples of sand to be used for a particular item shall be got approved by the Engineer who shall keep it in his office for reference.

- A.6.9 Royalty** : The contractor shall be responsible for observing the laws, rules and regulations imposed under the Minor Minerals act and such other laws and rules prescribed by Government Departments such as Forest and revenue and by competent Local Authorities Royalty, etc. payable for

securing the material shall be paid by the contractor subject to general conditions of contract.

Where rules permit refund of Royalty for use of the materials in Government work the Engineer will pass a certificate for the quantity so used.

No royalty shall be charged when the material is allowed to be obtained from Departmental quarry.

- A.6.10 Measurement :** When required to be measured, measurement shall be by volume with cu. meter as the unit. No deduction shall be made for the voids.

A.7. COARSE AGGREGATE

- A.7.1** Coarse aggregate shall consist of crushed or broken stone and be hard, strong, dense, durable, clean, of proper gradation and free from skin and coating likely to prevent proper adhesion of mortar. The aggregate shall generally be cubical in shape and as far as possible flaky, elongated pieces shall be avoided. Unless special stones of particular quarries are mentioned in the special provisions, aggregates shall be broken from the best trap/granite/quartzite/gneiss stones in that order available in the region and approved by the Engineer. Stone shall have no deleterious reaction with cement. Shingle of the appropriate grading may be permitted to be substituted for some proportion of the metal without price adjustment if it is shown that thereby strength of concrete is increased and workability improved.

- A.7.2** The maximum size of the aggregates may be upto 80mm in such proportions as to give maximum density to the concrete. The maximum size should be as large as possible within the above limit but should not exceed 1/4 of the minimum thickness of the member, provided however this size presents no difficulty in the case of R.C.C. to surround the reinforcement thoroughly and fill up the corners of the form work satisfactorily. In the case of general concrete work, a maximum size of 40 mm is used and in R.C.C. work a maximum size of 20 mm will be found satisfactory, but it should be restricted to 6 mm. less than the minimum lateral clear distance between bars or 6 mm. less than the cover, whichever is smaller.

The crushing strength of aggregate will be such as to allow the concrete in which it is used to build up the specified strength of concrete.

- A.7.3** Approximate range in grading of coarse aggregate may be as under :

Maximum size of Agreegate		Nominal Range	Percentage of coarse aggregate fraction			
		40 mm to 809 mm	20 mm to 840mm	5 mm to 20 mm	10 mm to 20 mm	5 mm to 10 mm
20 mm	—	—	—	100	55-67	33-45
40 mm	—	—	40-50	50-60	28-40	18-30

80 mm	—	20-36	16-36	35-44	10-30	13-29
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Grading tests shall be taken in the beginning and at change of source or machinery or type of metal. Where required by the Engineer, tests indicated in I.S. 383-1963 and I.S. 456-1964 shall be got carried out in an approved laboratory at the contractor's cost to show the acceptability of the material.

A.7.4 Coarse aggregate of a porous nature where absorption of water after 24 hours immersion in water, is more than 5 per cent. by weight shall not be used.

A.7.5 Limits of deleterious substances shall not exceed those prescribed in 2.3.1.1. and 2.3.1.2 of I.S. 515-1959.

A.7.6 Storage - The aggregates of different sizes shall be stored separately and handled in such a manner as to prevent intermixing of different mixes of aggregates required separately for grading purposes. No foreign matter shall be allowed to be mixed up with aggregates. If covered with dust, etc., they shall be washed clean before use.

A.7.7 Royalty, etc. - The contractor shall be responsible for observing the laws, rules and regulations imposed under the Minor Minerals' Act and such other rules prescribed by Government Departments such as Forest and Revenue and by competent local Authorities. Royalty, etc., payable in connection with securing the materials shall be paid by the contractor subject to general conditions of the contract.

Where rules permit refund of Royalty for use of the materials in Government work, the Engineer will pass a certificate for the quantity so used.

The Contractors shall be entirely responsible for operating existing quarries or opening new quarries including removal of over-burden shall bear all costs pertaining to them.

In the case of Departmental quarries, operations shall be carried out in such a way that their further usefulness is not affected. No Royalty will be charged when the material is allowed to be obtained from a Departmental quarry.

When the quarries are not owned by the Department, the contractor shall be responsible for securing the written consent of the land owners for opening new quarries or working old ones and for payment of all compensation, Royalty etc.

Samples of coarse aggregates requires for the work shall be got approved by the Engineer both regarding quality and shall be kept in Engineer's office. The coarse aggregate to be used shall conform to those samples.

A.7.8 Blasting :- Blasting shall be carried out according to instructions laid down in specification No. B.2.

A.7.9 Measurement :- When required to be measured, the measurement shall be by volume with cu. meter as the unit. No deduction shall be made for voids.

A.8. STONE FOR MASONRY AND PITCHING

- A.8.1** Stone to be used in the masonry and pitching work shall be trap, granite, quartzite, gneiss, laterites or any other type of good stones that may be specified in the item. In the absence of mention of a special type in the item or the special provision, good trap, granite, quartzite, or gneiss stones in that order available in the region and known to be satisfactory in use in view shall be used. The stone shall stand weathering well and when immersed in water for 24 hours shall not absorb water more than 5 per cent. of its dry weight when tested according to I.S. 1124-1957. The stone of the required quality shall be obtained from quarries specified in the contract or quarries approved by the Engineer. All stones shall generally be freshly quarried.

Laterite stone should be compact in texture and the mottled and streaked colours pervading it should not be very unevenly distributed. Those types in which clay occurs should not be used as building stone. Laterite stones exposed to weather to harden for some time should be preferred. It should not be used where subject to great pressure and liable to be soaked with water.

- A.8.2 Quality of face stones :-** The stones to be used in the face shall be tough, hard, dense, sound and durable, resistant to weathering action, reasonably fine graded, uniform in colour and texture and free from seams cracks or other defects which would adversely affect the strength, durability or appearance. They shall also be free from weathered portion and skin. The exposed faces shall be entirely free any type of discoloration. Preferably stone shall be from a quarry the product of which is known to be satisfactory quality in use. Stones, shall generally be freely quarried with clean faces and sharp edges shall be of such a character that it can be wrought to such lines and surfaces, whether curved or plane as may be required. Size and shape of stones shall be as per the requirements of each item.
- A.8.3 Quality of rubble stones :-** Rubble stones for heating shall be of approved quality, sound, hard, dense and durable, free from segregation, seams, cracks, weathered portions and other structural defects or imperfections tending to affect their soundness and strength. Stones shall generally be freshly quarried with sharper edges and clean faces. They shall be free from rounded, worn or weathered surfaces or skin or coating which prevents the adherence of mortar. Size and shape of stone shall be as per the requirement of each item.
- A.8.4 Quality of other stones :-** Stone to be used as headers, pin-headers, quoins, coping, etc., shall comply with the requirements of facing and hearing stone as may be relevant and shall further comply with the requirement of size and shape stipulated under the relevant item.
- A.8.5 Samples :-** Samples of stone so to be used in the work shall be got approved by the Engineer before the work is started and such samples shall be maintained in the Engineer's office.

- A.8.6 Royalty, Octroi duties etc.** :- Royalties, compensations, octroi duties, etc., payable in connection with securing the stones shall be paid by the contractor subject to conditions laid down in the general conditions of contract. The contractor shall be responsible for observing laws, rules and regulations imposed under the Minor Minerals Act and such other rules, etc., laid down by Government Department and Local Authorities.

Where rules permit refund of royalty for use of the materials in Government work, the Engineer will pass a certificate for the quantity so used. No royalty will be charged when the materials are allowed to be obtained from Departmental quarries. In the case of Departmental quarries, operations will be carried out in such a way that their further usefulness is not affected.

The contractor will be entirely responsible for operating existing quarries or opening new quarries including removal of overburden and shall bear all costs pertaining to them.

Where the quarries are not owned by the Department the contractor shall be responsible for securing the written consent of the owners for opening new quarries and working old ones and for payment of all compensation, royalty, etc. The stones whatever their source shall be of the specified quality.

- A.8.7 Blasting** :- Blasting shall be carried out according to instructions laid down in specification No. B.2

- A.8.8 Measurement** :- When required to be measured, measurement shall be by volume, length of numbers as the case may be with cu. meter, meter and one as the respective unit.

In case of rubble the measurement shall be by volume of stacks without deductions for voids.

In case of Khandkies the measurements shall be by length.

In case of stones such as the quoins, arch stones, etc., measurement shall be by numbers for specified sizes.

In case of stones such as the slabs, coping stones, etc., the measurement shall be by volumes for specified dimensions.

For pitching work measurements will be on square meter basis.

A.9. BRICKS

- A.9.1 First-Class Bricks** :- First-class bricks shall be of regular and uniform size, shape and colour, uniformly well burnt throughout but not over- burnt. They shall have plane rectangular faces with parallel sides and sharp, straight and right angled edges. They shall be free from cracks or other flaws. They shall have a frog of 10 mm. depth on one of their flat faces.

- A.9.1.1** They shall give a clear metallic ringing sound when struck.

- A.9.1.2** They shall show a fine grained, uniform, homogeneous and dense texture on fracture and be free from lumps of lime, laminations, cracks, air-holes, soluble salts causing efflorescence or other usefulness for the purpose intended.

They shall not have any part under-burnt. They shall not break when thrown on the ground on their flat face in a saturated condition from a height of 60 cm.

A.9.1.3 Size :- The size of the conventional bricks may vary from about 22.23 cm. x 10.64 cm. x 10.64 cm. x 6.67 cm to 22.86 cm. x 10.80 cm. x 7.62 cm. Only bricks of one standard size shall be used on one work unless specially permitted by the Engineer. The following tolerances are permitted in the standard conventional size adopted on a particular work.

Length	-	plus or minus 33 mm.
Breadth	-	plus or minus 1.5 mm
Depth	-	plus or minus 1.5 mm

(b) When I.S. bricks are used they shall comply with I.S. 1077- 1966.

A.9.1.4 Absorption :- After immersion in water, absorption by weight shall not exceed 20 per cent of the dry weight of the brick when tested according to I.S.S. No. 1077-1966.

A.9.1.5 Crushing Strength :- The load to crush the brick when dry shall not be less than 43.7 kg. sq.cm. and when thoroughly soaked, shall not be less than 32.8 kg/sq.cm.

A.9.1.6 Tests :- When bricks are to be used in high load bearing walls, where the load coming on the walls is of the order of 4.37 kg. per sq.cm. and more, where there is a doubt about the 'crushing strength of the bricks, the Engineer may order the compression tests as laid down in I.S. 1077-1966. If different kilns use different materials and methods of burning, one test shall be made for each group of kilns using the same type of materials and methods of burning. If the average strength is less than that mentioned in 1.5 above, the bricks from the kiln represented by the sample shall be rejected. All tests shall be done at the cost of the contractor.

A.9.2 Second-class Bricks :-

(a) Second-class brick shall be similar to first-class bricks except that they may be slightly over-burnt and may not have very sharp edges. Tolerance in depth shall be plus or minus 3 mm. Absorption of water when immersed in water shall not exceed 22 percent. When tested according to I.S. 1077-1966. Crushing strength may be 10 per cent less than that prescribed for First-class bricks.

All other provisions specified for first-class bricks shall also apply to second-class bricks.

(b) When I.S. bricks are used they shall comply with relative provisions for second-class bricks in I.S. 1077-1966.

A.10. MILD STEEL BARS FOR REINFORCEMENT

A.10.1 Material : Mild Steel Reinforcement bars : Mild steel bar reinforcement for R.C.C. work shall conform to I.S. 432-1966 and shall be of the tested quality of not less than Grade I. It shall also comply with the relevant part of I.S. 456-1964.

All the reinforcement shall be clean and free from dirt, oil, paint, grease, mill scale or loose or thick rust at the time of placing.

The contractor shall produce a test certificate of the manufacturer.

If independent tests are considered necessary, they shall be carried out according to I.S. 1251 and 1608-1960. The cost of such tests shall be borne by the contractor.

Bars or rods re-rolled from scrap steel shall not be used unless tests show that they fully comply with the I.S. 432-1966.

A.10.2 Storage :- Reinforcement steel shall be stored above ground surface upon platforms, skids or other supports to avoid desertion and sags of long lengths and shall be protected as far as practicable, from surface deterioration by direct contact with undesirable elements or by exposure to conditions producing rust and corrosion. All bars of the same designation shall be stacked separately in racks and distinctly marked.

A.10.3 Measurement :- When required to be measured, measurement shall be by weight with quintal or tonne as the unit. The bars may be directly weighted or the weights shall be calculated according to standard weights mentioned in the ISI Hand Book correct upto 0.10 kg.

A.10 (a) HIGH TENSILE STEEL BARS (Twisted)

The high tensile steel bars for use in pre-stressed concrete work shall conform to I.S. 2090-1962.

The storage shall conform to A.10.2.

The tensile strength of the high tensile steel bars shall be as specified in the special provisions of the item. In the absence of the given strength the minimum ultimate strength shall be taken as 100 kg/sq.mm.

Measurement shall conform to A.10.3.

A.11. STRUCTURAL STEEL

A.11.1 All structural steel shall conform to I. S. 226-1969 and I. S. 800-1962. The steel shall be free from defects mentioned in I. S. 226-1969 and I. S. 800-1962. The steel shall be free from defects mentioned in I. S. 226-1962 and shall have a smooth uniform finish. It shall be straightened if necessary, in the mill before shipment. Material shall be free from loose mill scale, rust-pits or other defects affecting its strength and durability. Rivet bars shall conform to I. S. 1148-1973.

A.11.2 Storage : Structural steel shall be stored above surface of the ground upon platforms, skids or other suitable supports to avoid distortion of sections in long length and shall be protected as far as practicable from surface deterioration by direct contact with harmful elements or exposure to conditions producing rust and corrosion. It should be so stored and handled that the material will not be subject to excessive stress and damage.

A.11.3 Straightening : All deformed structural material will be properly straightened by methods which are not injurious prior to being laid off,

punched or otherwise worked in the shop. Sharp kinks and bends shall be cause for rejection.

A.11.4 Tests : When the steel is supplied by the contractor, test certificates of the manufactures shall be produced. If further tests be necessary, they will be done according to I. S. 226-1969 and I. S. 1521-1972, 1608-1972; the cost of such tests will be born by the Department if the results are satisfactory and by the contractor if the results are unsatisfactory.

A.11.5 Measurement : The sections shall be supplied in specified exact lengths, smoothly cut to the required lines. The lengths of sections shall be measured correct to a centimetre and weight calculated on the basis of standard weights prescribed by I. S. I. for each relevant section correct up to 0.10 of a kg. Tolerances mentioned in I. S. 226-1969 shall be applicable unless other tolerances are prescribed in the specifications of any particular item.

The Contract rate shall be for a unit of one quintal (220 lbs. approx.) or one tonne (2,200 lbs. approximately).

A.15. MILD STEEL BINDING WIRE

A.15.1 The mild steel wire shall be of 1.63 mm. or 1.22 mm (16 or 18 gauge) diameter and shall conform to I.S. 280-1962.

The use of black or galvanised wire will be permitted for binding reinforcement bars. It shall be free from rust, oil, paint, grease, loose mill scale or any other undesirable coating which will prevent adhesion of cement mortar.

A.15.2 Storage :- The wire coils shall be stored above ground platform or other supports and protected from surface deterioration by direct contact with harmful elements or by exposure to conditions producing rust or corrosion.

A.15.3 Measurement and Payment :- No measurements will be taken of the wire used for tightening reinforcement bars. The rate of reinforcement steel and its fabrication shall incur the cost of the binding wire.

A.15.4 Measurement :- When required to be measured, measurement shall be by weight and quintal or tonne as the unit. The wire shall be measured correct upto 0.10 kg.

A.16. TIMBER

A.16.1 General : The specifications cover the requirements of good quality timber to be used for various works. When the kind of wood is not specially mentioned, good Indian Teak (Tectona Grandis) alone shall be used.

A.16.2 Quality : Timber to be used in building works shall be from the heart of a sound tree of mature growth, the sapwood being entirely removed. It shall be uniform in substance, straight in fiber, free from large, loose dead or cluster knots, flaws, shakes, warp, cup, spring, twist, bends or defects of any kind. It should be free from spongy, brittle, flaky or brush condition, sapwood and borer holes.

All timber shall be seasoned and be free decay, rot, harmful fungal and

insect attacks and from any other damage of harmful which will affect the strength, durability, appearance or its usefulness for the purpose for which it is required.

A.16.3 Colour : The colour should be uniform as far as possible, the darkness of colour amongst coloured surface of timber being generally a sign of strength and durability.

A.16.4 Kinds : Timber shall be of the species mentioned in the tender items. Normally for doors, windows, roof, scantlings, trusses, etc., in all permanent and first class works, Indian Teak Wood (*Tectona Grandis*) of the best quality like that from Dandeli, Ballarshah, and Bulsar shall be used. Properly seasoned and treated Nana (*Legarstromeia Lanceolata*) wood can be used as an alternative to teak wood when so specified.

A.16.5 Seasoning : Only properly seasoned timber shall be used for first class work. Seasoning of timber shall be judged from its moisture contents as laid down in I.S. 287-1960. The timber should be well seasoned in the log before being cut into scantlings and thereafter also in scantlings as long as possible. Care must be taken to see that warping and cracking does not set in during seasoning.

The minimum permissible moisture contents for timber for various purposes shall be as under :-

Climatic Zones as per I.S. 287-1960

	Zone I Dry Area Annual fall below 50 cm (20")	Zone II Moderately Dry Area Annual rain fall 50 to 100 cm (20 to 40 ")	Zone III Moderately Humid Area Annual rain fall 100 to 200	Zone IV Humid Area Annual rain fall over 200 cm (75") (40 to 75")
Moisture Content (Percent of over dry weight of timber)				
A) For roof & floor timbers, roof & weather boarding & other carpenter's work	12	14	17	20
	Zone I Dry Area Annual fall below 50 cm (20")	Zone II Moderately Dry Area Annual rain fall 50 to 100 cm (20 to 40 ")	Zone III Moderately Humid Area Annual rain fall 100 to 200	Zone IV Humid Area Annual rain fall over 200 cm (75") (40 to 75")
Moisture Content (Percent of over dry weight of timber)				
B) For joinery including frames, stair cases, moulding & other joiner's work.	10	12	14	16

c) Floor & mat -ch boarding	8	10	10	12
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Notes :- The above limits may be relaxed for timber intended for temporary construction such as shorings from work, bullies, and the like.

A.16.6 Grading :- Grading for structural timber shall be as per clause 5 of I.S. 883-1966.

A.16.7 Stacking :- As soon as the foundations of a building are laid, all necessary timber scantlings shall be brought to site and stacked as laid down generally in I.S.1141-1966 and kept under cover and allowed to remain till required.

A.16.8 Inspection :- Timber for building work shall not be wrought until seen necessary approved by the Engineer, who may reject defective timber shall be immediately removed from the site of work. Any effort like plugging, painting, using any adhesives or resinous materials to hide the defects shall render the pieces rejectable by the Engineer. Timber presented for inspection shall be clean and free from dust, mud paint or other material which may conceal the defects. Cut off ends for protection can be done after inspection with raw linseed oil or any other material approved by the Engineer. No timber work shall be painted, tarred or oiled without the previews permission of the Engineer.

A.16.9 Sawing :- All scantlings, planks etc., shall be sawn in straight lines and planes and of uniform thickness and of full measurement from end and shall be sawn in the direction of the grain. They shall be sawn with such sufficient margin as to secure specified dimensions, lines and planes after being wrought.

A.16.10 Tolerances :- The Engineer may allow tolerances in the defects permissible as per I.S. 883-1966, clause 5.2 and table II in it, if in his opinion any particular permissible defect does not reduce the usefulness of the piece for the purpose for which it is required. The tolerances for defects shall be mentioned in the specifications for individual item of wood work.

Maximum slope of grain shall range between 1 in 10 and 1 in 20 as per I.S. 883-1966, clause 4.2.3.

A.16.11 Rejected Timber :- Any timber rejected shall at once be removed from the site of works.

A.16.12 Classification :- Timber shall be classified as :

- a) Logs round, square or rectangular when the felled timber is not at all processed or when its only partially hewn to a square or rectangular shape on the outside. Quantity is measured in cubic meters.
- b) Pole or post-natural felled timber without any processing, is classified according to the midgrith or middiameter or according to the girth or diameter at top and bottom excluding bark in each case. These are measured in meters in groups of each girth or diameter.
- c) **Planks** :- When the thickness of the sawn scantling is less than 5 cms. and width is more than 5 cm. they are classified as planks .

Quantity is measured in cubic meters or square meters with specified thickness.

- d) **Battens** :- When the thickness and width are each less than 5 cm. these are classified as battens and supply is measured in meters only an completed item in sq.metres.
- e) **Scantlings** :- Sawn scantlings of dimensions other than the above. These are measured in cubic meters.

A.17. OIL PAINTS

General :- The specifications cover the requirements for oil paint to be used as a garnishing material with respect to its composition, form, conditions, and tests to be carried out. Unless expressly permitted in the special provisions or directed by the Engineer, nothing but ready mixed (factory mixed) paints satisfying the I.S. specifications for the particular paint shall be used. But in case when the Engineer permits use of stiff paints, the procedure for preparing paints shall be as described in the specifications given below in (b)

(a) Ready Mixed Paints

A.17.1 Material :-The paint shall be of the specified colour and shade and approved by the Engineer. The Paint shall comply in all respect with relevant Indian Standard form :

I.S. : 105, 107, 111 to 116, 130 to 132, 134, 149 to 153, 159 and 163-1950.

I.S. : 108, 135, 136 - 1952.

I.S. : 102 to 104, 106, 118 to 129 - 1962.

I.S. : 117-1964.

I.S. : 133,137,148,154 to 157 - 1965.

I.S : 109, 110, 158, 161, 162 - 1968.

The exact references depending on choice of paint, the specified purpose to be served such as under-coating, finishing, exterior or interior painting & mode of application of paint like spraying and brushing. The detailed specifications for any item on painting shall mention the mode of application of paint. If mode is not mentioned application shall be with brushes.

Except as otherwise required in the cited specifications, all paints shall meet the following general requirements.

- A.17.1.1** The paint shall not show excessive settling in a freshly opened full can and shall be redispersed with a paddle to a smooth, homogeneous state. The paint shall show no curdling, levering, caking or colour separation and shall be free from lumps and skins.
- A.17.1.2** The paint as received shall brush easily, possess good levelling properties and show no cunining or sagging tendencies when applied to smooth steel vertical surfaces at a rate of 10 sq.m. per liter (about 500 sq. ft. per gallon)

17.1.3 The paint shall not skin within 48 hours in a three quarters filled closed container.

A.17.1.4 The paint shall dry to a smooth uniform finish free from roughness grit, unevenness and other surface imperfections. The paint shall show no striking or separation when flowed on clean glass.

A.17.1.5 All vehicles shall be free resin and resin derivatives. They may contain additional agents such as anti-sticking and wetting aids.

The paints shall be supplied in strong, substantial containers, clearly marked with ready mixed weight and volume of the manufacturer. They shall not be opened until actually required for use. Paints from containers which have been opened shall be used first.

A.17.2 Use :- Ready mixed paint shall be used exactly as received from the manufacturers and generally to their instructions and without any admixtures whatsoever except with the previous approval of the Engineer.

A.17.3 Tests:- In case of doubt regarding the quality, the paints supplied by the contractor shall be tested in an approved laboratory as described in I.S. 101-1964 if considered necessary by the Engineer. The cost will be borne by the Department if the paint satisfies the specifications and by the contractor if otherwise.

ROLLING STEEL SHUTTERS

Providing and fixing rolling steel shutters fabricated from 18/20 gauge steel laths with side guides bottom rail, brackets, door suspension shaft, rolling springs, locking arrangements and housing at the top including painting complete.

1. General : The rolling steel shutters shall be of approved make and design and shall be suitable for fixing in the position ordered, i.e. outside, inside, on or below lintel or between jambs. The shutter shall be of the manually operated pull or push up type up to 10 sq. m. area. If the area of the shutter is between 10 sq. m. and 13 sq. m. three ball bearings shall be provided for easy operation. The particulars of the shutters shall generally be as under unless any other suitable changes are proposed by the approved manufacture and accepted by the Engineer :-

- a) The shutter shall be constructed with curved slats or laths from mild steel sheets of the specified gauge. The laths shall be machine moulded and straightened with an effective bridge depth of 16 mm. These slats shall slide into one another forming a continuous hinge throughout their length and shall be fitted with alternating end lock.
- b) Side guides and Bottom rail shall be built up from mild steel rolled sections but in the case of small shutters they may be of pressed steel. The sizes of these members shall be as shown on drawings or as approved by the Engineer. The guides shall be generally 6 cm.
- c) Rolling springs shall be manufactured from tested unbreakable high tensile tempered spring steel wire or strip of adequate strength to balance the shutter in all positions.

- d) The springs assembly shall be supported on strong mild steel or malleable cast iron brackets shaped to fit the lintel. The shutter when coiled up shall be housed in a box of 18 guage sheet metal.
 - e) Locking arrangement shall be provided at the bottom of the shutter at both ends. The shutter shall be opened from outside.
 - f) The shutter shall be complete with door suspension shafts, locking arrangements, pulling hooks, handles and other accessories.
 - g) Fixing shall be done in a workmanlike manner so that the operation of the shutter is easy and smooth. All work disturbed or cut away shall be made good to match the existing.
2. **Finishing** : The whole work shall be painted with a coat of red lead and 2 coat of aluminium or other paint of approved shade as directed as per specification No. B.21.a.
3. **Item to include** : The rate shall include all labour, materials and use of equipment to carry out the following :-
- a) Providing and fabricating the shutter, guides, brackets, bottom rails, housing box and other accessories.
 - b) Transporting, erecting and fixing the shutter.
 - c) Finishing as specified above.
4. **Mode of measurement and payment** : The contract rate shall be per sq. m. of the clear opening to be covered. The dimensions of the opening shall be measured correct to two places of decimals of a metre and the area calculated correct to three places of decimal of a sq. m.

COLLAPSIBLE STEEL GATES

Providing and fixing collapsible steel gates in one/two leaves, with channel pickets, pivoted flat bars, including top and bottom, guide, rollers, stoppers, handles, all fitting accessories, locking arrangements and painting complete.

1. **General** : The item refers to collapsible steel gates in one or two leaves as mentioned in the item. The gates shall be of the approved design and make and fabricated out of best quality mild steel channels, flats, etc. Dimensions and other particulars shall generally be as under unless other design is shown in the drawings or approved by the Engineer :-
- a) **Pickets** : These shall be of 20 mm. mild steel channels of heavy section unless other sizes are shown in the drawings. Distance centre to centre of channel pickets shall be 12 cm. with an opening of 10 cm or as ordered.
 - b) Provided mild steel flats shall be 20 mm. x 6 mm. or as ordered.
 - c) Top and bottom guides shall be tee or flat iron of approved size.
 - d) Other fittings like stoppers, fixing holdfasts, locking cleats, brass handles brass lock and cast iron rollers shall be of approved design and size.

The fitting shall be done in a workmanlike manner. The gate shall open and close smoothly and easily. All work cut and disturbed in fixing shall be made good to match the existing. The bottom runner shall be sunk level with the floor and proper groove shall be formed along the runner.

2. **Finishing** : The gate shall be finished with 2 coats of oil paints of approved colour and shade on an undercoat of red lead as per B.21.a.
3. **Item to include** : The rate shall include all labour materials and use of equipment to carry out the following :
 - a) Providing the fabricated steel collapsible gate with its accessories and fitting and transporting it to the site.
 - b) Erecting and fixing the gate in the required position as specified above.
 - c) Finishing.

XXXXX

GENERAL SPECIFICATIONS FOR GENERAL ITEMS

B.1. EXCAVATION

Excavation for foundation including shoring and strutting as necessary and disposing of excavated stuff as directed

General :- The excavation will generally refer to open excavation of foundation wet or dry.

- B.1.1. **Clearing Site** : The site on which the structure is to be built shown on the plan and the area required for setting out and other operations should be cleared and all obstructions, loose stones, materials and rubbish of all kinds, stumps, brush wood and trees obtained will be the property of Government and materials pronounced useful by the Engineer will be conveyed and properly stacked as directed within the specified lead. Useless materials will be burnt or otherwise disposed of as directed by the Engineer.
- B.1.2. **Setting Out** : After clearing the site, the centre, the centre lines will be given by the Engineer and it will be the responsibility of the contractor to install substantial reference marks, bench marks, etc., and maintain them as long as required true to line, curve, level and slopes. The contractor will assume full responsibility for alignment, elevation, and dimension of each and all parts of the work. Labour, materials, etc. required for setting out and establishing Bench Marks and other reference marks shall be arranged by the contractor at his own cost.
- B.1.3. **Excavation** : Foundation excavation shall include removal of all materials of whatever nature and whether wet or dry, necessary for the construction of foundation and substructure exactly in accordance with the lines, levels, grades and curves shown on the plans or as directed by the Engineer. It shall be taken to the exact width of the lowest step of the footing and the sides shall be left plumb where the nature of soil admits it. Unless there is

a specific extra provision in the contract for shoring or for cutting of slopes to a safe angle or both as approved by the Engineer when the strata need such treatment. The contractor shall notify the Engineer before starting excavation to enable him to take cross sectional levels for purposes of measurements before the ground is disturbed.

- B.1.4 Preparation of Foundation for Footing :** The bottom of foundation shall be levelled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, final surface should be slightly watered and rammed. If any soft patches come to light in inspection or ramming, these shall be dug out and dealt with as ordered by the Engineer. No footing will be allowed to bring the foundation to level. If by contractor's mistake, excavation is made deeper than shown on the plans or ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the foundation grade as directed by the Engineer and at the cost of the contractor. All rock or other hard foundation shall be cleaned of all soft and loose material and cut to a firm surface, either levelled, stepped, or serrated as on the plan will be considered as approximate only and the Engineer may order such changes in the dimensions and elevation of the foundation as may be deemed necessary to secure satisfactory foundation.

After each excavation is completed the contractor shall notify the Engineer to that effect and no footing will be allowed to be laid until the Engineer has approved the depth and dimensions of excavation and the nature of the foundation material and the levels and/or measurements are recorded.

- B.1.5 Shoring :** Unless separately provided for in the contract, excavation of slopes to prevent falling in of sides or providing, fixing, maintaining and removing shoring, bracing, etc., shall not be paid for. The contractor would be responsible for the design of shoring for the excavation to be properly upheld. Shoring shall be of sufficient strength to resist side pressure and ensure safety from slips and blows and to prevent damage to work and property and injury to persons. It shall be removed as directed after all the items for which it is required are completed.

- B.1.6. Protection :** Near towns and all frequented places foundation pits, well pits and similar excavation shall be strongly fenced and marked with red lights at night in charge of watchman to avoid accidents. Adequate protective measures shall be taken to see that the foundation excavation does not affect or damage adjoining structures. All measures required for the safety of the excavation, the people working in and near the foundation trenches, properly and the people in the vicinity shall be taken by the contractor at his own cost, he being entirely responsible for any injury to life and damage to property caused by his negligence or accident due to his constructional operations.

- B.1.7 Disposal of Excavated Materials :** No materials excavated from foundation trenches of whatever kind may be are to be placed even temporarily nearer than 1.5 m or greater distance prescribed by the Engineer from the outer edge of excavation. All materials excavated will remain the property of Government. Rate for excavation, includes sorting out of useful

materials and sacking them separately as directed within the specified lead. Materials suitable and useful for backfilling or other use shall be stacked in convenient places but not in such a way as to obstruct free movement of men, animals and vehicles or encroach on the area required or constructional purposes. It shall be used to the extent required to completely backfill the structure to original ground level or the elevation shown on the plans or as directed by the Engineer. For backfilling, the materials shall be placed in 15 to 20 cm. layers, moistened, and well compacted. Materials not useful in any way shall be wasted as directed by the Engineer. If useful excavated rubble is required by the contractor for use in other items, it shall be paid for at the rate fixed in the tender and if not so provided, at the rate in the divisional schedule current at the time of tendering or at mutually agreed rate if there is no rate in the divisional Schedule. The site shall be left clean of all debris on completion.

B.1.8 Dewatering : Unless specially provided for as a separate item in the contract, the excavation rate would include bailing or pumping out all water which may accumulate in the excavation during the progress of the work either from seepage, springs, rain or any other cause and diverting surface flow if any, by bunds or other means. The bunds shall be removed after their purpose is served.

Pumping out water from any foundation enclosure or trenches shall be generally in such a manner to preclude the possibility of any damage to the foundation trenches, concrete or masonry to any adjacent structure. The excavation shall be kept free from water (1) during inspection and measurement, (2) when concrete and/or masonry are in progress and till they come above the natural water level, and (3) till the Engineer considers that the mortar is sufficiently set.

B.1.9 Slips and Blows : If there are any slips or blows in the excavation they shall be removed by the contractor without cost to the Department so as to provide the correct dimensions required from the foundation.

B.1.10 Backfilling : All timber shoring and form-work shall be removed after their necessity ceases and trash of any sort shall be cleaned out from the excavation. All space between foundation masonry or concrete and the sides of excavation must be refilled to the original surface with approved materials, in layers of 15 cm. to 20 cm. in thickness, watered and rammed.

B.1.11 Blasting : Blasting shall be carried out according to specification No. B.2

B.1.12 Classification : All the materials encountered in the excavation would be mainly classified in the following groups.

1. Soils of all sorts, gravel, murum and other similar soft or loose materials.
2. Hard murum.
3. Hard murum and boulders.
4. Soft Rock.

5. Hard Rock (blasted)
 6. Hard Rock (chiselled, wedged or line drilled)
 7. Laterite.
1. **Soils of all Sorts, Sand, Gravel, Soft Murum and other similar soft or loose materials** : Soils of all sorts, sand, gravel, soft murum, softman, chopan yellow soil etc. shall include all materials of earthy or sandy nature which can be easily ploughed or small shingle and gravel which can be easily removed. Removal of small boulders not exceeding 0.03 cu.m. or 30 liters occurring such strata will be included in the rate of this item.
 2. **Hard Murum** : This shall include all kinds of disintegrated rock or shale or indurated clay free from boulders larger than 0.03 cu.m. or 30 liters and can be removed with pick and shovel though not without some difficulty.
 3. **Hard Murum and Boulders** : This shall include all kinds of disintegrated rock or shale or indurated clay interspersed with boulders less than half a cubic meter and larger than 0.03 cu.m. or 30 liters which do not normally need blasting and can be removed with pick, bar, wedges, and hammer. Boulders bigger than 1/2 cu.m. will be paid for as soft or hard rock according as it is soft or hard rock.
 4. **Soft Rock** : This shall include all material which is rock or hard conglomerate, all decomposed or weathered rock, highly fissured rock, old masonry and also soft rock, boulders bigger than 1/2 cubic meter and other varieties of rock which would normally be removed with pick, crow bars, wedges and hammer with some difficulty.
 5. **Hard Rock (Blasted)** : This shall include all rock occurring in masses or boulders bigger than half cubic meter each, which can best be removed by blasting and where in the opinion of the Engineer, blasting is necessary Manjra rock shall be considered as hard rock.
 6. **Hard Rock (Chiselled, Wedged or line Drilled)** : This shall include all rock occurring in masses which can best be removed by blasting but which owing to the proximity of structures, possibility of shattering the rock below or for any other reason should be cut by means of cold chisels or wedges or line drilling.
 7. **Laterite** : This shall include Laterite rock soft and hard which can be removed with Dhokans or blasting. Laterite murum which has not hardened into stone shall be classified as hard murum.

The classification of the excavation would be decided by the Engineer and his decision shall be final and binding on the contractor.

Rock referred to above would include trap, granite, quartzite, gneiss, laterite and other types.

B.1.13 Item to include : The rate for the item of excavation will include :

1. Clearing Site.
2. Setting out works, profiles, etc., according to sanctioned plan or as ordered and setting up bench marks and other reference marks.

3. Providing and subsequently removing shoring and strutting or cutting except when, separately provided for in the tender.
4. Bailing & pumping out water when separate provision does not exist for it in the tender.
5. Excavation and removal of all materials of whatever nature wet or dry and necessary for the construction of foundation including materials like explosives, removal of blows and slips and use of tools, plant and equipment necessary for satisfactory completion of the item and preparing bed for foundation.
6. Sorting out of useful excavated materials, conveying them up to the specified lead clear beyond the structure and stacking them neatly for back filling or reuse and wasting useless materials as directed by the Engineer.
7. Backfilling the trenches alongside masonry or concrete with approved material upto the natural ground level.
8. Necessary protection including labour, materials and equipment to ensure safety and protection against risk or accident.
9. Supply of facilities for inspection and measurements at any time by the concerned Government Officials.
10. Compensation for injury to life and damage to property if any caused by the Contractor's operations with this item.
11. small drill holes to explore the nature of substratum if necessary.

B.1.14 Measurement & Payment : The Payment for respective class of excavation shall be made at the unit contract rate per cubic meter for the quantity acceptably excavated limited to the dimensions shown in the sanctioned plans or as directed by the Engineer. Excavation to dimensions in excess of the above will not be measured not paid for and if so ordered by the Engineer the contractor shall have to fill up the excess depth with cement concrete or U.C.R. masonry specified for foundation without extra payment.

Driving of sounding bars, or jumping small drill holes to explore the nature of substratum of upto a total length of meter distributed in 2 or 3 places in each foundation if necessary, will be considered incidental work and will not be paid for separately.

Removal of slips and blows in the foundation trenches will not be measured nor paid for.

If it is necessary in the opinion of the engineer to carry foundation below the levels shown on the plans, the excavation for the first 1.5 m, of additional depth will be included in the quantity for the particular classification at tendered rate. The excavation below this additional depth of 1.5 meters will be paid for as extra work at rate or be decided under the general conditions of contract unless the contractor is willing to accept payment at tendered rates. For all depths less than the designed depth plus 1.5 meters the excavation will be paid for at tendered rates.

Dimensions shall be measured correct to two places of decimals of a meter and individual quantity shall be calculated correct to two places of decimals of a cubic meter.

B.2. BLASTING

B.2.1 General :- Blasting shall be carried out only with the written permission of the Engineer. All the laws, regulations, rules, etc. pertaining to the acquisition, transport, storage, handling and use of explosives shall be rigidly followed. The magazine for the storage of explosives shall be built to the designs and specifications of the explosives department and located at the approved site. No unauthorized person shall be admitted into the magazine and when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lighting conductor. The following shall be hung in the lobby of the magazine.

- a) A copy of rules both in English and in the languages with which the workers concerned are familiar.
- b) A statement of up-to-date stock in the magazine.
- c) A certificate showing the last date of testing of the lighting conductor.
- d) A notice that smoking is strictly prohibited.

In addition to these, the contractor shall also observe the following instructions and any further additional instructions which may be given by the Engineer and shall be responsible for damage to property and any accident which may occur or workmen or the public due to any and all operations connected with storing and handling or use of explosives and blasting. The Engineer shall frequently check the contractor's compliance with the precautions.

B.2.2 Materials, Tools and Equipment :

The black powder, explosives detonators, fuses, tamping materials, electrical firing equipment, if used, tools for drilling holes and tamping shall be subject to the approval of the Engineer. The Engineer may specify type of explosives to be allowed in special cases. The fuse to be used in wet locations shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and definitely known to permit such a safe length being cut as will permit sufficient time to the firer to reach safety before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators, fuses, etc. shall be fresh and not damaged due to damp, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed immediately.

B.2.3 Personnel : The blasting operation shall remain in charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

B.2.4 Blasting Operation : The blasting shall be carried out during fixed hours of the day preferably during the midday lunch hour or at the close of the work

as ordered in writing by the Engineer. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only.

Red danger flags shall be displayed prominently in all directions during the blasting operations. People except those who actually light the fuse shall be prohibited from entering into this area. The flags shall be stationed at 200 meters from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.

The charge holes shall be drilled to required depths and in suitable places.

When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.

When blasting is done with dynamite and other high explosives, dynamite cartridges are prepared by inserting the square cut end of a fuse into the detonator and finishing it with nippers at the open end, the detonator gently pushed into the primer leaving 1/3rd of the copper tube exposed outside. The paper of the cartridge is then closed up and securely bound with wire or twine. The primer shall be housed into the explosives. Bore holes shall be of such size that the cartridge can easily pass down. The holes shall be cleared of all debris and explosive inserted. The space for about 20 cm. (8") above the charge is then gently filled with dry clay, pressed home and the rest of the tamping is formed of any convenient material gently packed with a wooden rammer.

At a time not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognized manner for cautioning the people. All the people shall then be required to move to safe distance. The charges shall be lighted by the man in charge only. The man in charge shall count the number of explosion. He shall satisfy himself all the charges have been exploded before allowing the workmen to go to the work site.

B.2.5 Misfire : In case of a misfire the following procedure shall be observed

Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charge.

If it is blasting powder charge it shall be completely flooded with water, A new hole shall be drilled at about 45 cm. from the old hole and fired. This should blast the old charge. Should it not blast the old charge. alternatively the hole may be cleared of one foot of tamping and the direction then ascertained by placing a stock in the hole. Another hole may then be drilled 15 cm. away and parallel to it. This hole shall then be charged and fired when the misfired hole should explode at the same time. The man in charge shall report to the office at once all cases of misfire, the cause of the same and what steps were taken in connection therewith.

If a misfire has been found to be due to defective detonator or dynamite, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer for inspection to ascertain whether all the remaining materials in the box are also defective.

B.2.6 Accidents : The contractor shall be solely responsible for any accident during the entire procedure of handling explosive and blasting and shall pay necessary compensation to persons affected or damage to lands or property, etc. due to the blasting without extra claims.

B.2.7. Account : A careful and day-to-day account of the explosives shall be maintained by the contractor in an approved register and in an approved manner and shall be open to inspection of the Engineer at all times. Surprise visit may also be paid by the Engineer to the storage and in case of any unaccountable shortage or unsatisfactory account, the contractor shall be liable to be penalized by forfeiture of part or whole of his security deposit or by cancellation of tender in which case he shall not be entitled for any compensation.

B.5. CEMENT MORTAR FOR MASONRY, PLASTER AND POINTING

B.5.(a)1.Materials :

1. **Cement** : Ordinary Portland cement shall conform to specification No. A.2.
2. **Water** : Water shall conform to specification No. A.5.
3. **Fine Aggregate** : Fine aggregate shall conform to specification No. A.6. with grading suitable for the purpose of the particular item.

B.5.(a)2. Proportion : Cement and sand shall be mixed in specified proportions and being measured in measuring boxes. The proportions will be by volume on the basis of 50 Kg. bag of cement being equal to 35 liters. The mortar may be hand mixed or machine mixed.

B.5.(a)3.1 Preparation : In hand-mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Fresh and clean water as specified above shall be added gradually through a rose and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio may be as under or as directed by the Engineer.

Nominal Mix

Cement	Sand	Water cement ratio	Quantity of Water per 50 kg of Cement (litres)
1	1	0.25	12.5
1	1 1/2	0.28	14.0
1	2	0.30	15.0

1	2 1/2	0.35	17.0
1	3	0.40	20.0
1	4	0.53	26.5
1	5	0.60	30.00
1	6	0.70	35.00
1	8	0.90	45.00

Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar nor the mixing water of the mortar shall flow out.

B.5.(a).3.2 Machine mixed mortar shall be prepared in an appropriate mixer. About 5 percent to 10 percent of mixing water shall be put into the mixer and sand and cement in the required proportions shall be then added. The remainder of water, quantity of which shall be predetermined by consideration of strength and consistency shall be added uniformly. Mixing will be continued until all particles of sand are uniformly coated with cement paste.

Mixing for 1 1/2 to 2 minutes will normally be sufficient. Water cement ratio shall be as per hand mixed mortar.

B.5(a)4. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or mortar which has partially hardened or is otherwise damaged shall not be retempered or remixed. It shall be destroyed or thrown away.

B.6. ORDINARY CEMENT CONCRETE FOR PLAIN AND REINFORCED WORK

B.6.1 General : This specification covers the requirements of ordinary cement concrete of the specified proportions for use in various concrete items. Special requirements for a particular item will be laid down in the specifications for that item I.S. 456-1964 shall apply except for deviations laid down in this specification.

B.6.2 Materials :

- 1) **Cement** : Cement shall conform to specification No.A.2 When type of cement is not specified, Ordinary Portland cement shall be used.
- 2) **Water** : Water shall conform to specification No. A.5.
- 3) **Fine Aggregate** : Fine aggregate 0.15mm. to 5mm. I.S. sieve Nos. 15 to 480 shall conform to specification No.A.6.
- 4) **Coarse Aggregate** : Coarse aggregate 5mm. to 80mm. shall conform to specification No.A.7 and shall conform to specification No. A.6.

Size : The maximum size of coarse aggregate shall be as large as possible but normally not greater than 1/4th of the minimum thickness of the concrete member provided that in the case of R.C.C. This size presents no difficulty to surround the reinforcement thoroughly and fill up the corners of the formwork fully and is less than the minimum cover by 6mm. For plain cement concrete, maximum size of the coarse aggregate may be upto 80mm. subject to the above limitation and provided no limiting size is specified in the special provisions.

For heavily reinforced concrete members such as ribs of beams, etc., the maximum size of aggregate shall be restricted to 6mm. less than the minimum clear lateral distance between the reinforcement bars or 6mm. less than the cover whichever is smaller.

Generally a maximum size of 20mm. should be found satisfactory for reinforced concrete work.

The grading between the maximum size and minimum size of 5mm. shall be such as to produce a dense concrete of the specified proportion and consistency that will work readily into position without segregation and without the use of excessive water content and shall be within limits given in A.7.3.

B.6.3. Proportioning Mix : In ordinary concrete, although proportion of cement to fine and coarse aggregate is specified by volume, the quantity of cement shall be determined by weight assuming one bag to cement weighing 50 kg. net to be equivalent to 35 liter. Fine and coarse aggregate shall be measured by dry volumes in suitable wooden boxes. Due allowance shall be made for bulking in the fine aggregate due to moisture if any, at the time of mixing.

Ingredients required for concrete containing one 50 kg. bag of cement for different proportions of mix be as under :

Mix Cement	Fine Agregate Water	Coarse	Agregate
1:1 : 250 Kg. bag	35 liters	70 liters	23 to 27 liters
1:1 1/2. do .53.5 liters	53.5 liters	105 liters	23 to 30 liters
1:2:4.. do..	70 liters	140 liters	27 to 32 liters
1:3:6.. do..	105 liters	210 liters	37.5 to 45 liters
1:4:8.. do..	140 liters	280 liters	47.5 to 57 liters
1:5:10.. do..	175 liters	350 liters	56 to 68 liters

The ratio of the volume of the fine and coarse aggregates may be varied within limits of 1:2 1/2 to 1:2 1/2 as directed by the Engineer to suit the

maximum size of coarse aggregate, the grading, density, workability and strength without extra cost. But the sum of the volumes of fine and coarse aggregates so adjusted shall however be equal to the sum of the volumes of fine and coarse aggregates given above for the particulars mix.

The quantity of water shall be just sufficient, but not more than sufficient, to produce a dense concrete of required workability for its purpose. An accurate control shall be kept on the quantity of mixing water.

An allowance shall be made for surface moisture present in the aggregate when computing water content as indicated in I.S. 456-1964.

In the case of reinforced concrete work, the workability shall be such that the concrete will surround and properly grip all the reinforcement. Water cement ratio will be such as will give concrete just sufficiently wet to be placed and compacted without difficulty.

For vibrated concrete water content may be reduced by 15 percent to 20 percent to give the required reduced slump.

B.6.4 Mixing : For all important works concrete shall be mixed in a mechanical mixer at the site of work. Care shall be taken to see that the mixer and other accessories are in first class working condition and maintained so throughout the construction. Mixing shall be continued till there is a uniform colour is obtained and each individual particle of the coarse aggregate shall show a complete coating of mortar containing its proportionate amount of cement. In no case mixing shall be done for less than 1 1/2 minutes. The water cement ratio shall range between 0.55 to 0.64 for 1:2:4 mix.

When hand mixing is permitted by the Engineer it shall be done on a smooth water tight platform large enough to allow efficient turning over of the ingredients of concrete before and after adding water. Mixing platform shall be so arranged that no foreign material shall get mixed with concrete nor the mixing water shall flow out.

The cement in required number of bags shall be placed in a uniform layer on top of the measured quantity of fine aggregate required, also spread in a layer of uniform depth in the making platform. Dry sand and cement shall then be mixed thoroughly by turning over to get a mixture of uniform colour. Enough water shall then be added gradually through a rose and the mass turned over till a mortar of required consistency is obtained. The measured quantity of coarse aggregate shall then be placed on the mixing platform and wetted and the mortar added and the entire mass turned and returned until all the particles of the coarse aggregate are fully covered with mortar and the mixture is of a uniform colour and required consistency. In hand mixing, quantity of cement shall be increased by 5 per cent. above that specified in para B.6.3 without any extra cost.

Concrete shall have a consistency such that it will be workable in the required position and in the case of R.C.C. flow around reinforcing steel also.

For vibrated concrete, slump shall range between 2.5 c, to 5 cm. For hand

tamped concrete, slump shall range between 8 cm. to 13 cm. according to the type and nature of concrete item. The slump shall be the least permitted by workability. The slump shall be determined as detailed in appendix G of I.S. 456-1964 and maintained throughout the concreting operation of a member.

The concrete shall be placed in its final position and rammed, vibrated and finished with 30 minutes of adding water to cement retempering or remixing of partially hardened concrete shall not be permitted.

B.6.5a. Scaffolding : All scaffolding, hoisting arrangements and ladders etc. required for the facility of concreting shall be provided by the contractor at his own expenses and removed on the completion of work. The scaffolding, hoisting arrangements and ladders, etc. shall be strong enough to withstand all live, dead and impact loads expected to act and shall be subject to the approval of the Engineer. However the contractor shall be solely responsible for the safety of the scaffolding, hoisting arrangements, ladders, work and workman. The contractor shall pay all the necessary compensations arising out of the use of the scaffolding hoisting arrangements and ladders and for damages to work, property and injuries to persons.

The scaffolding, hoisting arrangements and ladders shall allow easy approach to the work spot and afford easy inspection.

B.6.5b. Forms : Forms shall generally comply with I.S. 456- 1964.

B.6.5b.1 Design : The detailed designs of the form work shall be prepared by the contractor and got approved by the Engineer well in time. Such an approval, however, will not relieve the contractor of his responsibility for the adequacy and strength of the formwork and falsework.

B.6.5b.2 Materials : The forms and false work shall be made of wood or metal.

The timber from which the forms are prepared should preferably be partially seasoned as too dry a timber will swell from absorption of moisture while green timber will dry and shrink. It shall be free from sap, shakes, loose knots, wormholes or other defects. The planks and scantlings shall be sawn straight and all edges and planes shall be straight and free from warps. Partially seasoned soft wood is generally preferable for formwork as it is difficult to drive nails in hard wood. The dimensions of scantlings should conform to the design. The strength of the wood shall not be less than that assumed in the design.

In metal forms, steel sheets of the designed gauge strengthened with framing of angle or other sections shall be used.

Wooden forms may also be lined with thin steel sheets or plywood to give the required surface or finish.

B.6.5b.3 Fabrication: The timber planks and scantlings of the designed dimensions shall be used in the formwork with appropriate spacing of studs, yokes, joists, girders, etc. as provided in the design. All timber in contact with concrete shall be wrought on one face and two edges, the unwrought

face being on the outside. The joints should be made mortat tight. This may be done either by providing tongued and proved or rebated joints or by caulking or nailing metal strips or applying adhesive tape on the joints. The forms shall be built with sufficient strength and rigidity and held in shape by bolts, clamps, ties, nails, wales or other contrivances to prevent distortion or collapse due to pressure of concrete and other loads incidental to the construction operations. The nuts and bolt heads inside the formwork adjoining the concrete should be countersunk. The form work should allow finished concrete to have a smooth surface and conform to the shapes, lines and dimensions shown on the plans and true to line and grade. The effect of vibration shall be taken into account in the design and fabrication of forms and false work.

Form shall be so designed and constructed as to be removable in sections without damaging the surface of the concrete and with facilities of removal in the ascending order of removal time, without disturbing the remaining forms required to be removed later.

B.6.5b.4 Treatment of the Inside of Forms : Before placing concrete, the inside of the forms which comes in contact with the concrete shall be coated with mineral oil or any other suitable material approved by the Engineer which will prevent adhesion of concrete to the forms but will not discolor the concrete. When oil is used, it shall be applied before reinforcement is placed. Care shall be taken to see that reinforcement does not come in contact with the coating. All chippings, saw dust and other rubbish shall be removed from the interior of the forms before concreting.

B.6.5b.5 Formwork: Formwork shall be built on foundation or base of sufficient strength to carry the loads without settlement. Formwork which cannot be founded on solid footing must be supported by piles or other similar devices. formwork shall be designed to carry the full loads including that due to construction operations coming upon it.

B.6.5b.6 Erection : The falsework and formwork shall be erected with an eye for absolute safety of the formwork and concrete work before, during and after pouring concrete. Watch should be kept to see that the behaviour of centering and formwork is satisfactory during concreting. Erection should also be such that it would allow removal of forms in proper sequence without damaging either the concrete or the forms to be removed later.

If there is failure of false work and/or formwork the contractor shall be responsible for the consequent damages to work, injury to life and damage to property.

B.6.5b.7 Inspection: The forms and false work will be inspected, checked and approved by the Engineer before concreting is commenced. But this will not relive the contractor of his responsibility for strength, adequacy and safety of the formwork and falsework.

B.6.5b.8 Removal of Forms : Formwork shall be removed carefully without damaging the concrete or giving sudden shocks. It should be ascertained from the exposed sides of concrete that it has gained adequate strength before the bottoms and supports of the formwork are removed.

Unless otherwise specified in the special provisions, forms of concrete work using ordinary portland cement may be struck after expiry of the following periods in normal circumstances :

- | | |
|---|----|
| i) Vertical sides of slabs, beams, columns
hours. | 48 |
| ii) Bottoms of slabs upto 4.5 m span
days | 7 |
| iii) Bottoms of slabs of more than 4.5 m span,
bottoms of beams and archribs upto 6 m span.
14 days | |
| iv) Bottoms of beams and archribs of more than 6 m span
days | 21 |

In important structures, the sequences of striking formwork shall be approved by the Engineer.

B.6.5b.9 Reuse : Before reuse, all forms shall be thoroughly scraped and cleaned, joints gone over and repaired and insides retreated to prevent adhesion, all to the entire satisfaction of the Engineer. The shape, strength, rigidity, mortar tightness and surface smoothness of reused forms shall be maintained at all times.

B.6.6. Transporting : The concrete shall be handled from the place of mixing to the final position as quickly as practicable by methods which will prevent segregation and loss of ingredients. In no case shall the operation take more than 15 minutes.

B.6.7. Placing : The concrete shall be placed into its final position, compacted and finished within 30 minutes of mixing the water and before setting commences. The method of placing shall be such as to avoid segregation. Placing shall be done in a balanced manner to avoid eccentric loads on formwork.

As far as practicable the concrete for a particular portion shall be done in one continuous operation. The construction joints when required shall be made only where located on the plans or shown in the pouring schedule unless otherwise approved by the Engineer. The joint shall be regular and vertical and shall be made by placing a bulk head at the joint. Before commencing subsequent concreting, all loose particles, laitance, etc. shall be removed and the surface shall then be covered by thick cement slurry as part of placement. Care shall be taken during the placing not to disturb the forms or the reinforcement. Concrete compacted manually, shall preferably be laid in layers of 15 cm. to 20 cm. the layers being decided by the time lapse between the successive layers. The time of layer shall not exceed 30 minutes. The successive layers shall commence within 30 minutes.

When work is to be resumed on a surface which has hardened, such a surface shall be roughened and scrubbed with brushes to remove laitance, care being taken to avoid dislodgment of coarse aggregate, swept clean, thoroughly wetted and covered with 6 mm thick mortar layer

composed of cement and sand in the same proportion as the cement and sand in the concrete, immediately before the commencement of concrete, for securing good bond.

The concrete shall be normally laid in the dry. If the area is under water, it shall be pumped dry and kept so while placing concrete and till it sets. Where it is necessary to deposit concrete under water, it shall be done as per I.S. 456-1984 para 7.1.7. No extra payment will be made for the special arrangements, plant, etc. needed for the purpose or for the additional 10 per cent. cement required to be added.

- B.6.8. Compacting :** The concrete shall be thoroughly compacted during depositing to get a dense concrete and thoroughly worked into the edges and corners of the formwork as also along its faces and around reinforcement in the case of R.C.C. by means of suitable tools such as spades and rods to get a good cast finish without honey combing. Concrete shall not be disturbed once it is set.

For important or big works where stiffer mix with less slump is adopted, use of mechanical vibrators is essential. The vibrators shall have not less than 3,600 and preferably about 5,000 impulses per minutes and shall be worked at an interval of about 60 cm. It shall be worked in one place for only such time as will allow formation of dense concrete without sinking and segregation of the coarse aggregate. Over vibration shall be avoided. Vibration shall be aided by spading and rodding.

- B.6.9. Curing:** The concrete shall be initially protected from damage on of impact. undue pressure, excessive heat of sun, rain etc. and covered with wet sacking, hessian or similar absorbent material soon after the initial set. After the final set, the concrete shall be kept continuously wet preferably by ponding water for a period of not less than 14 days from the date of placement. On sundays, holidays and days of cessation of work, arrangement shall be made to keep it continuously watered.

Should the contractor fail to water the concrete continuously, the Engineer may provide Labour, materials and equipment required for watering and recover the cost from the contractor.

When atmospheric temperature exceeds 40°C (104°F) following precautions should be taken.

1. **Stacking aggregates under shade and keeping them moist.**

2. Using cold water.
3. Reduce the time between mixing and placing to the minimum.
4. Cooling formwork by sprinkling water.
5. Starting curing before concrete dries out.
6. Restricting concreting to mornings and evenings.

- B.6.10. Finishing :** Immediately after the removal of forms, any undulations, depressions, cavities, honeycombing, broken edges or corners, high spots and other defects shall be made good and finished with cement mortar

1:2. But the necessity of such finishing must be exceptional and the total surface requiring finishing shall not exceed 1 percent on an average. If the initial experience shows that this percentage is exceeded the methods of working itself should be changed to get the required cast finish.

Where the concrete surface is to receive plaster, the surface shall be roughened immediately after removal of forms and within a day thereof to secure a hold for the plaster. The rate for concrete is inclusive of this roughening and finishing. Concrete after finishing shall be cured for the full period.

B.6.11. Retempering : Concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial set shall not be used. Concrete which is partially hardened shall not be retempered or re-mixed but shall be destroyed or thrown away.

B.6.12. Sampling and Testing : Sampling of materials and concrete shall be done carefully by the contractor under the direct supervision of the Departmental staff as per I.S. 456-1964 at the cost of the contractor. All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing, etc., shall be provided by the contractor. Testing of the materials and concrete will be arranged by the department in approved laboratory at the cost off the contractor. No plea will be entertained later on the ground that casting of the test specimen was faulty and that the result of the test specimen did not give a correct indication of the actual quality of concrete. Compressive strength of ordinary concrete shall not be less than those specified below :

No.	Mix	Work test on 15 cm cubes	
		Kg./sq.cm at 7 days	Kg./sq.cm at 28 days
1.	1:1:21	58	242
2.	1:1 1/2:3	131	200
3.	1:2:3	105	158
4.	1:3:6	66	100
5.	1:4:8	49	73

One set of six 15 cm. cubes shall be prepared from the concrete to be used in the work of compression test on each of the first three days operation and thereafter for every 60 cu.m. of concrete or three day's work whichever is less, by the contractor in the presence of a responsible officer of the Department of a rank not less than that of an overseer. If the source of aggregate or grading is changed, one set of six test cubes shall be taken for each changed batch. Three cubes shall be used for test of 7 day's age and three at 28 days.

After the relation between strengths at 7 days and 28 days is reliably

established for the particular set of materials from the same sources, subsequent tests may be carried out only on three cubes at 7 days. If the average strength of the cubes show ultimate compressive strength less than the above the Engineer shall have a right to order a change in the mix or water content for the remaining concrete without extra cost. Defective concrete having strength below 80 per cent of the required strength is liable to be rejected. Concrete of strength upto per cent of the required strength may be accepted as substandard work at a reduced rate provided such weak concrete is restricted to such members and in such quantities as will not endanger the safety of the structure.

B.6.13. Keeping record : A day-to-day record authenticated by a responsible officer of the department and the representative of the contractor, in the proforma approved by the Engineer shall be maintained by the contractor on the work site and kept open for inspection. This shall contain important information such as receipt of cement on the work site, daily use with details of use on various items, time of starting concreting and closure, number of batches through the mixer, sources of water, water cement ratio of concrete, slump, dates of erection of formwork, passing of formwork by the competent authority, dates of striking of forms, periods, and method of curing and other events worthy of notes. On completion of the work, the record shall be handed over to the Department.

B.6.14. Item to Include : 1. All labour, materials, use of equipment, tools and plant, installing and removal of scaffolding, false work and forms and bracing necessary for the satisfactory completion of the item except reinforcement steel.

2. Providing cement concrete of specified proportion including transporting, placing and compacting, curing, finishing to the dimensions and shapes shown on the plans or as ordered by the Engineer.

3. Necessary sampling and tests for materials of concrete.

4. Compensation for injury to persons and damages to work or property.

B.6.15. Mode of Measurement and Payment : The contract rate shall be for a unit of one cubic meter of concrete. The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on the plan or as ordered by the Engineer. No deduction shall be made for reinforcement in concrete in R.C.C. work. Individual dimension shall be measured correct to one cu.m. and quantities shall be worked out correct upto three places of decimals of a cubic meter.

B.7. CONTROLLED CEMENT CONCRETE

Controlled concrete is that concrete in which proportions of aggregates, cement and water are determined by preliminary tests of the materials to be actually used to obtain the specified strength with the use of minimum quantity of cement. It shall generally comply with relevant provisions in I.S. 456- 1964.

- B.7.1. Materials :** Ordinary Portland cement, fine aggregates, coarse aggregate and water shall comply with specifications laid down for the respective items in specification No. B.6 for ordinary concrete.
- B.7.2 Proportioning Mix :** The mix of the fine aggregates, coarse aggregate and water shall be designed by preliminary tests to give the densest concrete requiring the minimum quantity of cement paste for binding the materials to give the required strength. Water content shall be such as to suit the required consistency. Water content and the water cement ratio shall be determined from the results of preliminary tests of concrete to give the specified strength with the materials proposed for actual use in the work, carried out before the work is started, adopting the consistency suitable for the work & method of compaction that will be actually used on site.
- B.7.3 Tests :** Tests shall conform to the specification laid down in I.S. 456-1964. These tests shall be got done in an approved laboratory at the cost of the contractor.
- B.7.3.1 Preliminary Tests :** In preliminary tests, three separate tests shall be carried out on samples collected from different stacks. Each test shall be carried out with six samples of 15 cm. cubes and 3 of these shall be tested at 7 days and 3 at 28 days. In preliminary tests the average crushing strength attained shall be 33 per cent. higher than that required on work tests.
- B.7.3.2 Work Tests :** For each of the works tests, 6 samples shall be prepared from the concrete being used on the work, 3 samples being tested at 7 days and the remaining 3 samples at 28 days. Works test shall be carried out on each of the first six days and subsequently once in three working days or for every 60 cu.m. of concrete which ever is less and also whenever the quality or grading of the materials is changed. When a relation between the strengths at 7 days and 28 days is established only 3 samples may be prepared and tested at 7 days only. This normal number of control specimen tests may be increased if the Engineer considers it necessary.
- B.7.4. Field Mix :** The actual proportions of the fine and coarse aggregates will be determined by preliminary tests. In the work tests, bulkage of sand due to moisture actually present at the time of mixing. This moisture will be taken into account in controlling the mixing water also. The proportions once fixed by preliminary tests shall not be changed so long as the materials are the same, subject only to the quantities of fine aggregate and water being adjusted to compensate for bulkage due to the moisture in sand and free water in fine aggregate at the time of use.

No change of materials shall be allowed unless fresh tests with new materials show satisfactory results.

Water and cement content per batch of concrete as determined by preliminary tests shall be maintained constant except for suitable allowances to be made for surface moisture of the aggregates at the time of actual use.

The minimum quantity of cement to be used in controlled concrete shall not be less than 305 kg. per cu.m. of finished reinforced cement concrete of (M-150) grade and 395 kg. per cu.m. of finished reinforced cement concrete of (M-200) grade.

For any particular item, compressive strength required to be attained by the concrete at 28 days in the preliminary and works tests on 15 cm. cubes, minimum cement content required to be used and approximate proportions of approved fine and coarse aggregates shall be specified in the special provisions. These particulars will be only for the guidance of the contractor for quoting rates.

Immediately upon the receipt of the award of the contract, the contractor shall inform the Engineer the exact location of the sources of the acceptable materials which he proposes to use and get the materials approved. The mix with the actual approved materials to be used shall be got designed in an approved laboratory by the contractor with minimum quantity and cement to give the specified strength in the preliminary tests and the proportions got approved by the engineer in writing. These proportions shall be used so long as the materials continue to be of the same quality and from the same sources subject only to slight changes in the relative quantities of fine and coarse aggregates for the purpose of promoting workability provided the works tests also show the required strengths.

If during the progress of the work, the contractor wishes to change the materials, the proportions shall be fixed on the basis of fresh preliminary test to give the required strength after the Engineer is satisfied that the materials satisfy the specifications. No adjustment of cost shall be made for change of proportions of cement fixed in the original preliminary tests.

- B.7.5. Mixing :** Mixing shall comply with specification No. B.6.4. Mixing shall be done only by Mechanical mixers.
- B.7.6. Forms :** Forms shall comply with specification No.B.6.5(b).
- B.7.7. Transporting :** Transport shall comply with specification No. B.6.6.
- B.7.8. Placing :** Placing shall comply with specification No. B.6.7.
- B.7.9. Compacting :** Compacting shall comply with specification No. B.6.8.
Compacting shall necessarily be done by mechanical vibrators. No hand compaction will be permitted except (i) to supplement vibration near the edges and faces of forms, to fill the corners completely and to prevent honey combing or (ii) in members where vibration is not possible nor desirable in the opinion of the Engineer.
- B.7.10. Curing :** Curing shall comply with specification No.B.6.9.
- B.7.11. Finishing :** Finishing shall comply with specification B.6.10.
- B.7.12. Retempering :** Specification No. B.6.11. shall be followed.
- B.7.13. Sampling and Testing :** Sampling and testing shall comply with B.7.3 above, special provision in the tender and relevant provision of B.6.12.

B.7.14. Keeping Records : Records shall be maintained and dealt as per specification No.B.6.13.

B.7.15. Item to Include : All the provisions prescribed in specification No. B.6.14 and also the preliminary laboratory tests to determine the exact proportions of the concrete mix to give the specified strength and control tests during the concreting operations.

B.7.16. Measurement payment shall be as per specifications of B.6.15

The bidder shall ensure that the cement procured by him from open market shall be from fresh stock and of superior quality. It shall be his responsibility to get the mix design and use cement in quantities as obtained from the mix design tests for giving desired quality of controlled concrete as specified in the item.

The employer shall not accept any responsibility for any variation in the quantity of cement due to procurement of low grade or inferior grade cement by the bidder. Any extra liability on account of excess requirement of cement than the standards consumption factor as indicated under the respective items of Schedule 'B' shall be on the score of the bidder. No value adjustment charges shall be payable/recoverable for more/less use of cement than the standard consumption.

The contractor shall have to substantiate his claim about quantity of concrete by cube results. The minimum, requirement of cement consumption per Cu. M of concrete as mentioned in B.7.4 shall however be strictly adhered to.

B.8(a) BURNT BRICK MASONRY FIRST CLASS IN LIME/CEMENT MORTAR

Burnt Brick Masonry first class in lime/cement mortar of specified proportion including necessary scaffolding, watering masonry, etc., complete.

B.8.a.1 Materials : Bricks : First Class bricks shall be used for this item and shall comply with specification No. A.9.1. Sample shall be got approved by the Engineer who will keep it in his office for reference.

Mortar : Mortar shall conform to specification No. B.3(a) for lime mortar/B.5.a for cement mortar. The quantity of mortar to be used in one cu.metre of masonry shall vary from 0.24 cu.metre or 240 liters for thin masonry to 0.26 cu.metre or 260 liters for massive masonry of conventional bricks and 0.25 cu.m. or 250 liters for thin masonry and 0.27 cum. or 270 liters for thick masonry for I.S.I. bricks. The proportion of lime/cement mortar shall be as specified in the item and special provisions of the tender.

B.8.a.2 Construction Details :

B.8.2.1 Size : Bricks of different dimensions will not be allowed on the same work except when specially permitted by the Engineer.

B.8.2.2 Face Work : Bricks of entirely uniform colour and of best shape and which have greater resistance to weathering and penetration by rain should be selected for the face work when it is not be plastered.

B.8.2.3. Soaking : All bricks shall be immersed in water for two hours before being put into the work so that they will be saturated and will not absorb water from the mortar. Immersion will also assist in removing dirt and dust. The surfaces should be just moist but not too wet at the time of laying.

B.8.2.4 Bats : No bats or cut bricks be used in the work unless absolutely necessary around irregular openings or for adjusting the dimensions of different courses and for closer, in which case, full bricks shall be laid at corners, the bats being placed in the middle of the courses.

B.8.2.5 Laying : The bricks shall be laid in mortar to line, level and shapes shown on the plans, slightly pressed and thoroughly bedded in mortar and all joints shall be properly flushed and packed with mortar so that they will be completely filled with mortar and no hollows left anywhere. Bricks shall be handled carefully so as not to damage their edges. They should not also be thrown from any height to the ground but should be put down gently. All courses shall be laid truly horizontal and all vertical made truly vertical. Vertical joints in one course and the next below shall not come over one another and shall not normally be nearer than quarter of a brick length. For battered faces bedding shall be at right angles to the face. Fixtures, plugs, frames, etc., if any shall be built in at places shown in the plans while laying the courses only and not later by removal of bricks already laid.

Care shall be taken during construction to see that edges of bricks at quoins, sills, heads, etc., are not damaged.

The verticality of the walls and horizontality of the courses shall be checked very often with plumb-bob and spirit level respectively.

B.8.2.6. Bond : Bond used shall be English or such other as may be ordered and shall be carried throughout the work. At all corners, alternate courses of brick work shall be laid header and stretcherwise as seen on the face so as to secure good bond. The arrangement of bond at quoins shall be symmetrical.

B.8.2.7 Joints : Joints shall not exceed 10 mm in thickness and this thickness shall be uniform throughout. The joints shall be raked out not less than 10 mm deep when the mortar is green where pointing is to be done. Otherwise joints shall be struck flush with the face at the time of laying.

B.8.2.8 Uniform Raising : Brick work shall be carried up regularly in all cases where the nature of work will admit, not leaving any part 60 cm. lower than another. But where building at different levels is necessary, the breaks shall be stepped so as to give later a uniform level and effectual bond. Horizontal courses should be to line and level and even the face plumb or to batter as shown on the plan. The rate of laying masonry may be upto a height of 60 cm. per day if cement mortar is used and 45 cm. if lime mortar is used. Greater heights may be built only if permitted by Engineer in writing.

B.8.a.3. Scaffolding : Scaffolding will be double or single as warranted for the particular work. The ends of points if required to rest on the brick work

shall be located at convenient places. Scaffolding shall be erected with bullies, steel sections, pipes or bamboos of adequate strength so as to be safe for all the dead, live and impact loads likely to come on them due to construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect should also be complied with. The contractor shall be entirely responsible for any damage to property or injury to persons resulting from ill erected scaffolding, defective ladders and materials, or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed.

Put log hole shall be made good by bricks to match the face work when put logs are removed after ensuring that the holes behind are solidly filled in with 1:4:8 cement concrete.

- B.8.a.4. Dewatering :** Where water is met with, the work space shall be kept free of water by the contractor while the brick work is in progress and until the Engineer considers the mortar has sufficiently set. Dewatering shall also be done when required for taking measurements etc. Dewatering shall be carried out in such a manner as not to injure masonry in any way. Dewatering will be included in the rate of brick work unless separately provided in the tender.
- B.8.a.5. Watering :** The Bricks work shall continuously be kept well watered for 14 days after laying. Brick work when laid shall be initially protected against hot sun if necessary by wet sacking or straw or similar absorbent material. at no time during the curing period shall the mortar be allowed to dry. Initial watering should be done carefully through a rose so as not to disturb or wash out mortar. On Sunday and holidays or at the close of day's work or other periods of cessation of work, the masonry shall be kept well watered by employing sufficient number of labour. Should the contractor fail to water the work as specified, the Engineer may employ the requisite labour, materials and equipment to water the work properly and charge the cost to the contractor.
- B.8.a.6. Final Finish :** If the brick work is not to be plastered, the face, after pointing is properly cured, shall be washed down and all stains and adhering mortar lumps removed. Put log holes, etc., shall be solidly filled in the interior with cement concrete 1:4:8 and the face with bricks to match adjoining work.
- B.8.a.7. Bad Work :** Should the mortar perish, i.e. become dry or powdery through neglect of watering or masonry be hollow or the work not done according to plan and specifications, the work shall be pulled down and rebuilt at contractor's expenses. If hollows or other defects are suspected a brick may be removed here and there for confirmation. If hollows or other defects are confirmed such portions shall be dismantled and rebuilt at the cost of the contractor.
- B.8.a.8. Item to Include :** 1) All labour, materials, use of tools, equipment and other items incidental to the satisfactory completion of brick masonry.

- 2) Erecting and removing of all scaffolding, ladders and plant required for the execution of the work to the height and depths and shapes as shown on the plan or as ordered by the Engineer.
- 3) Dewatering required for completion this item and till the mortar of masonry, pointing, plastering is properly set, unless separately provided in the tender.
- 4) Constructing brickwork to lines, levels, batters, curves and to any position or shape, to the height and depth shown on the plans or as ordered by the Engineer including striking joints and raking out joints and housing frames, fixtures, etc. and rectifying defective work.
- 5) Watering the masonry.
- 6) Clearing the site round the brick work so as to restore the area to its original condition.

B.8.a.9 Measurement and Payment : The contract rate shall be for a unit of one cubic meter of brick masonry fully completed. The quantity of brick work to be paid under this item shall be in number of cubic meters measured for the completed work and to the limiting dimensions not exceeding those shown on the plans or as ordered in writing by the Engineer. Battered, tapered and curved portions shall be measured and quantity of individual items worked out correct to two places of decimals of meter and a cubic meter respectively.

No deduction shall be made for (1) ends of dissimilar materials like girders, beams, lintels, rafters, etc., upto 500 sq.cm. In section and (2) opening upto 0.1 sq.m. in faced area.

When the brick work is to be plastered measurements will be exclusive of plaster.

Brick work shall normally be measured as under :

Half work shall normally be measured as under :

All brick wall shall be measured in sq.m. stating the thickness.

Brick walls upto and including two brick in thickness shall be measured in multiples of half bricks which shall be deemed to be inclusive of the mortar joints, as under :

	Width for conventional bricks	Width for modular I.S.I. bricks
One brick wall shall be measured as	230 mm.	20 cm.
One and half brick shall be measured as	345 mm.	30 cm.
Two bricks shall measured as	460 mm.	40 cm.

Width of more than two bricks in walls will be measured actually and

limited to the width specified.

Where fractions of half bricks occur due to architectural or other requirements the measurement shall be taken as actual.

B.8b. BURNT BRICK MASONRY SECOND CLASS IN LIME/CEMENT MORTAR

Burnt brick masonry second class in lime/cement mortar of specified proportion including necessary scaffolding, watering masonry etc. complete.

B.1 Materials :

B.1.1 Bricks : Bricks shall comply with specification No. A.9.2. for second class bricks.

B.1.2 Mortar : Mortar shall conform to specification NO. B.3(a) for lime mortar/B.5 (a) for cement mortar. Quantity of mortar to be used in one cu.m. of masonry shall vary from 0.30 cu.m. or 300 liters for thin masonry to 0.32 cu.m. or 310 liters for thin masonry to 0.33 cu.m. or 330 liters for massive masonry of I.S.I. Bricks.

B.2 Joints : Joints shall not exceed 12 mm. in thickness and this thickness shall be uniform throughout.

All other specifications of first class B.B. masonry shall apply to this class of masonry also.

B.9. STONE MASONRY (GENERAL)

B.9.2 General : The following instructions are to be complied with for all classes of stone masonry.

B.9.2 Materials :

B.9.2.1 Building Stone : Building stone shall comply with the specifications detailed in A.8. Stones of the specified type and quality shall be obtained from the quarries defined in the special provisions or from other sources approved by the Engineer. The size of the stones shall be as specified for the item. The stone shall be kept free from dirt, dust, oil or any other injurious materials which may attack the stone or mortar or prevent adhesion of mortar. Stones with skins shall not be used.

Different categories of stones such as face stones headers, quoins, etc. shall be collected in advance to suffice at least for a week's requirement and shall be stacked separately categorywise.

B.9.2.2 Mortar : The mortar to be used shall be of the type and proportion mentioned in the item or special provisions. Lime mortar if used, shall comply with specification No. B.3(a). Cement mortar if used, shall comply with specification No. B.5(a). Water for curing shall comply with specification No. A.5.

B.9.3 Dressing : Different types of dressing. The stones shall be dressed to one of the following types specified for the item or as detailed in the specifications for the particulars item itself.

- B.9.3**
- a. **Rough Tooled Dressing** : Rough tooled surface shall have series of bands, 4 to 5 cm. wide, more or less parallel to tool marks all over the surface. These marks may be either horizontal, vertical or at an angle of 45° as required. The dressed stones may have depressions on the surfaces, the depth of gap between the surface and the straight edge held against it shall not exceed 3 mm. This is also called 'One line dressed'.
 - b. **Chisel or Punch Dressing** : A chisel dressed surface shall have series of parallel ridges. Chisel marks shall be left all over the surface. This dressing shall be more even than rough tooled dressing. The depth of the gap between the surface and a straight edge held against the surface shall not exceed 2 mm. This surface dressing is also called 'Two line dressing'.
 - c. **Close Punched or Picked Dressing** : A close punched dressed surface shall be closer dressed further giving finer surface than the chisel or punch dressing. The depth of gap between the surface and the straight edge held against it shall not exceed 1 mm. This is also called as 'Three line dressing'.
 - d. **Fine Tooled Dressing** : A fine tooled dressing is the one which is finer than the close punched dressing such that all the unevenness is removed and the fairly smooth surface is obtained. The surface shall have 5 to 4 lines per centimeter width. Other types of dressing may also be specified in the special provisions.
 - e. **Samples** : Samples of each category of stones of the specified quality & dimensions dressed to the specified requirements shall be got approved by the Engineer who will keep them in his office for reference.

B.9.4 Method of Laying Stone : The masonry shall be laid to lines, levels, curves and shapes shown in the plans. Fixture, plugs, frames, etc., if any, shall be built in at places shown on the plan or directed by the Engineer while laying the masonry and not later by removing the stones already laid.

- a) Stones in the hearting shall be laid on their broadest face which gives better opportunity to fill the space between the stones.
- b) Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.
- c) In battered walls, the beds of stone and the plane of courses should be at right angles to the batter.
- d) The courses of masonry shall ordinarily be pre-determined. They shall generally be of the same height. Where there is to be variation in height of courses, larger courses are to be placed at the lower levels, the height of courses decreasing gradually towards the top of the wall, unless plans specify otherwise due to architectural requirements.

- e) The stones shall be wetted before laying in mortar. Each mason shall be supplied by the Contractor with a vessel full of water and a tumbler for wetting stones, care being taken not to spill any water on green masonry. The bed which is to be the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately on placement and solidly bedded in mortar before it has set. Clean chips and spalls, carefully selected to fit in the spaces shall be wedged into the mortar joints and beds wherever necessary, to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into the rock singly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have embedded faces completely covered with mortar. If a portion of masonry is dismantled, every stone must be found with mortar adhering fast to all its embedded surfaces and there shall be no hollows. This will be one of the tests in deciding if the masonry is good or bad if need arises. Where hollows or other defects are suspected a stone here or there may be removed for confirmation. If these are confirmed such portions shall be dismantled and rebuilt at the cost of the contractor.
- f) Face work and hearting shall be brought up evenly but the top of each course shall not be leveled up by use of flat chips.
- g) In case any stone already set in mortar is disturbed or the joint broken, the stone shall be taken out without disturbing the adjoining stones and joints, the mortar thoroughly cleaned from the joints and stones and the stone reset in fresh mortar. Attempts must never be made to slide one stone over another already laid.
- h) Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering which will loosen the masonry will be permitted after it is once placed.
- i) There shall be good collection of stones and spalls within easy reach of each mason to enable proper selection of stones for individual location while laying. The stones shall be continuously replenished.
- j) **Bond :**
 - 1) To give sufficient lateral bond a stone in any course shall break joint with the stone in the course below or above about half the height of the course and generally not less than 8 cm. i.e. joints parallel to the pressure in courses above and below shall not lie too closely near the same vertical line.
 - 2) To give sufficient transverse bond, the prescribed number of headers shall extend from front to back of thin walls up to a width of 60 cm. or prescribed number of lines of over lapping headers from face to back of walls over 60 cm. thick. Overlaps shall be 15 cm. at each end. To ensure provision of full number of headers of the required size, they

shall be kept at specified intervals in each course in advance of starting masonry and then embedded in mortar. Their position in each course shall be staggered, so that each will be near about the middle of the two in the courses below and above. Their faces shall be marked with a distinguishing sign to identify them.

- 3) To bond work at all angle junctions of walls, the stones at each alternate course shall be so carried into each of the respective walls as to join the work thoroughly. Quoins shall be laid header and stretcherwise when seen on each side of the wall.
- 4) When new work has to be started on the old or one completed a long while ago or in the previous working season, 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.
- 5) Where practicable the whole of the masonry in any structure shall be carried upto a uniform level throughout. But where breaks are unavoidable in carrying up the work continuously in horizontal courses, sufficiently long step shall be left to join the courses to be laid later. All junctions of walls shall be formed at the time the walls are being built, cross-walls should be carefully bonded into the main walls.
- 6) The practice of building to faces tied with occasional through-stones and filling up the middle with dry packing and putting mortar on top must be strictly guarded against. Putting dry chips in the joints of stones before filling them with mortar shall not be permitted.
- 7) For ensuring good bond masonry shall be left uneven at the top of each course.

B.9.5 Treatment of Joints : When joints are to be pointed, they shall be raked to a depth not less than their width when the mortar is still green. When pointing is not to be done, the mortar in the joints shall be pressed and troweled smooth while masonry is being laid. If this is not done, the joints shall be raked when the mortar is green as mentioned above, cleaned and wetted filled with 1:3 cement mortar, pressed and troweled smooth. Joints shall be raked when plastering is to done.

B.9.6 Watering : All masonry built in lime or cement mortar shall be initially protected from sun, rain, etc., by wet hessian or straw till set and thereafter kept continuously wet for 14 days from the date of laying unless other length of period is ordered in the special provisions. Watering shall be done carefully in the beginning through a rose so as not to wash the mortar out of the joints. On Sundays, holidays, at the close of day's work and other periods of cessation of work, the masonry is to be kept continuously wet for the specified period of curing and labourers are to be employed for the purpose. Should the contractor fail to water the work to the satisfaction of the Engineer, the latter may supply requisite men, materials and equipment to water the work properly and charge the cost to the contractor.

B.9.7 Bad Work : Should the mortar perish, i.e. become dry, white or powdery through neglect of watering or if the masonry shows hollows joints or non adherence of mortar to the stones or if the work does not confirm to the plans and these specifications, the work must be pulled down and rebuilt at the contractor's expenses.

B.9.8 Final Finish : All masonry shall be washed down on completion and all stains and adhering mortar removed from the face as the scaffolding is being lowered and removed.

B.9.9 Iron, Stone, Concrete or other Fixtures, Buttresses, etc.:

All iron, stone, concrete or other fixtures, shall be built and bonded into the work in proper place as work proceeds not inserted or joggled on after the masonry is advanced.

B.9.10 Wet Foundations : In wet foundations, or other situations where water is met with, the work space shall be kept free of water by the contractor while the masonry is in progress and until the Engineer considers the mortar has sufficiently set. Dewatering shall be carried out in such a way as not to injure the concrete or masonry in any way. Dewatering shall also be done when required for taking checking measurements, passing foundations, etc. Dewatering will be included in the rate of masonry unless separate provision is made in the tender.

B.9.11 Scaffolding : Scaffolding required for facility of construction shall be provided by the contractor at his expense.

Scaffolding will be double or single as is warranted for the particular class of masonry. But the ends of poles should not be placed in the position of header stones. Scaffolding shall be erected with steel sections or pipes, bullies or bamboos of adequate strength so as to be safe for all construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to property or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed.

Put log holes shall be made good by stones to match the face work when scaffolding is being removed after ensuring that all holes behind are solidly filled in with 1:4:8 cement concrete.

Clauses of this General Specification shall be applicable in all pertinent points to the specifications for all classes of masonry.

B.9. (f) RANDOM RUBBLE MASONRY 1ST SORT.

Random Rubble masonry 1st sort in cement lime mortar of specified proportion including striking joints scaffolding, curing, etc. complete.

B.9(f)1 General : Specification No. B. 9 for stone masonry (general) shall apply in all pertinent particulars. Random Rubble masonry shall also comply with

the following in addition.

- B.9(f)2 Materials :** Materials shall conform to specification No. B.9.2.
- B.9(f)3 Dressing and size.**
- B.9(f)4 Face Stones :** Height shall not be greater than breadth of face and no stone shall have its length less than $1\frac{1}{2}$ times its height. All the sides of the stones on the face shall be dressed in straight lines and all the sides on the face shall be in one plane. The stone face shall be rough tooled (one line dressed) and the sides shall be rough tooled square up to and afford a bearing of at least 5 cm. (average) from face. Individual stones shall have generally a face area of not less than 0.05 sq. m. (about $\frac{1}{2}$ s. ft.). Face stones generally comply with specification No. A.8. The face stones shall be selected from the mass of quarry stones for their larger size, good beds, close grain and uniform colour. 50 percent of the stones shall be more than 0.010 cu. m. or 10 litres (about $\frac{1}{3}$ c. ft.) in walls up to 50 cm. (about 20") in thickness and 0.015 cu. m. or 15 litres (about $\frac{1}{2}$ c. ft.) in thicker walls. They shall be as far as possible of equal size on the face and rough tooled.
- B.9(f)5 Through stones :** One through stone shall be provided per half square metre of facing evenly distributed in a staggered pattern. They shall be about 0.05 sq. m. (about $\frac{1}{2}$ sq. ft.) in face area and shall have a tailing of the full width of the masonry when the width is 60 cm. (about 2') or less. If the wall or masonry be over 60 cm. (2') thick a line of headers overlapping each other by at least 15 cm. (about 6") shall be laid right through the wall from face to back. The length of the interior headers shall not be less than 44 cm. (about 18") and their average cross sectional area shall not be less than 0.03 sq. m. (about $\frac{1}{3}$ sq. ft.). Header shall be distinctly marked on its face.
- B.9(f)6 Vertical headers :** For massive work with a width of a metre (about 3.28") and more vertical headers 45 cm. (about 18") long or depth of two courses whichever is more shall be provided at the rate of one for every sq. metre (10.76 sq. ft.) of area in plan. For every course a new set of headers shall be introduced at this rate in a staggered pattern. The average sectional area of each should not be less than 0.03 sq. m. (about $\frac{1}{3}$ sq. ft.).
- B.9(f)7 Hearting and backing stones :** These stones shall comply with specification No. A.8.3. These stones shall not be less than 15 cm. (about 6") in any direction. In walls of 50 cm. (about 20") and less about 30 percent of the stones shall not be less than 0.010 cu. m. or 10 litres ($\frac{1}{3}$ c. ft.) and for thicker walls about 30 percent of stones shall not be less than 0.015 cu. m. or 15 litres (about $\frac{1}{2}$ c. ft.). Backing shall conform to U. C. R. masonry when it is to be plastered.
- B.9(f)8 Quoins :** Quoins shall be of selected stone and shall have rough / fine tooled dressing. They shall be cut to the required size and shall normally have a height of one course. If the plans show a height equal to two courses they shall be provided accordingly. The beds and tops shall be square to the face and rough tooled to 10 cm. (about 4") from the face and vertical joints square and rough tooled to 4 cm. (about $1\frac{1}{2}$ ") from the face.

The length of the quoins shall not be less than twice the height or 44 cm. (about 18") whichever is more on the longer face nor less than the height on the shorter face. In the embedded portion the length of the side shall not be less than that of the side opposite by more than 8 cm. for the longer side and 5 cm. for the shorter side.

B.9(f)9 Scaffolding : Scaffolding shall comply with specification No. B.9.11.

B.9(f)10 Wet foundation : To comply with specification No. B.9.10

B.9(f)11 Construction details.

B.9(f)12 Laying : Specification in B.9 shall generally apply.

The face stones shall be laid absolutely without any pinnings on the exposed faces. In each course the headers or lines of headers as the case may be, shall be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required numbers and intervals. They shall be embedded in mortar as masonry in that layer progresses.

Quoins shall be laid stretcher and headerwise as seen on each face and shall corresponds to the arrangement of quoins in the same course.

The quantity of mortar for one cubic metre of thin and massive masonry shall range from 0.25 cu. m. to 0.30 cu. m. and for water retaining masonry from 0.44 cu. m. to 0.46 cu. m.

B.9(f)13 Joints : No face joints shall exceed 6 mm. (about 1/4) in thickness. Stones shall be arranged to break joint as much as possible and long vertical lines of jointing shall be carefully avoided in the face work.

B.9(f)14 Striking joints : The face joints should be properly struck while the mortar is fresh. Joints which cannot be so struck at the time of laying, shall be prepared for it by raking joints to a depth of not less than 6 mm. (about 1/4") when the mortar is fresh. These joints should be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being trowelled, smooth.

B.9(f)15 Rate of raising masonry : The rate of raising random rubble masonry brought up in uniform levels may be limited to a height of 60 cm. (about 2') per day in case of cement mortar and 45 cm. (about 20") in the case of lime mortar. But no fresh course shall be laid over masonry previously laid within 4 hours of its Laying for cement mortar and 8 hours for lime mortar.

B.9(f)16 Item to include : 1) Random rubble stone masonry first sort laid in cement lime mortar of specified proportions, built in any position to any height or depth and to lines levels, curves, and batters shown on the plans or as ordered by the Engineer with headers, quoins, etc., including striking joints and curing. Cutting grooves holes, etc. for fixing frames, fixtures, etc. is also included.

2) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection

of the work including compensation for any injury, damage, etc.

- 3) Dewatering to allow construction in the dry and proper setting of masonry unless separately provided in the tender.
- 4) Clearing the site round the masonry and backfilling so as to restore it to the original condition.
- 5) All labour, use of tools, materials and other items incidental to satisfactory completion of the item.

B.9(f)17 Mode of measurement and payment : The quantity of random rubble masonry to be paid under this item shall be in number of cubic metres of the completed work including quoins, etc. and with the limiting dimensions not exceeding those shown on the plans or as fixed by the Engineer. The contract rate shall be based on a unit of one cu. metre (about 35 cft.) of masonry. Dimensions shall be measured correct to a centimetre and individual quantities shall be calculated up to two places of decimals of a cubic metre.

B.9. (g) RANDOM RUBBLE MASONRY 2ND SORT

Random Rubble masonry 2nd sort in cement / lime mortar of specified proportion including striking joints, scaffolding, curing, etc. complete.

The specification for this item shall be exactly same as standard specification for Random Rubble masonry 1st sort except for the following changes :

- 1) Faces shall be only hammer dressed as explained below. The bed and the joint faces shall afford a square bearing of 2.5 cm. (about 1") average from face by hammer dressing or chiselling.

The sharp and irregular projections on the stone face shall be knocked off by the flat end of the scabbing or spalling hammer. The surface shall be further dressed by lifting the hammer and then allowing the pointed end to drop on the surface freely. This process shall be continued till a fairly uniform and even stone surface is obtained.

Chisel may be used to obtain straight edges for the sides and square surfaces for the beds and joints.
- 2) The width of the joints shall not be more than 12 mm. (about ½").

If pointing or plastering is to be provided the joints shall be raked to not less than 12 mm. (about ½") when the mortar is green. Otherwise they shall be struck.
- 3) The quantity of mortar for one cu. m. of masonry shall range from 0.30 cu. m. to 0.35 cu. m. for thin and massive masonry respectively and 0.46 cu. m. to 0.48 cu. m. for water retaining masonry.

B.9. (h) COURSED RUBBLE MASONRY 1ST SORT

Coursed rubble masonry 1st sort in cement mortar of specified proportion including scaffolding, curing, etc. complete.

1. **General** : Specification No. B.9 for stone masonry (General) shall apply in all pertinent particulars. C. R. masonry 1st sort shall also comply with the following in addition.

2. **Materials** : Materials shall conform to specification No. B.9.2.

3. **Dressing and size** : (a) *Face stones-* i) *Khandki* : The khandki stones received from quarry shall be dressed so as to have the vertical and horizontal sides perfectly straight, parallel and at right angles to adjacent sides. The four sides of the stone on the face shall lie in one plane. Bushing on the face of the stones shall not project more than 4 cm. (about 1½"). The beds and tops shall be square to the face and rough tooled to at least 8 cm. (about 3"), from the face. The side vertical joint faces shall be square to the face and rough tooled to at least 4 cm (about 1½") from the face. The face have no depression below the plane of the sides.

All the khandki stones shall be more in breadth than in height and shall run back into the masonry for not less than 1.5 times the height 30 percent of the khandkis shall have tailing of twice their height. 30 percent of these face stones shall not be less than 0.02 cu. metre or 20 litres (about 2/3 cu. ft.).

The height of the khandki shall not be less than 14 cm. (about 6") or as specified for the particular item.

ii) These khandkis shall be provided for the interior face also when it is to remain exposed or so specially provided.

b) *Hearting and backing stones* : When the interior face is to be plastered or otherwise permanently remaining covered, backing stones shall be as specified for U. C. R. masonry. Hearting and backing stones shall be as big as possible 30 percent of these stones shall not be less than 0.010 cu. m. or 10 litres (about 1/3 cft.) for walls 50 cm. (about 20") or less in thickness and for walls thicker than 50 cm. (about 20") 30 percent of them shall not be less than 0.015 cu. m. or 15 liters (about 1/2 c.ft.).

c) *Quoins* : The quoins shall be of selected stone and shall normally be of the same height as that of the course in which they are to be used. If the plans show a height of two courses they shall be provided accordingly. The faces of quoins shall be rough tooled or hammer dressed as directed by the Engineer. A chisel draft of about 40 mm. (about 1½") shall be provided on each side of the exposed corners.

The beds and tops shall be dressed square to the face and rough tooled to 10 cm. (about 4") from the face and vertical joints similarly dressed to 4 cm. (about 1.5") from the face. The length of the quoins shall not be less than twice their height or 44 cm. (about 18") whichever is more on the longer face nor less than their height on the shorter face. In the embedded portion the length of the side shall not be less than that of the exposed side opposite by more than 8 cm. (about 3") for the longer side and 5 cm. (about 2") for the shorter side.

d) *Through stones* : The height of through stones shall be the full height of the course and width shall not be less than the height. The face, beds and

joints shall be dressed similar to khandkis.

They shall be about 0.05 sq. m. (about ½ sq. ft.) in face area and 0.03 sq. m. (about 1/3 sq. ft.) in average cross sectional area and shall have a tailing of the full width of masonry when the width is 60 cm. (about 2') or less. If the masonry be over 60 cm (about 2') in width, a line of headers overlapping each other by at least 15 cm. (about 6") shall be laid right through the wall from the face to the back. The length of the interior headers shall not be less than 44 cm. (about 18") and their average cross sectional area shall not be less than 0.03 sq. m. (about 1/3 sq. ft.). Face header shall be distinctly marked on its face.

(e) *Vertical Headers* : For massive work with a width of a metre (about 3.28') and more, vertical headers 44 cm. (about 18") long or depth of two courses whichever is more shall be provided. The average sectional area of each should not be less than 0.03 sq. m. (1/3 sq. ft.).

4. **Construction** : The stones shall be laid in horizontal course of not less than 14 cm. (about 6") height. The stones in each course shall be of equal height and all courses shall be of the same height unless otherwise specified or directed by the Engineer. But no course shall be thicker than any course below it unless otherwise shown on the plans or directed. The heights of different courses shall be predetermined and shall match with the corresponding course in other parts of the structure.

Khandki stones shall be provided for faces, remaining exposed.

The through stones shall be placed 1.5 metres (about 5') apart in the clear in every course before starting the construction of that course and finally embedded in the course.

Vertical headers shall be provided in the case of massive masonry where the thickness of the masonry is one metre or more at the rate of one for every sq. metre (about 10.76 sq. ft.) of area in plan. For every course a new set of headers shall be introduced at this rate, in a staggered pattern.

The quoins shall be laid header and stretcherwise as seen on each face of the wall and shall correspond to the arrangement of quoins in the same course.

The faces of masonry to be plastered or remaining permanently unexposed shall conform to U. C. R. masonry unless otherwise directed.

The thickness of joint shall not exceed 10 mm. (about 3/8"). Where pointing is to be done, the joints shall be raked to a depth of not less than 10 mm. (about 3/8") when the mortar is green.

The quantity of mortar for one cubic metre of thin and massive masonry shall range from 0.25 cu. m. to 0.30 cu. m. and from 0.44 to 0.46 cu. m. for water retaining masonry.

5. **Rate of raising masonry** : The rate of raising masonry in cement mortar shall be limited to 60 cm. (about 2') and in lime mortar shall be limited to 45 cm. (about 18") per day. But no fresh course shall be laid over masonry previously laid within 4 hours of its laying for cement mortar and 8 hours

for lime mortar.

6. **Striking joints** : The joints of the non-exposed face when pointing is not to be done shall be neatly struck when the mortar is green. Joints which cannot be so struck at the time of laying shall be prepared first by raking joints to a depth of not less than 10 mm. (about 3/8") when the mortar is fresh. These joints shall be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by trowelling smooth.
7. **Cement pointing** : When cement pointing is included in the item, it shall be done according to specification No. B. 13.
8. **Scaffolding** : Scaffolding shall conform to specification No. B. 9.11
9. **Wet foundations** : To comply with specification No. B.9.10.
10. **Item to include** : 1) Coursed rubble masonry first sort laid in cement mortar/lime mortar of specified proportion, built in any position to any height or depth and to lines, levels, curves and batters shown on the plans or as ordered by the Engineer including striking joints raking out joints and curing for the specified period. Chisel drafting, chamfering and dressing the stones to lines, shapes and curves shown on the working drawings, cutting grooves etc. for fixing frames, fixtures etc. headers and rough tooled quoins are also included.
 2) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item satisfactorily including compensation for any inquiry, damage, etc.
 3) Inspection facilities.
 4) Dewatering unless separately provided for in the tender.
 5) Cost of all labour, materials, use of tools and equipment and incidental items required for satisfactory completion of the item.
 6) Clearing site round the masonry.
11. **Mode of measurement and payment** : Then contract rate shall be for a unit of one cu. metre of masonry completed in all respects, in place and accepted. The quantity of coursed rubble masonry to be paid under this item shall be number of cu. metres of finished work and the limiting dimensions shall not exceed those shown on the plans or as ordered in writing by the Engineer.

Dimensions shall be measured and individual quantities calculated correct to 2 places of decimals of a metre and cubic metre respectively.

Battered, tapered or curved portions shall be measured net.

B.9. (i) COURSED RUBBLE MASONRY 2ND SORT :

Coursed rubble masonry 2nd sort in cement mortar / lime mortar of specified proportion including scaffolding, curing etc. , complete.

The specification for this item shall be exactly the same as standard specification B. 9. (h) for the coursed rubble masonry 1st sort except for

the following changes :

- 1) Two stones may be used for height in one course upto 50 per cent, of the face area.
- 2) The thickness of joint shall not exceed 12 mm.(about 1/2).
- 3) Backing shall be of U.C.R. masonry, when unexposed or plastered.
- 4) The quantity of mortar for one cu. m. of thin and massive masonry shall range from 0.28 cu. m. to 0.33 cu. m. respectively and 0.46 cu. m. to 0.48 mm. for water retaining masonry.
- 5) The faces of quoins shall be rough tooled or provided the same type of dressings as Khandkies as directed by the Engineer. A chisel draft of about 40 mm. (about 1 1/2") shall be provided on each side of the exposed corner.

B.9. (j) COURSED RUBBLE MASONRY 3RD SORT

Coursed rubble masonry 3rd sort in cement mortar / lime mortar of specific proportion including scaffolding etc. complete.

- 1) **General** : Specification No. B.9 for stone masonry (General) shall apply in all pertinent particulars. C.R. masonry 3rd sort shall also comply with the following in addition.
- 2) **Materials** : Materials shall conform to specification No. B.9.2.
- 3) **Dressing and Size** : Stones to be set in the work shall be as received from the quarry after merely knocking off weak corners and edges with a mason's hammer. All the sides of the stones on the face shall be dressed in straight lines and all these sides shall be in one plane. The beds and joints shall afford a bearing of at least 2.5 cm. (about 1") average. Individual stones shall have a width of not less 19 cm. (about 8") in its thickest part and no stone shall be less in width than height and less in length than 1 1/2 times its height. Each stone shall be about 0.015 cu. m. or 15 litres (about 1/2 cft.) or more
- 4) **Face stones** : Face stones shall generally comply with specification No. A.8 The face stones shall be selected from the mass of quarry stones for their larger size, good beds, close grain and uniform color. 50 per cent of the stones shall be more than 0.015 cu. m. or 15 litres (about 1/2 cft.) in walls up to 50 cm. (about 20") in thickness and 0.02 cu. m. or 20 litres (about 2/3 cu. ft.) in thicker walls.
- 5) **Through stones** : Each through stone on the face shall have its width not less than the height and shall tail into the work at least 3 times its height.

One through stone shall be provided per half square metre of facing evenly distributed in a staggered manner. Through stones of successive courses should not be placed one above the other. They shall be about 0.05 sq. m. (about 1/2 sq. ft.) in face area and shall have a tailing of 60 cm. (about 2) or the width of the wall whichever is less. If the wall of masonry be over 60 cm. (about 2) thick, a line of headers overlapping each other by at least 15 cm. (about 6") shall be laid right through the wall from face to

back. The length of the interior headers shall not be less than 45 cm. (about 18") and their average cross sectional area shall not be less than 0.005 sq. m. (about 1/4 sq. ft.). Face header shall be distinctly marked on its face.

- 6) **Vertical headers** : For massive work with a width of metre (about 3.28') and more, vertical headers 45 cm. (about 18") long shall be provided at the rate of one for every sq. metre (about 10.75 sq. ft.) of area in plan. For every course, a new set of headers shall be introduced at this rate in a staggered pattern. Their average sectional area shall not be less than 0.03 sq. m. (about 1/3 sq. ft.)
- 7) **Hearting and backing stones** : These stones shall comply with specification No.A.8.3. These stones shall not be less than 15 cm. (about 6") in any direction. In walls of 50 cm. (about 20") thickness and less, about 30 per cent of the stones should not be less than 0.010 cu. m. or about 10 litres (1/3 cft.) and for thicker walls about 30 per cent of the stone shall not be less than 0.015 litres (about 1/2 cu. ft.)
- 8) **Quoins** : The quoins shall be selected stone and shall normally be 19 cm. x 24 cm. x 39 cm. (about 8" x 10" x 16") or as directed by the Engineer. The faces of quoins shall be rough tooled or provided the same type of dressing as that of the face stones as directed. Chisel draft of about 40 mm. (about 1 1/2") shall be provided on each side of the exposed corner.
- 9) The beds and tops shall be dressed square to the face and rough tooled to 10cm. (about 4") from the face and vertical joints similarly dressed to 4 cm. (about 1.5") from the face. In the embedded portion the length of the side shall not be less than that of the exposed side opposite by more than 8 cm. (about 3") for the longer side and 5 cm. (about 2") for the shorter side. The sizes of quoins shall be uniform.
- 10) **Wet foundations** : To comply with specification No. B.9.10.
- 11) **Construction details** : *Laying* - Specification in B.9 for stone masonry (general) shall generally apply. The face stones shall be laid without any pinnings on the exposed faces. The edges of adjoining stones shall be parallel to allow joints of fairly uniform width. In each course, the headers or lines of headers as the case may be, shall be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required number and intervals. They shall be embedded in mortar as masonry in that layer progresses.

A horizontal joint shall be introduced at intervals specified on the drawings or as ordered by the Engineer throughout the masonry. The height of the course shall be a whole multiple of the height of the quoins.

Quoins shall be laid stretcher and headerwise as seen on each face and shall correspond to the arrangement of quoins in the same course.

Where the height of courses is less than 20 cm. (about 8 ") 30 per cent of face area shall be made up of stones of full height of the course. In the remaining area not more than 3 stones shall be used to make up the

height.

Where the height of courses is between 20 cm. and 40 cm. (about 8" and 16") 30 per cent of the face area shall be made up by stone each with a face area of not less than 0.03 sq. m. (about 1/3 sq. ft.) and for the remaining area the stones shall have a face area of not less than 0.015 sq. m. (about 1/6 sq. ft.)

The quantity of mortar for one cu. m. of thin and massive masonry shall range from 0.30 to 0.35 cu. m. respectively and for water retaining masonry from 0.46 cu. m. to 0.48 cu. m.

Joints - The face joint width shall not exceed 16 mm. (about 5/8").

Striking joints - The face joints shall be properly struck while the mortar is fresh. Joints which cannot be struck at the time of laying, shall be prepared for it by raking joints to a depth of not less than 16 mm. (about 5/8") when the mortar is fresh. These joints should be properly cleaned of loose particles, wetted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being trowelled smooth.

Rate of raising masonry - The rate of raising coursed rubble third sort masonry per day shall be limited to a height of 60 cm. (about 2') or the height of course whichever is less in case of cement mortar and 45 cm. (about 18") in the case of lime mortar. But no fresh course shall be laid over masonry previously laid within 4 hours of its laying for cement mortar and 8 hours for lime mortar.

- 12) Item to include** - (1) Coursed rubble third sort masonry laid in cement mortar/lime mortar of specified proportions, built in any position to any height or depth and to lines, levels, curves and batters shown on the plans or as ordered by the Engineer including quoins, headers etc. and striking joints and curing.
- (2) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item satisfactorily, safety of the labour and inspection of the work including compensation for any injury, damage, etc.
- (3) Dewatering unless separately provided in the tender.
- (4) Clearing the site round the masonry.
- (5) All labour, use of tools, materials and other items incidental to satisfactory completion of the item.

- 13) Mode of measurement and payment** : The contract rate shall be for one cu. m. (about 35 cft.) of finished masonry including quoins, etc.

The dimensions shall be limited to the dimensions shown on the plan or as ordered by the Engineer.

Dimensions shall be measured correct upto a cm. and the cubic contents calculated correct upto two places of decimals of a cubic metre.

B.9. (k) UNCOURSED RUBBLE MASONRY

Uncoursed Rubble masonry in cement / lime mortar of specified proportion including striking joints, scaffolding, watering etc. complete.

- 1) **General** - Specification No. B.9 for stone masonry (general) shall apply in all pertinent particulars. U.C.R masonry shall also comply with the following in addition.
- 2) **Materials** - Materials shall conform to specification No. B.9.2.
- 3) **Dressing and size** - Stones to be set in the work shall be as received from the quarry after merely knocking off weak corners and edges with a mason's hammer. In the case of face stones all the sides of the stones shall be dressed in straight lines and all the sides shall be in one plane. Individual stones shall have thickness and width of not less than 15 cm. (about 6") in its thickest part and no stones shall be less in length than 1 1/2 times its height.
- 4) **Face stones** - Face stones shall generally comply with specification No. A.8. The face stones shall be selected from the mass of quarry stones for their greater size, good beds, close grain and uniform colour. 50 per cent of the stones shall be more than 0.010 cu. m. or 10 litres (about 1/3 c. ft.) in walls upto 50 cm. (about 20") in thickness and 0.01 cu. m. or 15 litres (about 1/2 c.ft.) in thicker walls. The beds and joints shall have an average bearing of not less than 2 cm. (about 3/4")
- 5) **Through stones** - One through stone shall be provided per half square metre of facing evenly distributed. They shall be about 0.03 sq. m. (about 1/3 sq. ft. in face area and shall have a tailing of the full width of the masonry when the width is 60 cm. (about 2') or less. If the wall or masonry be over 60 cm. (about 2') in width line of headers overlapping each other by at least 15 cm. (about 6") shall be laid right through the wall from face to back. The length of the interior headers shall not be less than 45 cm. (about 18") and their average cross sectional area shall not be less than 0.025 sq. m. (about 1/4 sq. ft.) Face header shall be distinctly marked on its face.
- 6) **Vertical headers** - For massive work with a width of metre (about 3.28') and above, vertical headers 45 cm. (about 18") long or depth of two courses whichever is more shall be provided at the rate of one for every sq. metre (about 10.76 sq. ft) of area in plan. For every course a new set of headers shall be introduced at this rate in staggered pattern. Their average sectional area shall not be less than 0.03 sq. m. (1/3 sq. ft.).
- 7) **Hearing and backing stones** - These stones shall comply with specification No.A.8.3. In walls of 50 cm. (about 20") and less about 30 per cent. of the stone shall not be less than 0.010 cu. m. or litres (about 1/3 cft.) and for thicker walls about 30 per cent of stones shall not be less than 0.015 cu. m. or 15 litres (about 1/2 cft.).
- 8) **Quoins** - The quoins shall be of selected stone and shall normally be 19 cm. x 24 cm. x 39 cm. (about 8" x 10" x 16") or as directed by the Engineer. The faces of quoins shall be roughly tooled or provided the same type of dressing as that of the face stones as directed. Chisel draft of about 40

mm. (about 1½") shall be provided on each side of the exposed corner.

The beds and tops shall be dressed square to the face and rough tooled to 10 cm. (about 4") from the face and vertical joints similarly dressed to 4 cm. (about 1.5") from the face. In the embedded portion the length of the side shall not be less than that of the exposed side opposite by more than 8 cm. (about 3") for the longer side and 5 cm. (about 2") for the shorter side.

9. Scaffolding : Scaffolding shall comply with specification No. B. 9.11.

10. Wet foundation : To comply with specification in B.9 for stone masonry (general) shall generally apply.

The face stone shall be laid without any plannings on the exposed faces. In each course the headers or lines of headers as the case may be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required numbers and intervals. They shall be embedded in mortar as masonry in that layer progresses.

Quoins shall be laid stretcher and headerwise as seen on each face and shall correspond to the arrangement of quoins in the same course.

The quantity of mortar for 1 cubic metre of thin and massive masonry shall range from 0.30 cu. m. to 0.35 cu. m. respectively and for water retaining masonry from 0.46 cu. m. to 0.48 cu. m.

Joints : No face joints shall exceed 16 mm. (about 5/8").

Striking joints : The face joints should be properly struck while the mortar is fresh. Joint which cannot be so struck at the time of laying, shall be prepared for it by raking joints to a depths of not less than 16 mm. (about 5/8") when the mortar is fresh. These joints should be properly cleaned of loose particles, watted thoroughly and filled with good fresh cement mortar 1:3 and finished off by being trowelled smooth.

Rate of raising masonry : The rate of raising uncoursed rubble masonry brought up in uniform levels may be limited to a height of 60 cm. (about 2') per day in case of cement mortar and 45 cm (about 18") in the case of lime mortar. But no fresh course shall be laid over masonry previously laid within 4 hours of its laying for cement mortar and 8 hours for lime mortar.

12. Item to include : 1) Uncoursed rubble masonry laid in cement / lime mortar of specified proportion, built in any position to any height of depth and to lines, levels, curves and batters shown on the plans or as ordered by the Engineer including quoins, headers, etc. and striking joints and curing.

2) Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection of the work including compensation for any injury damage, etc.

3) Dewatering to allow construction in the dry and proper setting of masonry unless separately provided in the tender.

4) Clearing the site round the masonry.

- 5) All labour, use of tools, materials and other items incidental to satisfactory completion of the item.

13. Mode of measurement and payment : The quantity of uncoursed rubble masonry to be paid under this item shall be in number of cubic metres of the finished work including quoins etc. and with the limiting dimensions not exceeding those shown on the plans or as fixed by the Engineer. The contract rate shall be based on a unit of one cu. metre (about 35 cft.) of finished masonry. Dimensions shall be measured and individual quantities calculated correct upto two places of decimals of a metre and cubic metre respectively.

B.10. MILD STEEL BAR H.Y. STEEL TWISTED BAR REINFORCEMENT FOR R.C.C.

B.10.1. General : The item provides for the supply of mild steel twisted bars, cutting, bending, binding with galvanised iron wire and erecting in position for reinforcement in the R.C.C.

B.10.2. Materials : (1) Mild steel H.Y. Steel twisted bars shall confirm to the specification No. A.10 (2). The binding wire shall confirm to the specification No. A.15.

B.10.3. Supply : When the supply is made by the Department, the contractor shall convey the mild steel bars from the place of delivery mentioned in schedule 'A' of the tender to the site of work. The contractor shall be solely responsible for any damage during the conveyance and till it is used.

When the contractor supplied mild steel reinforcement bars obtained from the market they shall be supplied to the site of work without damage.

B.10.4. Fabrication : Reinforcing steel shall be thoroughly cleaned of all coatings of any character that would destroy or reduce the bond.

Bending Reinforcement shall confirm accurately to the dimension and shapes shown on the plans or as directed by the Engineer. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks, bends or cracks shall not be used. Bars shall be bent cold to the shape and dimensions shown in the drawings or as directed by the Engineer in writing. Bar bender may be used to attain proper radii of bends and shapes. Bars which may be bent during transport or handling shall be properly straightened before being placed in the work without heating them. Bending bar by heating to cherry red heat not exceeding 815°C (about 1,500°F) may be allowed for bars larger than 25 mm. diameter except for bars which depend for their strength on cold working. Hot bars shall not be cooled by quenching.

B.10.4.1 Details of lengths, sizes, laps and bending diagrams shall be got approved by the Engineer. This is to secure additional precautions against errors.

B.10.5 Splicing and Lapping : All reinforcement shall be furnished in full lengths indicated on the plans as far as possible. Splicing bars except as shown on the plans will not be permitted without the written approval of the Engineer. When full lengths are not available, bars shall be spliced. Splices of tensile reinforcement at points of maximum stress and of

adjacent bars at the same place shall be avoided. Splices shall be staggered as far as possible and located at suitable points. A welded or mechanical connection if adopted, shall develop the full strength of the bars. Unless otherwise shown on the plans, bars shall be lapped as specified in I.S. 456-1964 with due regard to the grade of concrete. In lap-splices, bars shall be placed in contact and just wired together to keep in place.

B.10.6. Coupling : Whenever plans and specifications call for the use of coupling boxes or bottlenuts to join bars, they shall have sufficient cross section to transmit the full strength of the bars. The ends of the bars which are joined by coupling shall be upset for a sufficient length so that effective cross section after cutting the screw threads shall be less than the normal cross section of the bars. Screw threads shall be standard with worth threads. Coupled joints will be paid for separately. Number of tensile tests shall be indicated in specification No. B.10.7.

B.10.7. Welding : Whenever plans and specifications call for welding of joints in reinforcement bars in lieu of lapping them, the bars shall be butt-welded so as to transmit their full strength. Welding shall generally conform to specification No. B.18 and I.S. 456-1964 except as modified below and when otherwise directed by the Engineer. Welded joints shall be so staggered that in any one section equal to the lap length of the bars, not more than 33 per cent of the bars are welded. Electricwelding or oxyacetylene process of welding, using a process which will exclude air from the molten metal and conforming to any special provisions for the welding as laid down by the Engineer in writing will be accepted. Suitable means shall be provided for holding the bars securely in position during the process of welding. The ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter and clean original metal exposed before welding. Only competent and experienced welders shall be employed on the work. Preliminary tests of the welds shall be carried out at the contractor's cost to see that the actual field welding method is satisfactory and dues required strength. Two welds in 100 welds or a minimum of two welds shall be made on the side on test pieces under conditions exactly similar to the field welding of actual reinforcement bars and tested for their tensile strength. The strength of the welded joint shall not be less than that of the original bar. If the tests are not satisfactory, change of welding procedure and further tests may be ordered by the Engineer. Bars welded alongwith the welded samples, found unsatisfactory on test shall be cut and rewelded. Additional welds if required on this account shall not be paid for. All the tests shall be at the cost of contractor.

When welded joints are required they will be paid for separately.

No part of the reinforcement embedded in concrete shall be used for conducting electric current.

B.10.8. Substitution : Substitution of sizes of bars different from those specified will be permitted at the contractor only if authorised by the Engineer. The

steel substituted shall have an area not less than the designed area provided further that the safe bond stress is not exceeded. If such substituted steel has larger area than that originally specified, such excess weight due to larger area will not be paid for.

B.10.9. Placing and Fastening : All reinforcement shall be accurately placed in position with spacing & cover shown on the plan & firmly held so during the placing and setting of concrete. Bars shall be tied at all intersections. Binding wire of 1.63 mm. or 1.22 mm diameter (about 16 or 18 gauge) shall be used. Alternatively the Engineer may permit spot welding instead of tying by wire. Spacing of bars shall be maintained by means of stays, blocks, ties, spacers, hangers or other approved supports at sufficiently close intervals so that bars will not sag between supports not be displaced during placing, vibrating or compacting concrete or by any other operation. Metal supports which extend to the surface of the concrete except where shown in the plans and wooden supports shall not be allowed. Placing bars for reinforcement on a layer of fresh concrete as the work progress, will not be permitted. The use of pieces of broken stones or bricks or wooden blocks for maintaining spacing or cover shall not be permitted. Layers of bars shall be separated by precast cement mortar blocks, spacer bar, or other approved devices. Special care shall be taken to prevent any disturbance of the reinforcement in concrete that has already been placed. Reinforcement after being placed in position shall be maintained in a clean condition till it is completely embedded in the concrete. All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected from rusting by a thin coat of cement wash.

B.10.10. Inspection : Full details of the numbers, sizes, lengths, weights, laps, welds, spacing of the bars placed in position in different parts of the work shall be recorded, certified and signed by the Engineer to show that all reinforcement has been placed correctly as per the sanctioned drawing or as order by the Engineer in writing before placing concrete. No concrete shall be deposited until the Engineer has inspected and certified the correctness of reinforcement, recorded the steel measurements and given permission to place the concrete in writing. After the approval of reinforcement by the Engineer it will be the contractor's responsibility to see that the reinforcement spacing and arrangements are not tampered with in any way before or during concreting.

B.10.11. Tests : When the contractor supplies his own steel, he shall produce the test certificate. If there is any doubt about the quality, tensile and cold bend tests shall be carried out according to I.S. 432-1966 in an approved laboratory and the cost of the tests shall be borne by the contractor if the results are unsatisfactory and by the Department if the results are satisfactory.

B.10.12. Items to Include : (1) Cost of labour, material, use of tools, plant and tackle and other incidental items to complete the work included under the item satisfactorily.

- (2) Supplying, conveying, cleaning, bending, binding with 1.63 mm. or 1.22 mm. diameter (16 or 18 gauge) wire or spot-welding and placing reinforcement in position and maintaining it clean and in position till the concrete is laid.
- (3) Cost of sampling and testing.

B10.13 Measurement and Payment : The contract rate shall be on weight basis for one metric tone of mild steel reinforcement. The weight of steel reinforcement incorporated in the concrete will be measured in metric tones based on the total computed weights for the sizes and lengths of bars, as shown on the plan or as ordered by the Engineer. The lengths of the bars shall be measured correct to two places of decimals in meters and the weight payable would be worked out correct to 0.10 of a kg.

The wire for tying and devices for supporting bars and maintaining various clearances will not be measured or paid.

No payment will be made for clips, binding wires, tack welding done in lieu of tying, separators, wire chairs and other materials used for fastening and supporting reinforcement in place. If the bars are substituted at the contractor's request and as a result more steel is used than specified, only the quantity specified shall be paid. Authorised lap lengths shall be paid for. If the lengths of bars contemplated in the designs are not available and the Engineer certifies the fact, steel involved in more number of laps will be paid for. When laps are made for splices other than those shown on the plans for the convenience of the contractor or lengths of laps more than indicated above, the extra steel will not be paid for. Any extra lengths of bars over the design if used (as shown on the plan) shall not be paid for..

B.11. CEMENT PLASTER

Plastering concrete, stone, or brick masonry surface in cement mortar of specified proportion and specified thickness including scaffolding, curing, etc., complete as directed.

B.11.1 Materials : Cement Mortar : Cement mortar shall have the proportion of cement to sand as mentioned in the wording of the items or in the special provisions and shall comply with specification No. B.5(a) for cement mortar for plaster.

B.11.2. Scaffolding : Shall be as per B.9.11.

B.11.3. Preparatory Work : All joints in the face work that is to be plastered shall be raked out to a depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done taking care not to allow any chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Smooth surfaces of concrete, old plaster, etc., must be suitably roughened to provide necessary bond for the plaster. All dirt, soot, oil, paint or any other material that might interfere with satisfactory bond shall be removed. In the case of stone masonry, bushing on the walls to receive the plaster shall not be more than 12 mm.

The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the preparatory work is passed in writing by the Engineer.

B.11.4. Gauges : Patches of plaster 15 cm. x 15 cm.(about 6"x ") shall be put on about 3 m apart as gauges to ensure even plastering in one plane.

B.11.5. Plastering : In all plaster work the mortar shall be firmly applied with some what more than the required thickness and well pressed into the joints and on the surface and rubbed and leveled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to ensure a perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer. The surface shall be finished to plane or curved surfaces as shown on the plan or directed by the Engineer and shall present a neat appearance.

The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. cement plastering should be done in squares or strips as directed. Plastering shall be done from top downward.

B.11.6. Finishing : In any continuous face of a wall, finishing treatment of any type should be carried out continuously and day to day breaks made to coincide with architectural breaks in order to avoid unsightly junctions.

B.11.7. Moulding : All moulding shall be worked true to template and drawn neat, clean and level. All exposed angles and junctions with door frames, etc., shall be carefully finished, arises shall be beaded if ordered.

B.11.8. Watering and Curing : All plaster work shall be kept damp continuously for a period of 14 days. To prevent excessive evaporation on the sunny or windward side of the building in hot, dry weather, matting or gunny bags may be hung over on the outside of the plaster in the beginning and kept moist.

Should the contractor fail to water the work to the satisfaction of the Engineer, the latter may engage requisite labour, materials and equipment to water the work properly at the cost of the contractor.

B.11.9. Bad Work : Should the mortar of the plaster perish through neglect of watering or for any other default and if the work is not done as specified above, the plaster shall be removed and redone at the contractor's expense.

B.11.10 Item to Include :

- 1) Erecting, dismantling and removing the scaffolding.
- 2) Preparing the surface to receive the plaster.
- 3) Providing cement plaster of the specified average thickness with specified number of coats.
- 4) Dewatering when necessary if not separately provided in the tender.
- 5) All labour, materials, use of tools and equipment to complete the

plastering as per specification.

- 6) Curing for 14 days.
- 7) Any moulding work if shown on the drawings or as specified unless separately provided in the tender.

B.11.11 Mode of measurement and payment :-

The contract rate shall be per square meter of plastering of specified thickness. All work shall be measured net in square mtrs. Dimensions shall be measured and quantity worked out correct upto two places of decimals in meter and square meter respectively. If the average thickness of polyester provided by the contractor is more than what is specified on any account, no extra payment will be made.

B.11.(a) Cement Plaster in one coat :-

The above specifications in B.11 will apply in all pertinent particulars besides the following ;

In case of stone masonry the bushings on walls to receive the plaster shall be removed to within 12 mm before laying in masonry and the plaster shall cover all projections by at least 6 mm.

The plaster shall then be laid on with somewhat more than the required thickness and pressed and leveled with a flat wooden rule or fault to required thickness. The average finished thickness of plaster shall be as required in the wording of the item. The surface shall be rubbed smooth after floating it with a thick coat of pure portland cement slurry while the base coat is still fresh. If neeru finish is specified floating with near cement will not be required.

B.11.(b) Cement Plaster in two coats :

Specification No. B.11 will apply in all pertinent particulars.

When plaster is to be laid in two coats, the average thickness of first coat of plaster is generally 10 mm on brick work and 20 mm (about 3/4") on rubble masonry. The first coat is applied as per B.11(a) but the surface is not floated or polished but roughened to give a key to the second coat of plaster. Before the first coat hardens, it shall be combined in way lines about 12 mm deep. The first coat shall be kept damp for at least 2 days immediately following its application. It shall then be allowed to become thoroughly dry. Before starting to apply the second coat the surface of the first coat shall be damped evenly. The finishing coat shall be of such thickness as to make the total average finished thickness equal to the required plaster thickness as per item. The finished surface shall be true and even and present a uniform texture throughout and all joining marks shall be eliminated.

B.13. CEMENT POINTING

Cement pointing with mortar of specified proportion to stone masonry or brickwork including raking out joints, watering, etc. complete.

B.13.1 Materials : Cement Mortar :

Cement mortar for pointing shall be of the specified mix and be as per specification No. B.5(a)

B.13.2. Scaffolding :

Scaffolding to be as per specification No. B.9.11.

B.13.3. Construction details :

B.13.3.1. Unless other types of pointing are specified in the item or the special provisions, pointing shall be of the grooved type. The joints in the masonry shall be raked out to a depth not less than the width of the joint for as directed in the special provisions or by the Engineer, when the mortar is green. The joints are to be brushed clean of dust and loose particles with a stiff brush. The area shall then be washed and the joints thoroughly wetted before pointing is commenced.

B.13.3.2 The raked out joints shall be filled with mortar of the specific mix and required consistency and well pressed and rubbed smooth.

B.13.3.3 The semi-circular depression 3 mm diameter shall be made in the joint by pressing a clean string with trowel keeping the string exactly horizontal and on the center line of the joint. The vertical joints shall be similarly marked. These depressed lines will then be immediately rubbed with a nayla till they become uniformly 6 mm.(about 1/4") wide and assume fairly blackish colour.

Intersection of the horizontal and vertical joints shall be finished neatly with the vertical lines just touching the horizontal line but not crossing it. Where joints are not horizontal and vertical as in the case of uncoarsed rubble masonry, the pointing shall be made along the center line of actual joints and the junctions of pointing made neatly. The pointing mortar shall not spread over the adjoining stones. Mortar pointing shall be restricted to the width of the joints and all superfluous mortar shall be removed with a trowel.

B.13.4. Watering :

The pointed face shall be kept continuously wet for 14 days after initial set.

Should the contractor fail to water the work as specified, the Engineer may if required in the interest of work and to keep the schedule programme, supply labour, materials and equipment to water the work and charge the cost to the contractor.

B.13.5. Bad Work :

Should the mortar perish or deteriorate through neglect of watering or any other default and if the work is not done neatly and as specified above, the pointing shall be removed and redone at the expense of the contractor.

B.13.6. Item to include :

Cement pointing shall include erecting and removal of scaffolding, all

labour, materials and equipment incidental to complete the pointing, dewatering if necessary till the mortar is unless separately provided for, raking out joints, cleaning, wetting, filling with mortar, troweling, pointing with nayla and watering.

B.13.7. Measurement and payment :

The contract rate shall be for a unit of one square meter of cement pointing. The dimensions of individual measurement shall be correct upto a centimeter and quantity calculated correct to two places of decimals of a square meter.

B. 15. R. C. C. CAST IN SITU BORED PILE

Providing RCC cast in situ bored piles of specified capacity founded on suitable strata including reinforcement and compaction of concrete.

B 15.1 General : Cast in situ RCC piles shall be of the design and layout shown on the plans or as proposed by the Patentee and approved by the Engineer. After the casing is sunk to the required depth in a suitable hard strata or to rock, the reinforcement cage shall be lowered into the casing. Cement concrete of the specified quality is then poured into the casing and compacted and the casing gradually withdrawn.

B 15.2 Equipment : The equipment will consist of heavy steel casing sections with screwed ends for connection and various types of percussion or rotary boring tools for boring and lifting the bored materials and water if any, from the casing, worked mechanically with suitable machinery, Arrangement for driving the casing as boring proceeds within it shall also be provided. The casing shall be of suitable thickness, sufficient strength and rigidity to permit driving with heavy hammers and to prevent its distortion due to soil pressure until filled with concrete.

B 15.3 Driving : The boring tools shall be centred at the exact pile location Boring and driving shall then proceed alternately till the appropriate strata is reached. When the casing is being driven in, care shall be taken to check that it is truly vertical. Sequence of boring and driving or vice versa will depend upon the strata passed through. The item will cover boring and driving the casing through all strata softer than rock. The contractor will not be entitled to any compensation or extra rate if the depths to which the piles are required to be driven are increased or decreased.

Contractor will be responsible for any compensation that may have to be paid due to injury to persons or damage to work and property caused by his pile driving operations.

When the boring is done to a satisfactory strata according to plan or as approved by the Engineer and the casting fully driven to the required depth, all loose material existing at the bottom of the hole after completing the boring operation shall be removed before pouring concrete.

Water may be used in the boring operations only to the extent absolutely necessary for facilitating boring. All necessary steps shall be taken to prevent surface water from entering the hole and all water which may have

infiltrated into the hole shall be removed before pouring concrete. If necessary the inside of the shell shall be inspected by lowering a light and it should be seen that any material like earth, clay, etc. sticking to the casing is removed.

- B 15.4 **Tolerances** : Utmost care shall be taken to see that the shell is driven true and plumb as far as possible. Unless remedial measures are necessary due to design requirements a shift of 8 cm. (about 3") in position and a cant of 2 percent of the height will be permitted. If the cant is more than 2 percent and shift more than 8 cm. (about 3') appropriate remedial measures by way of redesigning the pile-caps and / or driving additional piles as may be approved by the Engineer shall be provided by the contractor without extra cost to the Department.
- B 15.5 **Reinforcement** : Steel reinforcement shall conform to specification No. B. 10. Longitudinal bars of the required size shall be fabricated into a cage with spirals or stirrups accurately according to the design or plan or according to designs of the Patentee approved by the Engineer. Splicing of longitudinal bars may be by lap. The stirrups or spirals shall be tied to the longitudinal bars with 1.63 mm. diameter (16 gauge) wire. The longitudinal bars shall extend 60 cm. (about 2') over the top of the pile or as shown on the plans for being connected to the steel of the pile-cap or foundation-footing. The exposed length of reinforcement shall not be measured or paid. After driving the casting to the designed cover of concrete all-round during pouring concrete. The reinforcement of the cage shall be got approved in writing by the Engineer before placing it in the casing.
- B 15.6 **Concrete** : Cement concrete shall comply with specification No. B-6 for Ordinary Portland cement concrete 1:1½:3 proportion. The maximum size of coarse aggregate shall be 20 cm. (about ¾"). The contractor will be responsible to see that all the materials to be used including those supplied by the Department are of specified quality and not damaged in storage. The inside of the casing shall be cleaned if necessary before concrete is poured. As the concrete is to be poured into the casing, water sufficient to allow flow of concrete shall be provided. In case the surrounding area is dry, extra water will have to be added to enable water absorbed from the concrete by the ground, to be made up. The amount of extra water will be decided by the Engineer. Surrounding area shall also be well watered for at least 6 hours before concreting and kept well watered for 3 days. In waterlogged ground care shall be taken to ensure that the soundness of concrete is not affected by sub-soil water. When the concrete is being poured, compaction shall be made by approved means. The bottom of the shell shall be maintained not less than 30 cm. (about 1') below the top of the concrete during withdrawal of casing and pouring operations, unless otherwise permitted by the Engineer.

Concrete shall be placed in one continuous operation from the bottom of the bored hole to the bottom of the pile-cap and shall be carried out in such a manner as to avoid segregation.

If water is met with, it shall be removed. If it is impossible to remove it,

concrete shall be laid by tremie.

All the piles shall be cast to level previously fixed and any extra length of pile cast above that level shall not be paid for. This extra length of pile shall be cut carefully by chiselling in such a way that no damage results to the pile itself. The tops of piles shall be dressed to plain surface. Both these operations when necessary will be carried out by the contractor at his own cost.

- B 15.7 **Defective piles** : If the cant and shift are more than permissible, the concrete is of poor quality, the load test is unsatisfactory or there is any defect which, in the opinion of the Engineer, will affect strength or life of the pile, the pile will be rejected or the following or other corrective methods approved by the Engineer shall be adopted for the pile in question at the contractor's expense :-

1) One or more additional piles shall be cast adjacent to the defective pile and so arranged as to take the designed load.

2) The pile-cap or the footing shall be redesigned and extended to properly embed the pile to take the designed load.

- B 15.8 **Tests if concrete** : One test of three 15 cm. (about 6") cubes shall be made for the concrete poured on the first day and thereafter one for every fifteen piles cast or one for each week's operation whichever is more. The age of test shall be 28 days; but 7 days' test may be used if the relation between the strengths at 28 days and 7 days is established by sufficient number of tests. These cubes shall be got tested from an approved laboratory. All the expenses for materials, moulds, labour, transport, test, etc. shall be borne by the contractor. If any test cube results show the strength of concrete below the minimum specified, the piles represented by the sample shall be liable to be rejected.

- B 15.9 **Load tests** : Load tests shall be carried out on the piles indicated by the Engineer. They shall generally be about 1 percent of the total number of piles. The load tests shall be carried out according to specification No. B. 17

If the tests are not satisfactory, the piles may be rejected or if it is possible to adopt corrective measures by driving additional piles and redesigning the pile-cap in the opinion of the Engineer such measures shall be provided by the contractor without any extra cost to the Department. The load tests shall be paid for separately.

- B 15.10 **Item to include** : 1) All labour, materials use of equipment such as casing, boring and driving equipment, boring, providing concrete, compaction, reinforcement and withdrawal of casing including dewatering.

2) Compensation for any injury to persons and damage to property due to the operations of pile driving.

3) Tests of concrete.

4) Correction of defects if any.

Load tests will be paid for separately.

- B 15.11 **Measurement and payment** : The contract rate shall be for a unit of one linear metre of pile finished and accepted including reinforcement. Quantity of RCC cast in situ piles to be paid shall be actual number of linear metres of pile left in place in the completed and accepted work. The measurement shall be made from the bottom of the bored hole to the bottom of the pile-cap or bottom of footing as the case may be correct to one centimetre.

B.16. RCC PRECAST PILES

Providing and driving R. C. C. precast piles of specified dimensions and shape with M. S. reinforcement as per design and drawing for the specified capacity including use of necessary plant.

- B.16.1. **General** : This item would refer to the manufacture and supply of precast R. C. C. piles of the size and shape with reinforcement, etc. as shown on plans and as specified below, including driving the pile to the required bearing, levels, lines and in the location shown in the drawings or as approved by the Engineer.
- B.16.2. **Shape** : The piles shall normally be square in section and of the specified size with corners chamfered at least 2.5 cm. (about 1"). Other shapes shall also be adopted if shown in the plans.
- B.16.3. **Cement Concrete** : Cement concrete for R. C. C. precast piles shall conform to specification No. B.7 for controlled concrete. The strength of concrete in preliminary tests at 28 days and the minimum cement content per cubic metre of concrete shall be as per special provisions.
- B.16.4. **Reinforcement** : Reinforcing steel shall comply with specification No. B.10 for reinforcement bars and specification No. A. 15 for binding wire. The longitudinal bars shall as far as possible be in one length. If splicing is necessary, the bars shall be butt welded, with fish bars of the same diameter extending on both sides of the weld. Welding shall be done according to specification No. B. 18. Reinforcement cages shall be assembled according to specification No. B. 10 accurately according to design and plans.

While handling and transporting, the tackle should be attached at the designed pick-up points only. The cast-iron shoes shall be accurately fitted to the vertical bars so that the point is truly on the axis of the pile. Spacer forks of approved design should be inserted throughout. All crossings shall be securely bound with binding wire. All the longitudinal bars should end in the same plane and be kept back about 8 cm. (about 3") from the head of the pile. When the bars are drawn together at the end, they should not be bunched on one side as the pile may be damaged during driving. The cages shall be fixed straight and parallel to the moulds and held correctly to get the required cover by spacer blocks. Great care shall be taken to ensure correct and uniform cover throughout.

- B.16.5. **Pile Shoes** : Pile shoes shall be of grey cast-iron and of approved design. It shall have diamond points and mild steel straps cast in. Grey cast-iron shall conform to specification No. A.13. The shoes shall weigh not less than 20 kg.

B.16.6. **Casting Yard** : The layout of the casting yard should be designed to maintain the scheduled programme. This should involve providing storage spaces for cement, aggregates, reinforcement, mixers, sufficient forms, vibrators and floor space for storing piles so as to involve least handling. Casting floor should be firm to prevent warping or movement of green piles.

B.16.7. **Length of piles** : When length of pile is not specified or cannot be determined satisfactorily test bore shall be taken or a test road driven to ascertain the length of piles. If however these fail to indicate the length of piles required, test piles shall be driven. Such test piles must be of greater length than the length assumed in the design in order to provide for any variation in the sub-soil conditions. The contractor shall provide and drive test piles of the lengths and in locations ordered by the Engineer so that they may be incorporated in the permanent work.

The contractor shall not order for materials, or being casting operations until the specific order is given by the Engineer in writing regarding lengths of piles based on the result of test bores, rods or test piles. If the contractor furnishes the concrete piling in lengths other than those specified in writing by the Engineer, the extra length of the piles so furnished shall not be measured for payment. The provision for casting extra length beyond that ordered shall be made by the contractor for allowing embedment in the pile-cap and for probable damage to the top of the pile during driving. These allowances shall be incidental to the item and covered by the rate for the lengths specified in writing, though they might differ from those shown on the plans.

B.16.8. **Forms** : The forms may be of wood or metal and shall conform to the shape, lines and dimensions of the piles as shown on the drawings and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain position and shape and built in sections to give any length desired. The bottom of the form may be platform itself on which the piles are cast or sound planks or M. S. sheets strengthened with steel sections. The piles shall be cast horizontally on these platforms which shall be perfectly smooth and exactly level or in wooden or steel forms.

The contact surface of the forms shall be coated with a mineral oil or other suitable material approved by the Engineer to prevent adhesion of concrete to the forms. The oil or material shall be such as not to discolour the concrete. Chamfer shall be provided at top and the sides shown in the drawing.

B.16.9. **Placing reinforcement** : Reinforcement cage accurately assembled shall be placed in the form in correct position, allowing designed cover. Care shall be taken to see that the position of the cage is not disturbed in any way during placing of concrete and compaction by vibrator.

B.16.10. **Placing Concrete** : Only machine mixed concrete satisfying specification No. B.7 for controlled concrete of specified strength in preliminary tests shall be used. Placing shall be done in continuous operation until the pile

is completed. Great care shall be taken to ensure that the heads of the piles are formed plane and square to the axis.

- B.16.11. **Compaction** : All concrete shall be thoroughly compacted by vibrating and spading and rodding during operation of placing, and shall be thoroughly worked round the reinforcement and into the corners of the forms. Each pile shall be stamped or marked with the date of its manufacture. Preferably hooks shall be inserted at lifting points indicated on the drawings or these points shall be clearly marked.
- B.16.12. **Finising** : The side boards of the piles shall remain in position at least 24 hours after casting. Great care is to be taken when removing them so as not to damage concrete or disturb the pile in any way. Immediately after the forms are removed the surface of the pile shall be closely inspected and small irregularities shall be corrected and cavities filled up with 1.1½ cement mortar. Piles not satisfactory for driving shall be rejected.
- B.16.13 **Curing** : Piles shall be protected from heat by covering with hessian or other absorbent material which shall be continuously kept wet at least for 14 dasy.
- B.16.14 **Handling and storage** : Piles shall not be lifted before 80 per cent, of the specified strenght at 28 days is attained. They shall be handled very carefully with sling or toggles only at the pick-up points and severe jarring while in horizontal position or dropping shall be avoided. All piles shall be numbered serially and dated as cast and lift points marked. In addition to this scale showing length of the pilc at every 25 cm. interval begining from the shoe shall be marked. During storage, piles shall be firmly suported at suitable points and shall be separated from each other by at least 10 cm.(about 4") When piles are stored in tiers, suport shall be placed. directly over the support for the lower piles. No ties shall contain more than 4 piles. Pile shall be handled so as to avoid surface abrasion and other injuries exposing interior concrete.
- B.16.15 **Splice** : If proper resistance to driving is not obtained at designed level, the driving shall be continued and an additional length of pile required shall be poured in such a way as to develop the full strength of the section of the pile. Alternatively, the pile may be driven further to the full depth with the aid of a follower and then built up. When the piles are to be extended, the heads shall be stripped, the binders removed exposing main steel for one meter. The extension reinforcement shall then be added by welded butt joint. Concrete of the same proportion as for the original pile shall be poured to lengthen the pile as required by the Engineer and cured for 14 days. The pile shall not be redriven until the concrete has matured for 28 days. Just prior to placing extension concrete, the top of the pile shall be thoroughly cleaned and wetted and covered withthin coating of neat cement. The forms shall remain in position for not less 7 days shall then be carefully removed and the entire exposed surface of the pile finished as specified.
- B.16.16 **Handling and Transporting** : Handling and transporting of the precast piles from the storage yard to the actual place of driving shall be done by

suitable lifting tackle supporting them at designed pick-up points and conveyed to the actual spot of driving.

- B.16.17 **Driving caps** : The heads of concrete piles (when the nature of the driving is such as to unduly injure them) shall be protected with approved cushions and helmet caps of approved design. They shall preferably have a rope or other suitable cushion next to the pile head and fit into the casting which in turn supports the timber shock block. When the area of the head of the pile is greater than that of the face of the hammer, a suitable cap shall be provided to distribute the blow of the hammer throughout the cross-section of the pile and thus avoid tendency to split or shatter the pile.

Special types of pile driving heads, mandrels or other devices as may be necessary and approved by the Engineer, may be used to avoid injury to the pile while driving.

- B.16.18 **Hammer** : Piles may be driven with gravity hammer, steam or air hammer or combination of water jets and hammer, but steam hammer is preferable. Precast concrete piles may preferably be used to avoid injury to the pile while driving.

Unless otherwise stipulated, precast concrete piles shall be driven with a steam hammer which shall develop about 2200 kg. metres (about 16000 ft. lbs.) energy per blow at full stroke of the piston, not less than one kg. metre per 3.25 kgk. of weight driven (about one foot pound per lb. of pile driven). In no case total energy developed by the hammer shall be less than 830 kg. metres (about 6,000 foot pounds) per blow. If gravity hammer is used it shall have a weight not less than that of driving head and pile and the maximum drop shall not exceed 2.5 metres.

- B.16.19 **Leads** : Piles shall be secured against lateral movement during driving by leads or other suitable means. They shall be constructed in such a manner as to afford freedom of movement to the hammer and shall be held in required position by guys and steel braces to ensure rigid lateral support to the piles during driving. Inclined leads shall be used in driving battered piles.

- B.16.20 **Followers** : Driving of piles with followers shall be made only when only when absolutely necessary and shall be done only under written permission of the Engineer.

- B.16.21 **Driving** : The pile shall be held in the correct position and driven with hammers preferably worked by steam or air power to the depths shown on the plan or as directed by the Engineer true and plumb or to the specified batter to give the designed set for the last ten blows. Accurate records of number of blows for the last 30 cm. shall be kept in the required proforma for the guidance of the Engineer in determining allowable load on the pile. Record shall also be kept for each pile to show the number of pile, diameter, length, location, penetration effected each day, shift and cant if any and the load test if carried out. These records shall be got countersigned by the Engineer or his representative every day.

Where driving is interrupted before the final penetration is reached, the record for final penetration shall not be taken until after at least 20 blows are given on resumption of driving provided no rock is encountered. If required penetration is not obtained, driving will be done with increased number of blows per minute without extra payment. As soon as the pile is found to be sufficiently deep in hard strata, start will be made for taking the set. After the specified set is obtained ten more blows shall be given to the pile and the set recorded. If during these blows the set in 10 blows is found to be more than 12 mm. (about ½") the driving shall be continued further till a set of 12 mm. (about ½") or less is obtained for 10 blows. If during the process of driving piles, foundation masonry of old structure, or boulder is met with they are to be removed by the contractor by excavation for which no extra payment will be made. If any waterpipe line or drainages or other utilities are encountered while driving piles, the necessary diversion of drainage, water pipe or utilities shall be carried out as per Municipal or other regulations and as directed by the Engineer at the contractor's expense. The contractor will be held responsible for any damage that may be caused to the neighbouring structures or property due to the operations of driving piles.

The item will cover driving the piles through all strata softer than rock.

B.16.22 Tolerances : The contractor shall locate the position of piles as shown in the plan or as directed by Engineer on the actual plot of construction. Any deviation from such location shall not exceed 8 cm. (about 3") at the time when the driving is started except as may be made necessary by the presence of large boulders, broken piling, or other unavoidable obstructions. Only when shown on the plans or with the permission of the Engineer, shall piles be driven closer together than 75 cm. (about 2' - 6"). While being driven the piles shall be so held with toggle, shores or cable as to prevent deviation as far as possible from the vertical or battered line shown on the plans. Unless remedial measures are necessary due to design requirements, a shift of 15 cm. (about 6") in position and a cant of 2 percent of the height will be permitted. If these deviations are exceeded, proper remedial additional construction by way of additional piles or modified pile-cap shall be provided at the contractor's expense.

B.16.23 Defective Piles : Procedure incidental to the driving of piles shall not subject them to excessive and undue stress resulting in crushing or spalling of concrete. Manipulation to force them into proper position causing excessive stress in the opinion of the Engineer will not be permitted. Any pile damaged due to internal defects or by inappropriate driving, or driven out of its proper location shall be corrected at the contractor's expense by adopting the following or other methods approved by the Engineer :-

- a) The pile shall be replaced by a new one and if necessary by additional piles. If approved by the Engineer, the injured part may be replaced by splicing or otherwise repaired to properly embed the piles.
- b) Additional piles shall be driven adjacent to the defective pile with the necessary modification in the construction of the pile-cap.

- c) The pile shall be spliced or rebuilt or the footing or pile-cap extended and enlarged or to properly embed the piles.
- d) All piles pushed up by driving adjacent piles or by any other causes shall be driven down again.

B.16.24 Cutting of piles : All piles driven and accepted shall be cut off to a horizontal plane at the levels indicated on the drawings from tops of piles or below any unsound portion of the piles as directed by the Engineer.

Piles driven or cut off after being driven below the levels indicated in the drawings for tops of piles may be rebuilt or extended with the approval of the Engineer. Splicing and extending of the pile shall be done as specified above in specification No. B. 16.15.

B.16.25 Loading test : The loading test when required shall fully conform to the Specification No. B. 17. It will be paid for separately.

B.16.26 Jet Pipes : If the piles are to be driven through strata of sand, water jet may be used and its arrangements shall be made as follow:-

Pile shoe is to have two oblique holes, near the point, served by a short length of 20 mm. (about 3/4") diameter screwed black steel pipe for water jetting 32 mm. (about 1½") diameter screwed and socketted black steel pipe shall be placed and cast within the body of each pile with reducing socket for extending into the pile shoe and it has to be brought out near the lead with crewed connection to receive hydraulic pressure pipe from the jetting pump. The contractor is at liberty to make alternative arrangements for water jetting subject however to the approval of the Engineer, either with the use of collapsible rubber tubes cast in the concrete or for using jet pipes from outside. All water jetting shall be contractor's responsibility and his rate for providing and driving piles shall be inclusive of pipes, jet pumps and of other arrangements for driving including water jetting pipes successfully.

The number of jets and the volume and pressure of water at the jet nozzle shall be sufficient to freely erode material adjacent to the pile. The plant shall have sufficient capacity to deliver water at not less than 7 kg. per sq. cm. (about 100 p.s.i.) at two 20 mm. and the pile shall be driven with hammer to secure final penetration.

B.16.27 Item to include : (1) preparing casting yard.

- (2) Taking test before, driving test rod or manufacture of test pile and driving to secure all data. Only test piles if driven will be paid at the tendered rate. Taking test before or driving test rod shall be considered as incidental to the item.
- (3) All labour, materials and equipment (including hammer, which will have to be changed if necessary, according to circumstance) and incidental items for fabrication and assembling the reinforcement including welding where necessary, casting, curing, storing, handling and driving the piles including the pile shoe.
- (4) Taking tests of concrete.

- (5) Extension of pile as required.
- (6) Driving piles.
- (7) Cutting piles.
- (8) Finishing of piles.
- (9) Providing and fixing jet pipes if necessary.
- (10) Dealing with defective piles.
- (11) Treatment of pile heads.
- (12) Driving the piles including jet and other necessary work to obtain required penetration set and bearing of the piles.
- (13) Additional work required for remedial measures and lengths required to be cast for embedding into the pile-cap and to allow for damage of the pile top during driving.
- (14) Compensation for damage to work of property and injuries to persons due to accidents connected with the pile driving operations.

B.16.28 Mode of Measurement and payment : The contract rate shall be for one running and metre (about 3.28') of R. C. C. present pile of approved size, shape, design and length ordered and driven to the required set. The length of precast pile driven shall be measured correctly up to 2 places of decimals of a metre for the full length ordered even if the final length driven is less. Payment for test piles shall be made for the actual length of the pile cast. The length payment shall be made for the remedial measures required to be taken in the case of piles driven beyond the tolerance limits. No payment shall be made when damage to the pile is established to be due to faulty manufacture, handling and driving. As a check on the length of pile driven, complete record of driving piles shall be maintained on the work for each pile specifying the number of pile, length, location and penetration effected each day in a prescribed form. The penetration under the last 10 blows of the hammer and the result of any test shall also be recorded. All these records will have to be countersigned by the Engineer's representative on site daily.

Driving one test bore or one test rod for a group of 25 piles shall be considered as incidental work and shall not be paid for. When pipes are embedded in the piles or ducts left for water jetting purposes, no deduction will be made in the concrete nor payment made for the pipes or hollows.

B.17. LOAD TESTS OF PILES

Carrying out loading tests of pile or pile group including construction of test caps, accessories and instruments, dismantling the caps, after test, etc. complete.

B.17.1. General : The load test shall be carried out on any particular pile or pile-group selected by the Engineer after a period of not less than 28 days after casting. The load test shall be carried out by applying a series of test loads as specified below on a test cap or suitable platform over the pile or

group of piles unaided by any other support. Direct loading or application of pressure by hydraulic jacks with gauges or any other suitable method may be adopted as approved by the Engineer. Before any load test is made, the proposed apparatus and procedure shall be got approved by the Engineer. Readings shall have to be recorded with the help of deflectometers from two sides of the cap or platform, precision levels or any other suitable device approved by the Engineer. Reference points for measuring pile settlement shall be sufficiently removed from the test pile to preclude the possibility of disturbance. A complete record of all load tests shall be filed with the Department.

- B.17.2. Procedure of Test :** The pile or pile group to be tested shall be loaded by a method which will maintain constant load under increasing settlement. The test load shall be 150 percent of the proposed safe working load on the pile or the pile group. The load shall be applied in equal increments of 10 tonnes at intervals of half an hour till the full test load is reached. Full test load shall remain for a period of 48 hours. During the period of test, careful observations shall be made for settlement taking place before and after each increment of load.

The test load shall be removed in decrement not exceeding 10 tonnes with intervals of not less than fifteen minutes. The rebound will be recorded after each decrement. The final rebound shall be recorded 24 hours after entire test load has been removed. Reading of settlement and rebound shall be referred to a pucca Bench Mark. These shall also be recorded to 0.5 mm for each increment or decrement of load by means of deflectometers.

The contractor shall himself arrange to provide the necessary loads, R. S. joists, apparatus, test caps or platforms and all other materials and equipment, power and labour necessary for successfully carrying out the test to the satisfaction of the Engineer. The contractor shall be responsible for any injury to life and property, if any, caused during or due to the test. After the test load is removed, the head of the pile should be carefully examined for any damages. Damage, if any shall be made good to the satisfaction of the Engineer.

- B.17.3. Acceptance of test :** The test shall be accepted as satisfactory.

- i) If the total set under full test load after a period of 48 hours does not exceed 12 mm. (about half inch) and if the ultimate settlement after removal of test load does not exceed 6 mm. (about quarter of an inch), and
- ii) If the general behaviour of the pile or pile-group during the test period does not disclose any defects.

If the pile fails to comply with the requirements due to defective pile or defective driving, the pile will be rejected unless it is possible to carry out effective remedial measures which will be done at the cost of the contractor. The cost of testing such defective piles shall be borne by the contractor.

In the case of precast piles, if the pile sinks under test load due to weak

strata, the pile shall be extended and driven to the required depth to obtain the specified loading capacity.

- B.17.4. **Item to include** : 1) Building up of test cap or platform or any other arrangement approved by the Engineer for satisfactorily loading of the pile or pile-group with the test load and removal.
- 2) Necessary suitable material for loading in specified batches upto the total test load or necessary arrangement for applying the test load by hydraulic jacks with suitable yokes and tested pressure gauges.
 - 3) Suitable apparatus for accurately measuring the test load, the settlement or rebound of the pile under each increment or decrement of load.
 - 4) All labour, equipment, power, material incidental to making the loading test satisfactorily as directed by the Engineer.
 - 5) If the reinforcement bars projecting beyond the top of the pile are required to be cut for test purposes, the item will include chipping of the pile to the required length to uncover the reinforcing bars for securing sufficient lap length for the bars required to be added and rebuilding the pile to the required level, curing etc.
 - 6) Clearing the site after the test.
- B.17.5. **Measurement and payment** : Test of one pile or pile-group shall be measured as one test and payment will be made at the rate quoted in the leader for one loading test.

B.18. WELDING

- B.18.1. **General** :- The specifications given hereunder shall apply to welding as applied to new and existing mild steel structures and mild steel reinforcement for R. C. C. work. Welding may be adopted in R. C. C. work in the following cases :-
- a) Fillet welding for placing the reinforcement in correct position or for providing cross bars in lieu of hooks.
 - b) But welding or reinforcing bars. Welding shall be made by the metal arc process unless oxyacetylene gas welding is specially permitted by the Engineer in writing. The specifications for the former have been given in B. 18 (a) and for the latter in B. 18 (b).
- B.18.2. **Welding Contract** : i) The welding work shall not be given to a contractor who does not produce satisfactory evidence of his ability to handle the work in a competent manner. The contractor shall also prove the ability of the operators employed by him to produce welding connection of the required strength.
- ii) The contractor shall employ a competent welding supervisor or charge-hand to ensure that the standard of workmanship is satisfactory.
 - iii) The Engineer shall have free access to the work being carried out by the contractor at all reasonable times and facility shall be provided so that

during the course of welding he may be able to inspect any layer of weld metal. He shall be cut out and rewelded.

- B.18.3. **Safety requirements and health provisions** : The contractor shall make all safety and health provisions for his welders as are laid in I. S. 818-1968, i.e., Code of practice of safety and health requirements in electric and gas welding and cutting operations.

B.18.(A) METAL ARC WELDING

- B.18.(a)1. Metal arc welding in structural steel work - Material - Electrodes - Electrodes used for strength welds shall conform to I. S. 814-1974. They shall be of shape and size approved by the Engineer. They shall be preserved from oxidation and shall be kept in clean condition.

Welding : The size of the weld and the position where the weld shall be placed shall be entirely as per the drawings supplied or as directed by the Engineer.

Design of welds, drawings, permissible stresses in welds, welding in compression and tension members, welding in plate girders lacing, battening, welding equipment and electrodes shall be all as per I. S. 816-1969. Code of practice for the use of metal arc welding for general construction in mild steel.

Welded fabrication of structural steel shall be on the lines given in I. S. 800-1962.

The following instructions shall also be followed from point of view of workmanship :-

- i) Welders and work shall as far as possible be protected from wind and weather.
- ii) Welds should be made in the flat position wherever possible.
- iii) 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.
- iv) Structural steel shall not be painted or oiled on any areas where welding is to be done and shall be well cleaned to remove any paint, scab, or rust and expose original clean metal surface immediately before welding.
- v) The member shall be securely held in position by means of tack welds, service bolts, clamps or jigs before commencing welding so as to prevent any relative movement due to distortion, wind or other causes. When wind or manual handling is liable to cause distortion, the work shall be securely held in approved frames or jigs.
- vi) Freedom of movement of one member of the joint shall be allowed wherever possible. No butt joint shall be welded without allowing one component freedom of movement of the order of 2 mm (about 1/12").
- vii) The sequence of welding shall be such that when possible, the

members which offer greatest resistance to compression are welded first.

- viii) The welding of a joint shall be so arranged that resulting tensile and compressive stress produced by each portion of the weld tend to balance each other. The step back method shall be adopted for continuous runs.
- ix) Fusion faces may be cut to the required shape by shearing, chipping, machining or machine gas cutting. Hand cutting by gas may be substituted for machine gas cutting only if the latter is impracticable; the cutter shall be adequately guided so that the cut edge is clean and uniform. If the fusion face is rough it shall be dressed by chipping, filing or grinding in a satisfactory manner.
- x) Welds showing slag inclusions, porosity or lack of proper penetration shall be cut out and rewelded. Overlap of the toe of the weld and under cutting or the parent metal should be avoided and where present to a serious extent shall be rectified.
- xi) All slag shall be removed from each run before another run is superimposed and from the final run. When cold, the final run shall be protected with clean boiled linseed oil and shall not be painted until approved by the Engineer.
- xii) Grinding of finished weld is permitted provided the weld is not reduced below the prescribed section.
- xiii) All welds which have not been ground shall be scrubbed with a 10 percent solution of hydrochloric acid which shall be satisfactorily washed off with water before the paint is applied unless alkali resisting paint is used.

B.18.(a)2. Metal arc welding of M. S. bar reinforcement in R. C. C. works - materials
 - Electrodes shall comply with I. S. 814-1974. They shall be of shape and size as approved by the Engineer. They shall be preserved from oxidation and shall be in clean condition. Electrodes shall be of the heavily coated type. The electrodes shall satisfy the following mechanical properties :-

- a) Ultimate strength not less than 44 kg./sq.mm. (about 28 tons p. s. i.)
- b) Yield point not less than 31 kg. / sq. mm. (about 20 tons p. s. i.)
- c) Elongation of a length equal to 3.54 times the diameter of the rod, not greater than 20 percent, and
- d) Izod impact test 4 kgm. (about 30 ft. lbs.).

The maximum size of electrodes shall be based on following table :-

Diameters of bars corresponding to in mm.	Diameters of bars in inches	Maximum size of Electrodes	Amperage
(1)	(2)	(3)	(4)
		S. W. G. mm (in)	
12 to 25	½" to 1"	10 3.25 mm (0.128)	
25 to 32	1" to 1¼"	8 4.06 mm (0.160)	
	Double bevel	10 3.25 mm (0.128)	
32 to 50	1¼" to 2"	10 3.25 mm (0.160)	As specified by the manufacturer
	Double bevel	8 4.06 mm (0.160)	
25 to 50	1" to 2"	6 4.06 (0.160)	
		6 4.88 (0.192)	

Forms of Butt welds. - Butt weld shall be made in one of the following forms :-

No. of	Type	Diameter	Min. Gap.	Angle of V	Root Face	details
		Range mm (D)	mm(g)	(a)	(E)	welds
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1.	Single V Butt weld	12 to 40 (½" to 1½")	D/4	60° to 70°	None	
2	Double V Butt weld 28 and above	3 to 6 (1/8" to 1/4")		60° to 70°	None	

The form and dimensions of weld surface shall be such as will provide access for the electrode to be welded and enable the welder to see clearly the work in progress.

A butt weld shall be built up so that the effective throat diameter is greater than the diameter of the bars joined. Such increase in diameter shall be not less than 10 percent and not more than 25 percent of the diameter of the bars joined.

Workmanship : 1) The surface to be welded and the surrounding material for a distance of at least 12 mm. (about ½") from the weld shall be freed from scale and cleaned so as to remove dirt, grease, paint, heavy rust or other surface deposit, wire brushing being used if necessary.

2) Fusion faces may be cut to the required shape by shearing, Chipping, machining or gas cutting.

3) All the bars to be butt welded should be aligned and set in position with their axis in one straight line. This should be done either by wiring to the

other reinforcement or by attachment in a jig or clamp or by use of standards and guides and chairs on a prepared platform. One of the bars shall have freedom of movement in the direction of its axis to avoid residual stresses. Turning or rotating the bar till half the bar is welded should be avoided. Turning or rotating the bar shall be done without disturbing the alignment and without introducing any twist in the bar during the process of welding.

4) The welding current shall conform with respect to voltage and amperage (and polarity if direct current is used) to the recommendations of the manufacturers of the electrodes being used. The arc length, voltage and amperage shall be suited to the diameter of the bar to be welded.

i) A single layer of weld metal whether deposited on one pass or made up of several parallel beads shall not exceed 3 mm. (about 1/8') in thickness.

ii) The electrode manipulation during welding shall ensure that -

a) complete fusion between the base metal and the deposited weld metal is obtained.

b) the melted base metal is replaced by weld metal so that no under cut remains along the edges of the finished weld,

c) the melted weld metal makes all slag, oxide and gases float to the surface behind the advancing arc. All the slag should be removed from each run before another run is superimposed and from the final run by hammering lightly and wire brushing.

d) full penetration into the root of the weld is obtained, and

e) surface of the weld shows regular and even ripples and edges of the weld merge thoroughly with the base metal.

5) Welder shall be provided with such staging and if necessary, with protection as will enable them to perform the welding operation properly.

6) All welding equipment shall be in good condition and capable of enabling the welder to provide and maintain the correct arc at all times.

Test : Two welds in 100 welds or a minimum of two welds shall be made on the site on test pieces under condition exactly similar to the field welding of actual reinforcement bars and tested for their strength. The strength of the welded joint shall not be less than that of the original bar i.e. failure shall be in the parent metal and not in the welded joint.

If the tests are not satisfactory of welding procedure or personnel may be ordered by the Engineer. Bars welded along with the welded samples found unsatisfactory on test shall be cut and rewelded. The tests shall be got made at the cost of the contractor.

B.18.(b) Oxy-acetylene Welding

B.18.(b)1. Oxyacetylene welding in structural steel work - Material - Filler Rods. - Filler rods shall conform to I. S. 12781-972. They shall be preserved from oxidation and shall be in a clean condition.

4) The design method of welding, workmanship in oxyacetylene welding

shall be as per I. S. 1923 1973, Code of practice for oxy-acetylene welding for structural work in mild steel. The instructions given in B.18(a) regarding workmanship shall also be adhered to in this type of welding.

- B.18.(b)2. Oxy-acetylene welding for M. S. reinforcement bars in R. C. C. work - material - Filler Rods. - Filler rods shall conform to I. S. 1278-1972. They shall be preserved from oxidation and shall be in a clean condition. They shall satisfy the same mechanical properties as mentioned for electrode in B.18.(a)2.

Welding : Shapes of the ends of the bars at the weld shall be the same as laid down in B.18(a)2. unless other shapes are premitted by the Engineer in writing.

Workmanship : Same as for B.18(a)2 in all relevant particulars.

Test : Same as for B.18(a)2.

B.19. STRUCTURAL STEEL WORK

- B.19.1. **General** :- This specification covers the requirement of providing fabrication and erection of structural steel work including painting.
- B.19.2. **Materials** : Structural steel sections : This shall comply with specification No. A. 11, Rivets : Shall conform to I. S. 1148-1973 and I. S. 800-1962.
- Belts** : These shall comply with I. S. 1148-1973 and I. S. 800-1962.
- B.19.3. **Fabrication and erection** : Cutting, holding, assembly, riveting, bolting, machining, painting, marking and erection shall be carried out in accordance with approved plans and as directed by the Engineer from time to time and shall comply with I. S. 800-1962.
- B.19.4. **Damaged members** : Any material found damaged or defective shall be stacked separately and shall be marked in a distinctive colour. Such material is to be dealt with expeditiously under the orders of the Engineer.
- B.19.5. **Riveting, welding and bolting** : 1) Riveting or welding shall not be started until such time as the Engineer has personally satisfied himself that the alignment is correct, the vertical plumb, the camber correct with all camber jacks screwed tight, all joints and cover plates fixed tight with service bolts and field rivet holes coinciding. While assembling, holes in different components shall be made concentric with the use of drifts before service bolts are fixed.
- 2) Welding if required to be done, shall conform to specifications No. B. 18.
- 3) All permanent machine-fitted or other bolts must be perfectly tight and should be burred or otherwise checked, to prevent nuts from becoming loose. No unfilled rivet or bolt holes are to be left in any part of the structure.
- 4) Fitting and riveting (or welding) of connections of tee sections, in cases where pieces are short or of full length shall be done in such a manner that the metal is not unduly strained or cracks caused.
- 5) Care shall be taken to see that cracks are not filled with paint, putty,

cinders, dirt, oil or fillings for the purpose of deception.

6) Particular care must be taken to ensure free expansion and contraction wherever provided for in drawings or as the Engineer directs.

7) Chipping of rivets, angle flanges and edges of plates must be done without breaking out the metal. Chipped edges shall be finished off with a file and all concave corners shall be rounded off.

- B.19.6. **Painting** : Painting shall generally comply with I. S. 800-1962 and I. S. 1477 (Part I)-1971 subject to such additions or alterations as may be prescribed in the special provisions for any particular item. It shall also comply with relevant part of specification No. B.21. One printing coat of red lead shall be applied immediately after fabrication. Two coats of oil paint of approved shade shall be applied after complete erection.

Structural steel work to be encased in concrete shall not be painted.

B.19.7. **Inspection and Testing**

s : These shall be carried out in conformity with I. S. 800-1962.

- B.19.8. **Item to include** : 1) The item shall include supply fabrication and erection in position at site of all structural steel sections of the required dimensions and labour, materials, and use of equipment required for all operations of fabrication, hoisting, erection and satisfactory completion of the item.

2) Item shall also include labour, materials and use of equipment required for painting the structural steel work.

- B.19.9. **Mode of measurement and payment** : The contract rate for the item shall be one quintal (about 220 lbs.) or one tonne (about 2,200 lbs.)

In the case of rolled sections lengths shall be measured correct to a cm. and weight calculated on the standard weight per metre tabulated in the I. S. I. Hand Book for structural steel sections limited to the length shown on the plans correct upto 0.10 of a kg. weight of steel plates of each thickness shall be calculated separately on the basis of actual shape provided without taking into account wastage or cut off. In case of bolted work, weight of bolts, nuts and washers shall be added in full and no deduction shall be made for bolt holes. In riveted work only the weight of rivet heads shall be added. No deductions shall be made for rivet holes. No increase in weight shall be allowed in welded work due to welding.

B.20. GENERAL WOOD WORK

- B.20.1. **General** :- The specifications refer to wood work in general, including carpentry and joinery work in roofs, floors, verandahs, staircase, door and window frames, bridges, coffer dams, shores, struts, large gates, etc.

B.20.2 **Materials** :-

1. Timber shall comply with specifications No. A. 16 in all respects.
2. **Species of Timber** :- The species of timber to be used shall be mentioned in the items. Where no species is mentioned, good Indian teak (*Tectona Grandis*) alone shall be used, In case a

particular jungle wood species has to be changed the Engineer's decision about the alternative shall be final.

Engineer may inspect all logs and scantlings previous to use and reject any which he considers defective in the requirement of specification.

3. **Glue** : Glues are of two types (i) organic type which glue shall be from skin or bone material, and (b) synthetic type. It shall be of such a material, that it may be used without causing harm and adhere. A freshly prepared hot solution shall be of a clear amber colour, translucent, free from black or cloudy spots and shall swell considerably when immersed in cold water without dissolving.

Organic type shall comply with specification No.I.S. 852- 1957 and synthetic shall comply with I.S. 851-1957 in all respects.

4. **Nails, Screws, etc.** : Nails, screws, ties, straps, bolts, etc. shall be of the material, make and pattern specified in the item or the special provisions and approved by the Engineer.

B.20.3 Precautions against Decaying :-

1. The contractor must in all cases obtain orders from the Engineer regarding time at which he shall do painting or oiling to woodwork and obtain permission of the Engineer before he paints, oils or otherwise treats woodwork.
2. All parts of woodwork resting on or set in masonry shall be well painted with 2 coats of hot boiled tar approved by the Engineer. The tar shall be so applied as not to appear on the exposed timber. No extra payment shall be made for such tarring. Timber buried in the ground shall be well coated with tar.

When the end of a beam or joist is embedded in masonry and air space of 6 mm. shall be left at the end and sides wherever practicable and necessary in the opinion of the Engineer.

B.20.4. Workmanship : All woodwork shall be neatly and truly finished to the exact dimensions required. Unless otherwise required in the special provisions, woodwork which will remain exposed to view when the work is perfectly smooth and to lines, planes, or curves as required. Unless otherwise specified all joints shall be simple tenon and mortise joints with the end of the tenon exposed to view. All mortise tenon and other joints shall fit truly and fully without wedging or filling, in a workmanlike manner. Only where specially required, the end of the tenon shall not show. All joints shall be of the types shown on the drawings or specified for the item and as directed by the Engineer. Where no specific instructions are given to the contractor, he shall observe the following principles in forming joints :

1. To cut the joints and arrange fastenings so as to weaken as little as possible the pieces of timber they connect.
2. To place each abutting surface in a joint as nearly as possible

perpendicular to the pressure it has to transmit.

3. To form and fit accurately every pair of surfaces that come in contact. All framed joinery, for external work shall be put together with white lead and joints pinned with hardwood or bamboo pins. For internal work where joints are not likely to be affected by moisture, the joints may be glued and similarly pinned. Where ordered, the butt joints shall be cross tongued and the tongues cut all right angles or diagonally to the grain of the wood. All mouldings shall be clean and accurately finished and all miters, etc. shall be properly met. Where turning is required it shall be done to the exact shapes shown in the drawings.

B.20.5. Framing :- Framed woodwork includes all sawing, cutting, planning, jointing, framing, supply and use of all straps, bolts, hold fasts, nails, triennials, spikes, screws, etc. necessary for framing and fixing.

Framing and trussing are to be done in the best possible manner and all necessary ties, straps, bolts, screws, etc. fitted as shown on the drawings or as directed by the Engineer.

Holes of correct size shall be drilled before inserting screws. Driving in or starting the screws with hammer is prohibited. All screws shall be dipped in oil before being inserted in the wood. The kind of nails and screws shall be subject to the approval of the Engineer. The heads of nails or screws shall be sunk or dealt with as the Engineer may direct.

B.20.6. Scaffolding :- The contractor shall provide all labour, scaffolding ladders and tackle necessary for hoisting and fixing construction. He is also responsible to see that the tackle and scaffolding, etc. are of the requisite strength and that the work is secured in a proper manner during inspection. The contractor shall be responsible for the safety of the work, workmen and for any action or compensation that may arise in this connection.

B.20.7 Iron Work :- All iron work connected with woodwork and going to be embedded in masonry shall before erection, receive 2 coats of hot coal tar. If it is to be painted, it shall be given the first 2 coats on the ground before being fixed in position and the third coat afterwards.

B.20.8 Precautions against fire :- No woods work of any kind shall be laid within 60 cm. (about 2') of a fire place or fuel. During the progress of work all shavings, cuttings and other rubbish shall be cleared away as the work progresses, and all precautions, shall be taken against fire. No rubbish shall be let under floor boards or in other concealed positions on the job.

B.20.9 Inspection : All woodwork shall be inspected by the Engineer before being put into the work. The Engineer shall not be barred from rejecting any wrought timber on account of defective quality by reason of his having previously passed the same before it had been worked upon. In no case the woodwork shall be painted or otherwise treated before it is inspected and approved by the Engineer.

All woodwork in a building shall after it had has been passed by the

Engineer, having the primary coat of paint put on or otherwise treated before being fitted in position. The subsequent coats of paint or other finish shall be applied after the woodwork is fixed in position.

B.20.10 Defective work :- If within three months after the work is completed any undue shrinkage or bad workmanship is discovered the contractor shall forthwith replace or refix the same to the satisfaction of the Engineer without extra charge.

B.20.11 Item to Include :-

1. Supply of specified species of timber sawn to requisite sizes without any defect, wrought, framed and fixed in position with the required standard of workmanship including supply and fixing of fixtures, straps, bolts, holdfasts, spikes, nails screws, etc., applying contractor's glue or other jointing materials, coal-tarring embedded parts and painting joints.
2. All materials, labour, scaffolding, use of equipment, etc., for framing and fixing and completing the item as specified.
3. Applying two coats of double boiled linseed oil to internal woodwork unless other types of finishing is specified in the special provisions.

B.20.12 Mode of Measurement and Payment :- This will depend upon the item in the tender for which woodwork is executed. All woodwork when put up shall be of the dimensions shown on the drawings or as directed by the Engineer. Woodwork will be paid by net measurements and no allowance will be made for wastage or for dimensions supplied beyond those specified. But the length of each piece shall be measured overall so as to include projections for tenons or scarfs. For curved pieces cut out of the solid, the minimum overall dimensions of the required original rectangular section of scantling will be allowed in the measurements. The dimensions of sectional measurement shall be taken correct up to 2 mm. (about 1/12") and the length will be measured correct upto two places of decimals of a meter. The quantity shall be calculated correct to three places of decimal of a cubic meter. When the schedule calls for supply of wrought timber, the rate shall as in all other cases include carriage to and delivery at the site of work.

B.21. OIL PAINTING

B.21.1 Materials and accessories :

B.21.1.1 Oil Paints : Oil Paints shall conform to specification No.A.17. All paints shall be thoroughly stirred with a clean stick before use. While being used the paint shall be stirred often to keep the pigment in uniform suspension. Ready mixed (factory mixed) paints only shall be used unless other types are specifically mentioned. Sample colour boards shall be prepared by the contractor and got approved by the Engineer before painting is started.

B.21.1.2 Brushes :- Unless other methods of application like spraying are specified paint shall be applied with brushes. On no account shall rags be used in the application of paints. The size of brushes to be used for painting of

various works shall be got approved by the Engineer. All brushes shall be either round or oval shaped. Flat brushes when specifically authorised by the Engineer in writing shall not be over 8 Cm. (about 3") wide.

B.21.1.3 Containers :- The paint while being applied shall be kept in shallow pans and not in deep cans and must be kept well stirred. All paint cans must be cleaned out at the end of each day's work.

B.21.2 Scaffolding :- Scaffolding if necessary shall be as per B.9.11.

B.21.3 Precautions in using in lead Paints :

1. White lead, sulphate of lead and all products containing those pigments (but not white pigments containing not more than 2 per cent of lead) shall not be used in internal painting of building except for priming coat and artistic painting or fine lining work. They shall be as far as possible used in painting operations in the form of paste or ready mixed paint and measures shall be taken wherever practicable, to prevent danger arising from the application of the paint in the form of spray or by dust caused by rubbing down and scraping.
2. Paint workers must be warned to avoid getting smeared with the above paints.

B.21.4 Cleaning :- Cleaning operations shall precede painting so that paint may be applied to clean surfaces. The work shall be carried out in such a manner that dirt and matter removed by cleaning will not come in contact with freshly applied paint. The method to be applied for cleaning and preparing surfaces for painting shall be mentioned in the specifications for each type of surface. When not so mentioned, any suitable method approved by the Engineer for exposing the original surface without damage shall be adopted.

B.21.5 Application :- The primer coat of paint shall be applied as soon as possible after the surface has been cleaned before deterioration of the surface by rust (in case of steel surfaces) and contamination of the surface by dust, dirt or any other foreign material for all surfaces. Preferably painting should be done immediately after cleaning on the same day. If rusting occurs after the surface is prepared or there is contamination of cleaned surface with salts, acids, alkali or other harmful materials before the priming coat is applied, & between the application of the remaining coats of paint, the surfaces shall be cleaned again.

Paints shall not be applied when the air is misty or atmospheric conditions are such as to promote condensation or in the opinion of the Engineer, the conditions are otherwise unsatisfactory for the work. Painting shall normally be done only in dry weather. It shall not be applied upon damp and moist surfaces.

Paint may be applied by spraying or brushing. Unless otherwise specified paint shall be applied with brushes. Paint shall be worked into all crevices and corners where possible and surfaces not accessible to brushes shall be painted by sheepskin or spray or any other method approved by the Engineer. All runs or sags shall be brushed out. Painting shall be done in

a neat and workmanlike manner. Paint shall be applied so as to produce a uniform even coating over the entire surfaces, free from streaks, pitting, wrinkles or other irregularities.

The number of priming and finishing coats shall be as specified for the particular item.

Sufficient time shall be allowed for one coat of paint to dry before the next is applied.

B.21.6 Protection : Painted surface shall be protected from sun, rain, condensation, contamination or surface damage until it is dry to the fullest extent. Boards indicating 'Wet Paint' shall be put up where necessary.

B.21.a Painting Iron and Steel Work :- In addition to specifications for oil painting 'General' the following shall also apply for painting Iron and Steel Work.

B.21.a.1 Operation and workmanship for painting Iron and Steel work shall be as per I.S. 1477 (Part I) 1959, code of practice for finishing of Iron and Steel in Buildings, painting and allied finishes subject to the following ;

1. The method of preparation of the surface for painting work shall be as specified in the special provisions for each item and as B.21.4. Where Iron and Steel works need repainting (as maintenance), instructions detailed in clause 8 to I.S. 1477 (Part I) 1959 shall be followed.
2. Red lead paint shall be used for primer coat unless other paints are specified. The number of primer coats shall be given in detailed specifications for each item. When not given it shall be one coat.
3. Intermediate protective treatments (Pre-treatments) shall be omitted unless specified in the special provisions.
4. The finishing coats shall be of the paint as specified for each item by the Engineer. The number of finishing coats of the required shade of colour shall also be specified for each item separately. They shall be two when the number is not specified.
5. Actual date of painting girders, steel tanks and other steel structures shall be neatly marked by the contractor on the structure according to the instructions of the Engineer.

B.21.b.1 Painting New Wood Work :- In addition to specifications for 'Oil Painting General', the following specifications shall also apply for painting new woodwork.

B.21.b.2 Preparation of Surface :- Before any paint is applied the woodwork shall be finished smooth with the plane. The surface shall then be rubbed smooth with sand paper first with coarse grade about 2 1/2 and then finished with a medium grade say 1 1/2. Sand papering must be finished with the grain. When finished, no scratches from the coarse paper should show.

Before priming coat is applied the knotting shall be done by one of the

following methods as directed by the Engineer.

1. **Ordinary or Size Knotting** : This shall be applied in two coats. The first to be made by grinding red lead in water and mixing it with strong glue size, used hot. The second coat shall be of red lead ground in linseed oil and thinned with boiled linseed oil and turpentine.
2. **Lime Knotting** : This consists of two coats of a varnish made by dissolving shellac in methylated spirits of wine.
3. **Priming Coat** : After preparing the surface of wood work as above, priming coat shall be applied.

Priming coat shall be as follows :

- a) **On Inside Woodwork** :- It shall consist of 0.25 Kg. of red lead + 4 Kg. of white lead + 1.14 liters of boiled linseed oil + 0.57 liter raw linseed oil + 40 gm. of litharge or patent dryers and shall be applied before the woodwork is fixed in place.
- b) **On Outside Woodwork** :- It shall consist of 4.5 Kg. of white lead + 2.28 Liters of raw linseed oil + 27 gm. of red lead + 54 gm. (about 2 oz) of litharge or patent dryers and shall be applied before the woodwork is fixed in place.

B.21.b.4 Stopping :- After priming, all small holes, cracks, open joints and similar minor defects of every kind if already allowed by the Engineer to remain, shall be stopped with putty made from pure whiting, mixed to the proper consistency with raw linseed oil, a little white lead being worked in after mixing to help the hardening of the putty. On no account putty is to be used before the priming coat is put on.

B.21.b.5 Additional Coats :- After applying priming coats, the work shall be lightly rubbed down smooth with sand paper and the subsequent coats of paint of the specified shade approved by the Engineer, shall be applied. The paints shall be applied with brushes. It shall be spread as smoothly as possible with the brush by means of crossing (at right angles to the grain) and then laying off with the brush in the direction of the grain over the crossing. The final coat shall be very carefully crossed and laid off so that the brush marks are not visible. Each coat of paint shall be allowed to dry thoroughly and shall be lightly rubbed down before the next is laid. Every coat shall be passed by the Engineer before the next is laid on it. The finished surface shall not show any hair marks, ridges, or dry patches of paints, and no puddles shall be left in the corners of panels, and angle of moulding.

For new woodwork exposed to the weather unless the number of coats of paints is mentioned in the special provisions three coats of paint shall be applied exclusive of the priming coat. In the interior of the buildings 2 coats shall suffice.

B.21.b. 6 Embedded Timber :- The outside of the chowkats of the doors and windows as also other timber embedded in masonry shall be given

two coats of hot coal-tar before erection. This is incidental to the item and shall not be paid separately.

- c. **Repainting Old Woodwork** :- In addition to specifications for 'Oil Painting General' the following specifications shall also apply for repainting old woodwork.

B.21.c.1 Cleaning the surface :- All the paint shall be removed either by scraping, burning or by a paint remover as ordered by the Engineer. Following precautions shall be taken :

1. While removing paint by burning by using a blow lamp, particular care shall be taken to avoid burning woodwork. If any woodwork is found to be charred it will be replaced at the cost of the contractor.
2. In the event of a paint remover containing alkali being used, the surface, shall subsequently be washed down with a weak acid such a dilute vinegar, so as to neutralise the alkali.
3. While removing paint by scraping, care shall be taken not to damage the underlying surface of wood.

The surface shall then be rubbed down smooth with sand paper.

B.21.c.2 Priming Coat :- The priming coat shall then be applied as specified for painting in B.21.(b).

B.21.c.3 Stopping :- After priming, the defects shall be stopped with putty. The putty for stopping wood work shall be prepared from pure whiting mixed to the proper consistency with raw linseed oil, a little white lead being worked in after mixing to help the hardening of the putty. On account shall putty be used before the priming coat is put on.

B.21.c.4 Finishing :- The surface shall again be lightly rubbed smooth with sand paper and specified number of coats of required shade of paint shall then be applied as specified above or ordered by the Engineer.

B.21.d. Painting plastered surface :- In addition to the specifications for 'Oil Painting General', the following specifications shall also apply for painting plastered surfaces :

B.21.d.1 New plaster shall not be primed or painted till it is completely dry and hard.

B.21.d.2 Preparation of the surface :- The surface shall be carefully rubbed smooth and thoroughly cleaned with clean fresh water. Supplementary specifications if any, will be laid down in the special provisions for the item according as the particular nature of the surface to be painted, requires. The surface shall be dry, smooth, clean and free from dirt.

B.21.d.3 Priming Coat :- This shall consist of equal parts of white and red lead mixed in boiled linseed oil to the required consistency applied uniformly over the surface. When this coat is dry, all cracks, holes and other such defects shall be filled with a mixture of one part white lead and three parts ordinary putty. The surface shall then be rubbed down with sand paper and dusted clean.

B.21.d.4 Finishing Coats :- It may be necessary to give four coats of paints over

the priming coat. The first coat shall be thin so that plaster may be thoroughly saturated. The second coat shall be thicker and shall contain a small quantity of turpentine with some of the required coloring pigment. The third coat also shall be thicker having equal parts of linseed oil and turpentine. The last coat shall be as specified for each item of painting. Walls and ceilings shall be given a flat finish as glossy finishing coat shows up the irregularities in the plaster.

The paint shall be applied with brushes. It shall be spread as smoothly as possible.

B.22. DEWATERING OR BAILING OUT OF WATER

Dewatering during excavation and excavated foundation trenches and pools of water in the building area by using pumps and other devices, including disposing of the water to a safe distance as directed.

- B.22.1 General :-** The foundation trenches and the building area shall be kept dry by resort to pumps alone or in combination with manual labour for bailing out water with buckets, etc. or any other satisfactory method. The method to be adopted shall be entirely left to the choice of the contractor provided dewatering is carried out satisfactorily and scheduled programme is adhered to. The contractor shall plan, construct, and maintain satisfactorily, safe and pool-proof arrangement for dewatering to ensure safe foundation excavation and laying concrete and masonry in the dry. The contractor shall supply details of his proposals for approval of the Engineer, but such an approval will in no way release the contractor from his responsibility and for the adequacy of dewatering arrangements and for the quality and safety of the work, for all of which the contractor shall be solely responsible.

Cement grouting of other approved method may be used by the contractor at his discretion and cost of prevent or reduce seepage and to protect the area to be excavated if the soil is porous.

- B.22.2 Pumping :-** Adequate pumping arrangements shall be made for dewatering foundation trenches and pools in the building area and keeping the same dry while excavation masonry or concreting is in progress and till the mortar has sufficiently set. Pump of required capacity and in required number and stages shall be provided to ensure the above. Pumping from the foundation trenches shall be done directly from the foundation trenches or from a sump outside the excavation as necessary, in such a manner as to preclude the possibility of movement of water through the fresh concrete or masonry and washing away parts of concrete or masonry and washing away parts of concrete mortar. No pumping shall be allowed during laying of concrete or masonry and for a period of at least 24 hours thereafter unless it is done from a suitable sump separated from concrete or masonry by effective means. No pumping shall be done in such away as not to cause damage to the work of adjoining by blows, subsidence etc. The contractor shall make his own arrangements for necessary labour, materials, pumps engines, well points and other suitable machinery and devices required for successful execution of the item of dewatering.

B.22.3 Desilting :- If any foundation pits are filled due to accumulation of surface flow during the progress of the work of during rainy season or due to any other causes, all pumping required for dewatering the pits and removing silts shall be done without extra cost.

B.22.4 Shorting etc. :- Staging, shoring, strutting, sumps and other protective works required for facility of dewatering shall be designed and put up by the contractor to ensure full safety to the work, workmen, machinery and property and shall be removed after they have served their purpose in a manner and etc. the extent directed by the Engineer. The contractor shall be responsible for all damage and injury caused by the execution of this item.

B.22.5 Disposal of water :- The water from the excavated trenches shall be disposed off in the manner detailed below or in any other manner in conformity with the rules in force and approved by the Engineer.

- a) In case the area is developed, such as cities which are sewerage or have open gutters along the roadside, the water may be led to the nearest such gutters or sewers.
- b) In undeveloped areas such as country side where sewerage system has not been introduced, the water may be led to the nearest natural drain or pond through properly laid and dug channels or through pipes.

Disposal of water shall in no case cause inconvenience or nuisance to the inhabitants of the area or cause damage to the property and structures nearby. Municipal or Government regulations shall be complied with the rights of private land owners shall be respected regarding disposal of water.

Contractor shall be responsible for all the incidental formalities like obtaining permission of local bodies (Municipalities etc.) and persons concerned, to lead the water to the open or underground sewers, or digging up channels, making use of lands and properties owned by private persons or public bodies etc. and for damage caused in the preparation of this item.

22.6 Item to Include :-

1. All labour, materials, pumps, plants, equipments staging shoring, strutting, sumps and other arrangements necessary for dewatering during excavation and construction of other requiring dewatering.
2. Dewatering foundation trenches and construction area and keeping the same dry while excavation. Masonry and concrete work is in progress and till the work comes above the water level and till the Engineer considers that the mortar or concrete has sufficiently set.
3. Dewatering till all the items requiring dewatering are fully completed. This shall also include time required for passing foundation and taking measurements of all the items, requiring dewatering.
4. Removing stuff of any sort which might find access into the trenches by blowing slip or due to any other cause wherever from the sides or

bottom of the foundation or excavation or from else where during after or due to dewatering.

5. Leading water, to the nearest natural or artificial drains, with all the incidental requirement like taking permission from Municipal & other authorities & private persons concerned pay compensations etc.
6. Compensation for the injury to the workmen and the public or damages to the nearby properties during and on account of dewatering and disposal of water.

B.23 GENERAL SPECIFICATION FOR ALL WATER SUPPLY AND SANITARY ITEMS

All the items under this group shall conform to the detailed specifications given for each of the items, in addition to the by-laws of the local bodies within whose jurisdiction the items are executed.

Where the by-laws of the local bodies differ from the detailed specifications for an item, the bye-laws shall over ride these specifications.

All damage done to floors, walls etc. during the process of fixing water supply drainage and sanitary installations shall be restored to their original conditions.

All the pipes, fittings and appliances shall be free from cracks and other flaw before fixing and shall be undamaged in all respects during and after fixing. Any damage shall have to be rectified satisfactorily.

All the pipes, fittings and appliances shall be thoroughly cleaned before fixing and particular care shall be taken to see that no extraneous materials, gets into them during fixing.

All items required for ensuring leakproof joining and efficient functioning of the pipes and appliances shall be carried out without extra claims.

All cutting and waste of pipes involved in fitting them shall be included in the rate.

All diameters of pipes shall be the diameters of the inside bore.

All pipes, appliances, fixtures and all other materials, to be used shall be new and of good quality.

All the water supply and sanitary items, shall be carried out by experienced and/or licensed plumbers to the entire satisfaction of the municipal byelaws and the Engineer.

Work in general shall be carried out as per the I.S. Code No. 2069-1973 Code of practice for selection installation and maintenance of sanitary appliances.

TECHNICAL SPECIFICATION

PACKAGE TYPE AIR COOL AIRCONDITIONER UNIT

SCOPE:

The scope of work comprises supply, erection, testing and commissioning of the air conditioning unit conforming to these specifications.

SPECIFICATION OF DUCTABLE TYPE AIR COOLED UNITS:

1) EVAPORATOR UNIT:

Cooling Coil:

Cooling coil of the Evaporator shall be selected for face velocity not exceeding 500 fpm and shall be constructed from 3/8" O.D. copper tubing (22G) with serrated and extended aluminium fins. Tubes shall be arranged in a staggered design for better efficiency. The tubes shall be expanded hydraulically to give tight bonding with the fins. Cooling coil circuits shall be fed liquid refrigerant through the thermostatic expansion valve and distributor. Provide filter/drier in liquid line.

Blower:

The fan blower shall be statically and dynamically balanced to give required air flow against desired static pressure and shall be given by TTEFC motor.

Filters:

This shall be non combustible fibrous cleanable filters to ensure clean air and easy replacement. Filters to be 25mm thick minimum.

Drain Pan:

The drain pan shall be constructed out of 18 G.G.I. insulated. Drain Pan shall be protected from corrosion by application of 2 coats of bitumastic.

Casing:

The casing shall be constructed of 16 gauge CRCA sheet and painted with anti-corrosive powder coated paint to give protection against rusting painting shall be powder coating.

AIR COOLED CONDENSING UNIT:

The air-cooled condensing unit shall be complete with the following:

- a) Compressor (Scroll hermetic)
- b) Condenser coil
- c) Condenser fan with motor
- d) Sheet steel casing with louvered bird screen etc.
- e) Suitable base frame on/mounting bracket for outdoor installation
- f) Anti-vibration mount
- g) Electrical isolating switch

Compressor:

The compressor shall be hermetically sealed scroll compressor with internally built high and low pressure cutouts and having low noise level with a refrigerant cooled motor. The entire unit shall be mounted on ant vibration mounts. Provision for incorporating refrigerant suction and discharge pressure gauges in required. There shall be one or two compressors per unit.

Condenser coil:

Condenser coil shall be selected to give optimum performance. The coil shall be 3/8" O.D. copper tubing (22G) with serrated and extended aluminium fins. Tubes shall be arranged in a staggered design for better efficiency. Condenser coil working pressure to be 300.

Condenser Fan:

Axial flow fan for condenser shall be adequately sized and shall be direct driven. The fan shall be selected for low noise level and speed shall not exceed 920 rpm condenser fan motor to be IP53.

Casing:

The unit casing shall be heavy gauge MS construction and painted with anticorrosive powder coated paint to give protection against rusting in high humid conditions. Painting shall be powder coating.

Condenser fan motor to be IP55 (suitable for outdoor mounting) and all electrical component shall be housed in a water proof enclosure.

CONTROL BOX EQUIPMENT:

All Electrical controls shall be from electrical panel mounted in Plant Room as per our given specifications.

Microprocessor panels (6 features)

Sequencing of evaporator blower and each of compressor and condenser fans with time delay facility.

Status:

Evaporator Blower	-	run/start/stop
Compressor (each)/unit	-	run/start/stop

Indication :

Evaporator Blower	-	on/off
Compressor(each)/unit	-	on/off

Evaporator Blower overload trip indication
 Compressors –1,2,3 HP/LP trip indication
 Compressors –1,2, overload indication
 Three stage thermostat
 Auto rest on unit tripping on HP/LP

ELECTRICAL CHARACTERISTICS:

The units shall be suitable for operation on 230V+/- 10%, 1 phase, 50 Cycles/415V=?-10%, 3 Phase, 50 cycles, 4 wire electrical supply

2) M.S.ANGLE STAND:

The condenser stand should be made from mild steel arrange as per the size required to mount the condenser unit. The MS angle should be 60 x60 x 6 same to be grouted in the floor with sand cement concrete with anticorrosing treatment to be applied all surface of angles and 2 coats of enamel.

3) HUMIDITY PLAN:

Humidification arrangement consisting of pan humidifier to control the humidity. The humidification system may consist of educate size pan humidifier. Capable of holding sufficient quantity of water duly incorporated with heating element of Emerson type heater for proper evaporation of the water the working of heater shall be control in steps with the help of humidifier shall have a provision of atleast 50% heating elements to act as standby. The pan humidifier tank shall filled with float valve, quick feel get valve, overflow connection.

4) HUMIDIFIER CONTROL ARRANGEMENT:

Hannibal make humidistat to be fix for humidity control.

5) CENTRIFUGAL BLOWER:

Single inlet single width centrifugal fan clockwise rotation one way discharge to be operated by V-belt construction of centrifugal fan heavy steel housing of welded contraction with smooth interior to avoid any accommodation of dust particulars in side. The inlet and outlet flanges to be provided on the housing 2 facility easy connection of the fan to the system.

6) G.I. DUCT:

Scope :

1. Scope of this article comprises of supply installation of all sheet metal ducts as shown on drawings.

Materials:

1. Ducts shall be made of either galvanized steel sheets or alluminium sheets the galvanized steel sheet shall conform IS:277-1977 Alluminium shall be of grade SIC of B-3 as specified in IS :177-1974.
2. Thickness of sheet shall be as given below.

Maximum Side (mm)	Thickness	
	G.S.S.	Alluminium
Upto 750	0.63	0.80
751-1500	0.80	1.00
1501-2250	1.00	1.50
2250-2500	1.20	
Plenums & Ducts above 2500	1.60	

The bracing shall be as per ISS 655-1963. Supports for ducts at 2.4m distance apart upto 2250/1.2m distance apart for larger ducts. Each support shall have minimum 2 vertical rods of 10mm/12mm diameter with 40x40x6 or 50x50x6 angles.

Additional duct supports shall be provided as required.

- 4.2.3 Ducts shall be rectangular in cross section and fabricated in accordance with the following.

Max.size	Min.Thick	Transverse joints	Reinforcement
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DETAILED SPECIFICATION

Upto 400	0.63 (24SWG)	25mm Pocket/s slip	Cross break
401 to 750	0.63 (24SWG)	25mm Pocket/s slip	25x25x3.2 Girth angle@1000
751 to 900	0.80 (22SWG)	38x38x3.2 Companion flanges	25x25x3.2 Girth angle@1000
901 to 1500	0.80 (22SWG)	38x38x3.2 Companion flanges	38x38x3.2 Girth angle@760
1501 to 2250	1.00 (20SWG)	38x38x3.2 Companion flanges	38x38x3.2 Girth angle@760
2251 to over	1.25 (18SWG)	50x50x3.2 Companion flanges	50x50x3.2 Girth angle@610
Plenums	1.25 (18SWG)	50x50x5.4 Companion flanges	50x50x5.4 Girth angle@300

Girth angles and companion flanges shall be mitered and welded at corners and riveted to duct sheets at 75mm centers. Flanged joints shall be made with 4.5mm GI bolts spaced at 15cm centers and provided with 3.2mm rubber or 5.0mm. All joints and seams shall be rendered air tight Duct panels are not to be cross broken if insulate. Longitudinal seams shall be inside groove of Pitsubugh type.

All ducting supports, bracing and frame work shall be painted with 2 coats of epoxy primer & 2 coats of epoxy paint min. (50 microns).

Wherever ducting is exposed to view all duct support and bracing o be painted silver colour to match the duct work.

Accessories:

All dampers, except where shown, shall be louver dampers having multiple opposed blades type or with parallel blades of air foil construction. The construction of the dampers shall be robust and tight fittings. Blades shall be connected with a suitable linkage for operation by an extending lever which shall have a locking quadrant with positions of the damper indicated on it. Dampers and their operating device shall be made robust, easily operable and accessible through suitable access doors in the ducts.

Dampers shall be provided in ducts at every branch supply or return air duct connections whether or not indicated on the drawings for the proper volume control and balancing the system.

Where shown splitter dampers shall be installed. This dampers consists of double thickness air foil blade hinged on the downstream edge. The operating lever shall extend outside the duct and insulation with an air tight hub and locking arrangements. The thickness of the damper blades shall be the same as the duct in which they are installed but not less than 1.5mm thickness.

Fire dampers shall be motorized type and shall be provided in the ducts to minimize spreading of fire through ducts i.e. points where duct passes fire (rated 1 ½ hrs or more)

wall or slab. Fire dampers shall be 230mm deep and face area as required. The outlet casing of the damper shall be fabricated out of 12 gauge M.S.Sheet. The louvers shall be provided with smooth pivotal linkage, tripping mechanism of steel bar with heavy duty spring assembly and provision of motor. The louvers to be arranged to pivot and hold in an open position and can be closed by an electrically operated motor. The damper is used in conjunction with a smoke alarm system. The entire assembly shall be duly epoxy primer (epoxy paint) or aluminium spray painted. The dampers shall be designed for automatic as also manual tripping.

Motor shall be rated for fire damper (spring to close power to open) operation and shall be suitable for outdoor installation (IP55). Fire damper are closed on a signal from the fire control module. Module supply and wiring by fire control contractor.

Motorised dampers should be single flap dampers with 18 gauge construction with Belimo make spring return type. Opening time should be more than 75 secs and closing time should be 30 secs. 24V power shall be given from the electrical panel and will be routed through the unit.

300mm x 300mm access panels with gasket neoprene and stud bolt type shall be provided near louver dampers/splitters damper and fire damper.

All duct shall be supported from the slab above or from beams. Duct supports shall be fixed through use of anchor fasteners or beam clamps anchor fasteners.

Transverse joints shall be provided with rubber gaskets (6mm thick) of non-flammable type. In no case shall the use of felt be permitted.

Wherever ducts are acoustically lined the duct size shall be increased by the thickness of the duct lining.

Installation :

The duct fabrication and installation shall generally conform to IS 655-1963.

The contractor shall provide and neatly erect all sheet metal as shown on drawings or as may be required to carry out the intent of those specification and drawings and this work shall meet with the approval of the Engineer in all its parts and details. However supports shall be fixed to the ceiling through anchor fasteners 2 nos. for each leg. The anchor fasteners shall be of approved make. Where ducting is supported from steel structure provide beam clamps.

All necessary allowances and provisions shall be made by this contractor for beams, pipes or other obstructions in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work or plumbing or other pipes or conduits, the duct shall be transformed, divided or curved to one side the required area being maintained all as approved or directed by the engineer.

All metal work in dead or furred down spaces shall be created in time to occasion no delay to other contractors on the building.

Ducting over furred ceiling shall be supported from the slab above, or from beams. In no case shall the duct be supported from the ceiling hangers or be permitted to rest on a hung ceiling.

If a duct cannot be run as shown on the drawings the contractor shall install the duct between the required points by any path available, subject to the approval of the Engineer and Architect.

All ducts shall be rigid and shall be adequately supported where required with standing seams tees or angles of ample size to keep the ducts true to shape and prevent buckling vibration and breathing.

All duct joints shall be made tight with rubber gaskets or nonflammable type and all interior surfaces shall be smooth. Bends shall be made within radius not less than one half of the width of the duct or with scientifically designed interior curved vanes as approved by the Engineer. Two vanes shall be spaced so that the aspect ratio of each of the individual elbows formed by the vanes will be about five to one.

All sheet metal connections, partitions and plenums required to confine the flow of air to and thorough the filters and fans, shall be contracted from 16 G galvanized iron, thoroughly stiffened with 25mm x 25mm angle iron braces and fitted with all necessary doors as required by the Engineer to give access to all parts of the apparatus. Doors shall not be less than 46 cm x 71 cm. Sheet metal connections to indoor units shall be flexible, double thickness fiberglass cloth or equivalent non-flammable material.

Where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight joints shall be made by mean of closely fitting heavy flanged collars.

Provide resistoflex or similar vibration isolation material of 6mm thickness between duct and duct supports.

8) CONTROL PANEL:

Providing, fixing, testing and commissioning cubical type control panel of sheet metal, free standing back and side covered MV switch board 500A busbar and internal wiring suitable for operation 415 Volts, 0 Hz AC supply M.V. Panel consisting of the following and as per the attached detailed specification.

INCOMING:

1. 400A MCCB, 4 pole (bricking capacity 50 KA at 415 V) with ammeter and volt meter with S/S CT's and phase indicating lamps 1 No.

OUTGOING:

2. 63 Amp TPN SDF with HRC fuses, Ammeter, Voltage scanner CT's and S/S (for package A.C. & Spare) – 10 sets
3. 10 Amp Dp-MCB, 9 KA – 7 Nos (1 for FA & 3 for pan humidifier and 1 for annunciation panel 1 for fresh air and 1 for spare)

Annunciation panel fitted in the MV switch board for A.C. Package system with necessary control fuses relay's thermostat humidistat censoring devices for

Audio visual indication in case of following

- a) Control room temperature higher than present value
- b) Control room RH high and Lower than present value
- c) Stoppage of AC packing in case of operation of F/D alarm however the Board shall provide F/D system
- d) Non-operation of pan humidifier heater in case of low water level in pan humidifier.
- e) Non working of buster fan
- f) Filter chock indicators
- g) Failure of condenser fan

9) **THERMAL INSULATION:**

The supply and return air duct shall be insulated using 25mm thick rigid board of density 150 IB/Cub fit or 6mm thick thermoplast. The fiber glass shall be furnished with factor approved alluminium foil all longitudinal and transverse joints shall be sealed using PVC tape the insulation shall be finished in good condition.

The duct expose to the whether shall be using minimum 50mm thick. Expanded polystyrene. The insulation shall be wrapped by polythene sheet with chicken wire mesh the sand cement plaster shall be applied over this in layers of 3mm each.

10) **ACOSSTIC INSULATION:**

Acoustic insulation for duct shall be done with 12mm thick crown 300 rigid fiberglass stuck to the duct with hot bitumen and covered with 26 G perforated alluminium sheet and fixed for the duct using GI nut, bolts and washers, with GI bracing. All holes made to the duct for passing of the GI bolts shall be sealed using M-seal.

11,12) **GREELS & DEFUSERS:**

All linear continuous Grilles, Diffusers shall e-fabricated out of extruded Alluminium sections and shall be powder coated with approved Colour by consultant and necessary

fixing arrangement shall be carried out. The diffusers shall be removable core type. All supply air diffusers shall have dampers and return air diffusers without dampers. The damper shall be opposed blade and alluminium in construction and shall be powder coated.

13) FIRE DAMPER:

Fire damper shall be made of GI sheet with opposed blade in construction both side flanged with fuse link and volume control duly painted properly with alluminium paint and proper 'on' 'off' indication.

14) UNDER DECK INSULATION:

The under deck insulation shall be carried out using 50mm thick TF quality expanded polystyrene (Thermocol). The insulation shall be stuck to the slab using hot bitumen as adhesive and then camped/screwed to the slab using GI washers and screw of minimum 3" length. The clamping shall be carried out at the four corners and the Centre of each EPS sheet. The expanded polystyrene (Thermocol) sheet shall be covered by Alluminium foil.

15) FRESH AIR PACKAGE:

Fresh air package make form GI sheet duct of 24 SWG with luars and damper buster fan coarse and fine filters shall be provided in the opening in meshnanery or in a window as required and insulated properly whenever traverses and air-conditioned area.

16) COPPER PIPING:

The copper piping shall be carried out using 20 gauge hard drawn copper tubes with proper brizing using silver rods. The section line shall be properly insulated with Hilton/superlon pipe insulation and covered with PVC tape. The size of the pipe shall be prepared from the equipment. The refrigerant piping shall be properly clamped on the wall at regular intervals of 48 inches using pressure clamp. The pressure clamp shall be duly painted with red oxide and black oil paint.

17) PLUMBING:

Providing plumbing work to supply the water to the pan humidifier by using GI pipe of 18mm dia with union elbow coupling or run on the surface and 25mm dia for condensing water to be connect nearest drain points.

18) FALSE CEILING:

Providing fixing of false ceiling alluminium perforated powder coated panels of size 600 x 600 with side valve of 12mm high above the panel 25mm thick rigid board put in to the polythene bag. The perforated alluminium panel to be fixed with alluminium 'T' section

of size 25 x 25 x 5 the GI suspender with level adjustment as per required. Necessary slots for fixing electrical fixtures/fittings shall be left as per electrification layout. No separate payment will be made for the same.

Coat interior of duct with shalikota primer. Fix 25mm resin bonded fiberglass Twiga 300 finished with RP tissue to duct using spot hot bitumen. Seal all joints with bitumen. The acoustic lining to be covered with RP tissue and perforated aluminium sheets of 30G thickness. The lining of aluminium sheet facing to be mechanically fastened to the duct with GI bolts, nuts and washers contractor to ensure a smooth internal finish.

All plenums, connecting pieces connected to air handling units and return air pieces shall also be acoustically treated.

There shall be a minimum of 75mm overlap between the acoustically and thermal insulation on ducts.

The entire AC unit complete with accessories shall comprise.

1. Evaporator unit with mounting brackets/supports
2. Air-cooled condensing unit with outdoor support structure. The outdoor support structure shall be painted with 2 coats of epoxy primer and 2 coats of epoxy paint.
3. Electrical panel with starters etc., for compressor motor condenser fan motor, evaporator motor interlock local isolators for motors.
4. Operating thermostat and safety controls.
5. Single phase preventors
6. Installation accessories mounting brackets, refrigerant piping, filter drier etc.
7. First charge of R-22 refrigerant gas and oil
8. Breaking holes and making good
9. Drain piping for evaporator unit
10. Insulation of indoor unit refrigerant piping and drain piping
11. Electrical wiring from power supply provided by others.
12. Testing and commissioning

**TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM
FOR BAY CONTROL ROOM/SHIFT INCHARGE/CONFERENCE HALL**

1.0 GENERAL

- 1.1 This specification covers supply, installation, testing and commissioning and handing over of Air conditioning system for the control room building

Air conditioning units for control room building shall be set to maintain the following inside conditions.

DBT 24.4 deg. C +/- 2 deg.C

- 1.2 Air conditioning requirement of rooms shall be met using split AC units. High wall type split AC units of 2TR capacity each with high wall type indoor evaporator unit shall be used for all rooms.

- 1.3 Scope:

The scope of the equipment to be furnished and services to be provided under the contract are outlined hereinafter and the same is to be read in conjunction with the provision contained in other sections /clauses. The scope of the work under the contract deemed to include all such items, which although are not specifically mentioned in the bid documents and /or in Bidder's proposal, but are required to make the equipment /system complete for its safe, efficient, reliable and trouble free operation.

- 1.3.1 Twelve (12) nos. of high wall type split AC units of 2TR capacity each complete with air-cooled outdoor condensing unit having hermetically sealed compressor and high wall type indoor evaporator unit with cordless remote controller.
- 1.3.2 Copper refrigerant piping complete with insulation between the indoor and remote outdoor condensers as required.
- 1.3.3 PVC drain piping from the indoor units upto the nearest drain pipe.
- 1.3.4 Power and control cabling between the indoor unit and outdoor unit and earthing.
- 1.3.5 MS brackets for outdoor condensing units, condensers are required.

- 2.0 Specification for Split AC units.
- 2.1 The split AC units duly complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.
- 2.2 Outdoor unit shall comprise of hermetically sealed reciprocating /rotary compressors mounted on vibration isolators, propeller type axial flow fans and copper tube alluminium finned coils all assembled in sheet metal casing. The casing and the total unit shall be properly treated and shall be weather proof type. They shall be compact in size and shall have horizontal discharge of air.
- 2.3 The indoor units shall be of high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have no noise centrifugal blowers driven by special motors and copper tube alluminium fined cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multi-function cordless remote control unit with special features like programmable timer, sleep mode and soft dry mode etc.
- 2.4 The split AC units shall be of Carrier, Voltas, Blue star, Hitachi, Daikin, L.G., National, 'O' General or Samsung make.

FIRE PROTECTION ARRANGEMENT FOR EACH EHV SUBSTATION

1. Requirement of Fire Extinguishers for Transformer Area.								
Typical size of Trans-former	For the first two units				For every additional two units or part thereof.			
	50L.M. Foam Extr.	75 Kg. DCP Extr.	9L.M. Foam Extr.	9L Bkt. (sand/ Water).	50L. M.Foam Extr.	75 Kg. DCP Extr	9L.M. Foam Extr.	9L Bkt. (sand/ Water).
Above 20 MVA	3	2 (Out-door)	6	4 each (Out-door)	2	1 (Out-door)	2	4 each (Out-door)
Above 50 MVA	4	3(Out-door)	8	6 each	2	1 (Out-door)	2	6 each

2. Requirement of Fire Extinguishers for other Areas of EHV Sub-stations.			
Sr. No.	Description of the area	Type/Capacity/Quantity of Fire Extinguishers for 400/220 kV EHV S/S	Type/Capacity/Quantity of Fire Extinguishers for 132/110/100 kV EHV S/S.
a	Control Room	22.5 Kg. CO ₂ - 2 Nos. 6.5 Kg. CO ₂ - 4 Nos.	22.5 Kg. CO ₂ - 1No. 6.5 Kg. CO ₂ - 4 Nos.
b	Cable Trench in Control Room	6.5 Kg. CO ₂ - 2 Nos. 10.0 Kg. DCP - 2 Nos.	6.5 Kg. CO ₂ - 1 No. 10.0 Kg. DCP - 1 No.
c	Battery Room	6.5 Kg. CO ₂ - 1 No.	6.5 Kg. CO ₂ - 1 No.
d	PLCC Room	6.5 Kg. CO ₂ - 1 No.	6.5 Kg. CO ₂ - 1No.
e	Stores Room	9L W/CO ₂ - 1 No. 9L M. Foam - 1 No.	9L W/CO ₂ - 1 No. 9L M. Foam -1 No.
f	Auxiliary Room	6.5 Kg. CO ₂ - 1 No. 10.0 Kg. DCP - 1 No.	6.5 Kg. CO ₂ - 1 No. 10.0 Kg. DCP - 1 No.
g	Each Bay Control Room	6.5 Kg. CO ₂ - 1 No.	-

SPECIFICATION FOR 75 KG HIGHER CAPACITY DRY POWER FIRE EXTINGUISHER (TROLLEY MOUNTED)

1.0 SCOPE

This standard lays down requirements for material, design and construction workmanship and finish of dry power fire extinguisher (trolley mounted) having capacity of 75 Kgs. Attached with suitable capacity CCE approved CO₂ gas cylinder complete with initial charge confirming to IS : 10658 latest.

2.0 MATERIAL

- 2.1 The material of construction of various parts of the extinguisher shall be strictly as per IS:10658 latest. The dished end shall be forged construction.
- 2.2 The dry power used in the extinguisher shall confirm to IS:4308 latest having ISI certification mark.
- 2.3 The extinguishers shall be conforming to IS:10658 bearing ISI certification mark.

3.0 DESIGN

- 3.1 The design calculation in respect of thickness of the shell and head details of construction shall be strictly as per IS:2825 or ASME Section VIII. Design calculations to be given along with the tender.
- 3.2 The extinguisher shall be fitted with a safety valve on its top dished end to requirements of IS:2825. The set pressure shall be 17.0 kgf/cm².
- 3.3 For expulsion of dry powder the extinguisher shall be fitted with suitable capacity CO₂ gas cylinder (CCE approved) conforming to IS:7285. The CO₂ cylinder shall have wheel valve mechanism to operate and discharge gas. The valve shall be ISI marked (SI:3224).
- 3.4 The complete unit shall be mounted suitably on trolley as per IS:10658, however, it may be ensured that the extinguisher is easily handled by one or two persons.

4.0 EXPANSION SPACE

A test, to check that the expansion space is adequate, shall be carried out as per clause 5.4 of IS:10658 in one of the extinguisher of each lot and the chemical powder of same quality and volume/wt shall be maintained for the rest of the extinguisher of the lot.

5.0 ANTI-CORROSIVE TREATMENT AND PAINTING

Painting and anti-corrosive treatment shall be carried out on each extinguisher as per clause 6 and 7 of IS:10658. Post office red colour shall be used and MSETCL shall be embossed.

6.0 MARKING.

- 6.1 The name of the manufacturer, year and month of manufacture, capacity, serial No. and hydraulic test pressure shall be stamped on a metallic label and attached to the body of the extinguisher. Method of operation shall also be written and the same shall be legible.
- 6.2 Due date of hydraulic test and safety valve testing shall be painted or stenciled on the shell. Frequency of H.P. Testing is 3 years and safety valve test is one year from the date of shop testing.

7.0 INSPECTION SCOPE:

- 7.1 Check the extinguisher for conformity to IS:10658 and above specifications.
- 7.2 Check and certify design calculations including safe CO₂ quantity.
- 7.3 Check certification of CO₂ cylinder conforming IS:7285 or gas cylinder rules.
- 7.4 Spot radiography of each extinguisher shall be carried out to ensure quality of welding required as per IS:2825.
- 7.5 Testing of each safety valve for correct set pressure.
- 7.6 Check the treads for quality and cap for tightness.
- 7.7 Check and test for expansion space for one of the list and dimensional check of rest of the extinguishers in the lot.
- 7.8 Hydraulic testing of each extinguisher at 30 kgf/cm² and discharge hose as per respective standards.
- 7.9 One extinguisher out of the lot shall be tested for ultimate failure test as per clause 8.2 of IS:10618.
- 7.10 Extinguishers shall be received along with the test certification and acceptance certificate by our authorized Inspector. Necessary documents shall be procured to our Inspector while carrying out the Inspection/Testing.

Note: Bidder should specify the material component wise and brand name of the offered produce. Photocopy of the valid BIS license should be submitted along with the offer.

TECHNICAL SPECIFICATION

Particulars	MSETCL's Specification	Bidders comments
Item	Dry powder type fire extinguishers (5 & 10.) Kg.) Gas Cartridge type	
Operation Type	Upright Operation	
Construction	Cylindrical model complete with cap assembly, discharge nozzle with discharge hose, Lead coating inside the extinguisher body.	
Material	Material of construction of various parts of fire extinguisher shall be strictly as per IS:2171 (Latest Edition)	Bidder should specify the material component wise and brand name of the offered product.
Design Code	IS:2171 (Latest Edition) Gas Cylinders and gas cartridge both should be ISI marked. Dry powder charge should have approval and certification mark IS:4308	
Test Pressure	25.0 Kgf/cm ²	
Material Certificates	Extinguishers and gas cartridge both should have approval and certification mark of IS: 4308	Photocopy of the valid BIS license should be submitted along with the offer.
Inspection	Pressure Test and discharge performance test as per IS:2171	
Remarks	Supply shall be completed with initial charge and wall bracket accessories for installation.	

DETAILED SPECIFICATION

Particulars	MSETCL's Specification	Bidders comments
Item	CO2 type fire extinguishers (6.5 kg capacity & 22.5 capacity)	
Operation Type	Upright Operation	
Construction	Cylindrical body of wheel type valve, wire braided high pressure flexible hose fitted with discharge horn (non-conductor of electricity) & internal brass siphon tube suitable mounted on a two wheel rubber type trolley	
Material	Material of construction of various parts of fire extinguishers shall be strictly as per IS:2878 (Latest Edition)	Bidders should specify the material component wise and brand name of the offered product.
Design Code	IS:2878 (Latest Edition) For Valve IS:3224 for CO2 Gas IS:307	
Test Pressure	236 Kgf/cm2 Burst Pressure of discharge hose – 275 kgf/cm2 (with controlled discharge).	
Material Certificates	Extinguishers should be ISI marked. C O2 cylinder must be approved by Dept. of Explosive, Nagpur. – Valve of the cylinder should be ISI marked.	Photocopy of the valid BIS license should be submitted along with the offer.
Inspection	Pressure Test of cylinder and discharge house, discharge performance test as per IS:2878	
Remarks	Cylinder should be fully charged with CO2 gas as per IS:307 with 99.9% purity.	

Particulars	MSETCL's Specification	Bidders comments
Item	Mechanical Foam Type-AFFF Fire Extinguisher (50 Ltrs.)	
Operation Type	Extinguishers shall be operated by holding the extinguisher upright and piercing gas cartridge (300 gm.)	
Construction	Cylindrical body of welded type complete with cap assembly, piercing mechanism discharge nozzle with discharge hose and internal brass siphon tube, Brass Safety Valve, lead tin alloy coating inside, suitably mounted on a wheeled cartridge (Rubber tyred)	
Material	Material of construction of various parts of fire extinguisher viz. body, neck ring, cap, plunger, spring, piercer, siphon tube, discharge hose, snifter valve etc. shall be strictly as per IS:13386 with amendments, if any	Bidders should specify the material component wise
Design Code	IS:13386:1992 (with amendments) Gas Cartridge should confirm to IS:4947. AFFF (6%) should confirm to IS:4989 (Part 02)	
Test Pressure	30Kgf/cm ² For 2 min without leakage or visible distortion.	
Material Certificates	Extinguishers Gas Cartridge and AFFF charge should be ISI marked.	
Inspection	Pressure test, discharge performance test, burst failure test, foam tests etc. as per IS:13386.	
Remarks	The extinguishers duly painted and marked as per IS:13386 shall be supplied with initial charge and spare charge.	

Particulars	MSETCL's Specification	Bidders comments
Item	Mechanical Foam Type-AFFF Fire Extinguisher (9 Ltrs.)	
Operation Type	Extinguishers shall be operated by holding the extinguisher upright and piercing gas cartridge.	
Construction	Cylindrical body of welded type complete with cap assembly, piercing mechanism discharge nozzle with discharge hose and internal brass siphon tube, lead tin alloy coating inside the extinguisher body.	
Material	Material of construction of various parts of fire extinguisher viz. body, neck ring, cap, plunger, spring, piercer, syphon tube, discharge hose, snifter valve etc. shall be strictly as per IS:10204 with amendments.	Bidders should specify the material component wise
Design Code	IS:10204 (with amendments) Gas Cartridge should confirm to IS:4947. AFFF (6%) should confirm to IS:4989 (Part 02)	
Test Pressure	25Kgf/cm For 5 min without leakage or visible distortion.	
Material Certificates	Extinguishers Gas Cartridge and AFFF charge should be ISI marked.	
Inspection	Pressure test, discharge performance test, burst failure test, petrol fire extinguishing test etc as per IS:10204.	
Remark	The extinguishers duly painted and marked as per IS:10204 shall be supplied with initial charge and spare charge and wall bracket fittings/fixtures.	

DETAILED SPECIFICATION

Particulars	MSETCL's Specification	Bidders comments
Item	Water CO2 type fire extinguishers (9 Liters)	
Operation Type	Upright Operation	
Construction	Cylindrical model complete with cap assembly and discharge nozzle. Superior quality of lead coating inside the extinguisher body.	
Material	Body – CRC Sheet Nozzle – Gunmetal Cap – Gunmetal etc. as per relevant IS.	Bidders should specify the material component wise and brand name of the offered product.
Design Code	IS:940 (Latest Edition) Gas Cartridge as per IS:4947 (Latest Edition).	
Test Pressure	25.0 Kgf/cm ²	
Material Certificates	ISI marked.	Photocopy of the valid BIS license should be submitted along with the offer.
Inspection	Pressure Test and discharge performance test as per IS:940	
Remarks	Supply shall be completed with initial charge and wall bracket accessories for installation.	

DETAILED SPECIFICATION

Particulars	MSETCL's Specification	Bidders comments
Item	Fire Bucket (9 Ltr.)	
Construction	Round bottom having suitable handle for hanging on the stand and supplementary bottom handle suitable for easy handling.	The Bidder should specify the material and brand name of the offered product.
Material	Conforming to the relevant standard.	
Design Code	IS:2546 Latest Edition.	
Remarks	The bucket shall be painted white inside and red outside as per IS Specification.	

Particulars	MSETCL's Specification	Bidders comments
Item	Hydrant Valve	
Operation Type	Hand Wheel Type	
Construction	Single headed – oblique type	
Ends	Outlet – instantaneous Female coupling Inlet - Flanged.	
Outlet	Provide with instantaneous spring lock for hose connection 63 mm	
Inlet	M.S. 80 mm Flanged drilled as per ANSIB 16.5	
Material	Gun metal	
Design Code	IS:5290	
Test Pressure	21.0 kgf/cm ²	
Material Certificate	ISI marked and TAC approved.	

Assignment and Sub-Letting

1 Assignment

The Contractor shall not assign the contract any part thereof, or any benefit of interest therein or thereunder, otherwise than by a charge in favour of the Contractor's bankers of any nominees due or to become due under this contract, without the prior written consent of the Employer.

2. Sub-letting

The Contractor shall not sub-let the whole of the works. Except where otherwise provided by the contract, the contractor shall not sub-let any part of the works without the prior written consent of the Engineer, which shall not be unreasonably withheld, and such consent, if given, shall not relieve the contractor from any liability or obligation under the Contract and he shall be responsible for the acts defaults neglects of any sub-contractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglect of the contractor, his agents, servants or workmen provided always that he provision of labour on a piecework basis shall not be deemed to be a subletting under this clause.

CONTRACT DOCUMENTS

Language/s and Law

- a) The contract documents shall be drawn up in English language.
- b) The laws of Maharashtra State shall be applicable to the contract and the contract shall be constructed, according to these laws only.

GENERAL OBLIGATIONS

1 Contractor's general responsibilities

- 1.1 The contractor shall, subject to the provision of the contract, and with due care and diligence, execute and maintain the works and provide all labour, including the supervision thereof, materials, Constructional plant and all other things, whether of a temporary or permanent nature required in and for such execution and maintenance, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the contract.
- 1.2 The Contractor shall take full responsibility for the adequacy, stability and safety of all site operations and methods of constructions, provided that the contractor shall not be responsible except as may be expressly provided in the contract, for the design or specification of the permanent works, or for the design or specification of any Temporary Works Prepared by the Engineer.

2 Contract Agreement

The Contractor shall, when called upon so to do, enter into and execute a contract Agreement, in the form annexed, with such modifications as may be necessary.

3. **Inspection of site**

The Employer shall have made available to the Contractor with the Bid documents such data on hydrological and sub-surface conditions as shall have been obtained by or on behalf of the Employer from investigations undertaken relevant to the Works and the bid shall be deemed to have been based on such data. But the Contractor shall be responsible for his own interpretation thereof. The contractor shall also be deemed to have inspected and examined the site and its surroundings and information available in connection therewith and to have satisfied himself, so far as is practicable, before submitting his bid, as to the form and nature thereof, including the sub-surface conditions, the hydrological and climatic conditions, the extent and nature of work and materials necessary for the completion of the works, the means of access to the site and the accommodation he may require and in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or effect his bid.

4.1 **Sufficiency of bid**

The Contractor shall be deemed to have satisfied himself before bidding as to the correctness and sufficiency of his bid for the Works and of the rates and prices stated in the priced bill of quantities, i.e. Schedule B and the Schedule of rates and prices, if any, which Tenders Rates and Prices shall except insofar as it is otherwise provided in the Contract, cover all his obligations under the contract and all matters and things necessary for the proper execution and maintenance of the works. In case the bidder is of the opinion that any of the item rate indicated under Schedule B by the employer is incorrect or on very much higher / lower side he shall promptly bring it to the notice of the Owner and get clarification thereof before opening of the bid.

4.2 **Adverse physical conditions and artificial obstructions**

If, however, during the execution of the works the contractor shall encounter physical conditions, other than climatic conditions on the site, or artificial obstructions, which conditions or obstructions could, in his opinion, not have been reasonably foreseen by an experienced contractor, the contractor shall forthwith give written notice thereof to the Engineer representative & if in opinion of the Engineer such conditions or artificial obstructions could not have been reasonably foreseen by an experienced Contractor shall have been put by reason of such conditions, including the proper and reasonable cost.

a) of complying with any instruction which the Engineer may issue to the Contractor in connection therewith, and

b) of any proper and reasonable measures approved by the Engineer which the Contractor may take in the absence of specific instructions from the Engineer, as a result of such conditions or obstructions being encountered.

5 **Work to be done to the satisfaction of engineer**

The Contractor shall execute and maintain the Works in strict accordance with the contract to the satisfaction of the Engineer and shall comply with and adhere strictly to the Engineer's instruction and directions on any matter whether mentioned in the contract or not, touching or concerning the works. The contractor shall take instructions and directions only from the Engineer or, subject to the limitations referred to in clause 2 hereof, from the Engineer's representative.

6 **Programme to be furnished**

6.1 Within fifteen days after the acceptance of his bid, the contractor shall submit to the Engineer for his approval a programme showing the order of procedure in which he proposes to carry out the works. The contractor shall whenever required by the Engineer or Engineer's Representative, also provide in writing, for his information, a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the works.

6.2 If at any time it should appear to the Engineer that the actual progress of the works does not confirm to the approved programme referred to in sub-clause 12.1, the Contractor shall produce, at the request of the Engineer, a revised programme showing the modification to the approved programme necessary to ensure completion of the works within the time for completion as defined in clause 26 hereof.

6.3 The submission to and approval by the Engineer or Engineer's Representative of such programmes or the furnishing of such particulars shall not relieve the contractor of any of his duties or responsibilities under the contract.

7 **Contractor's Superintendence**

The contractor shall give or provide all necessary superintendence during the execution of the works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the contract. The Contractor or competent and authorised agent or representative approved of in writing by the Engineer, which approval may at any time be withdrawn, is to be constantly on the works and shall give his whole time to the superintendence of the same, the superintendence shall be by properly qualified and experience of the same. The superintendence shall be properly qualified and experienced personnel only. If such approval shall be withdrawn by the Engineer, the contractor shall, as soon as is practicable, having regard to the requirement of replacing him as hereinafter mentioned, after receiving written notice of such withdrawal, remove the agent from the works and shall not thereafter employ him again on the works in any capacity and shall replace him by another agent approved by the Engineer. Such authorised agent or representative shall receive, on behalf of the Contractor, directions and instructions from the Engineer or subject to the limitations of clause 2 hereof, the Engineer's representatives.

8.1 **Contractor's employees**

The contractor shall provide and employees on the site in connection with the execution and maintenance of the works.

a) only such technical assistants as are skilled and experienced in their respective callings and such sub-agents, foremen and leading hands as are comptent to give proper supervision to the work they are required to supervise, and

b) such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely execution and maintenance of the works.

- 8.2 The Engineer shall be at liberty to object to and require the contractor to remove forthwith from the works any person employed by the contractor in or about the execution or maintenance of the works who, in the opinion of the Engineer, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose employment is otherwise considered by the Engineer to be undersirable and such person shall not be again employed upon the works without the written permission of the Engineer. Any person so removed from the works shall be replaced as soon as possible by a competent substitute approved by the Engineer.

9 **Watching and lighting**

The contractor shall in connection with the works, provide and maintain at his own cost all lights, guards, fenching and watching when and where necessary or required by the Engineer or the Engineer's representative, or by any duly constituted authority, for the protection of the Works, or for the safety and convenience of the public or others.

10 **Care of works.**

10.1 ***Excepted risks***

The excepted risks are war, hostilities (whetherwas be declared or not), invasion, act of foreing enemise, rebellion, revolution, insurrection, or military or usurped power, civil war or, unless soley restricted to the employees of the Contractor or of his subcontractors and arising form the conduct of the works, riot, commotion or disorder, or use or occupation by the Employer of any part of the Permanency works, or a cause solely due to the Engineer's design of the works, or supersonic speed or any such operation of the forces of nature as a experienced contractor could not foresee or reasonably make provision for or insure against, all of which are herin collectively referred to as "the excepted risks".

11 **Damage to persons and property**

- 11.1 The contractor shall, except if, and so far as the contract provides otherwise, indemnify the employer against all losses and claims in respect of injuries or damage to any person or material or physical damage to any property whatsoever which may arise out of or in consequence of the execution and maintenance of the works and all clamins, proceedings, damages, costs, charges and expensees whatsoever in respect of or in relation thereto except any compensation or damages for or with respect

to :-

- a) the permanent use or occupation of land for the works or any part thereof.
- b) the right of the employer to execute the works or any part thereof on, over under, in or through any land.
- c) injuries or damage to persons or property resulting from any act or neglect of the Employer his agents, servants or other contractors, not being employed by the contractor, or for or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or where the injury or damage was contributed to by the contractor, his servants or agents such part of the compensations as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the damage or injury.

11.2 Indemnity by employer

The employer shall indemnify the contractor against all clamims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the provision to sub-clause 11.1.

STATEMENT - D
Standard Cement Consumption

For various items of works.

Sr. No.	Item	Unit	Requirement in bags
1.	2.	3.	4.
PLAN CEMENT CONCRETE			
1.	Cement concrete (1:1:2)	Cum.	9.76
2.	Cement concrete (1:2:4)	Cum.	5.84
3.	Cement concrete (1:3:6)	Cum.	4.05
4.	Cement concrete (1:4:8)	Cum.	3.20
5.	Cement concrete (1:5:10)	Cum.	2.52
REINFORCED CEMENT CONCRETE			
6.	Cement concrete M-15 (1:2:4)	Cum.	5.90
7.	Cement concrete M-20 (1:1½:3)	Cum.	6.90
8.	Cement concrete M-25	Cum.	8.50
9.	Cement concrete M-30	Cum.	9.20
10.	Cement concrete M-35	Cum.	10.20
BRICK WORK			
11.	B. B. masonry in C. M. 1:6 proportion	Cum.	1.44
12.	B. B. masonry in C. M. 1:8 proportion	Cum.	1.13
13.	Half brick masonry in C. M. 1:4 proportion	Sqm.	0.22
STONE MASONRY			
14.	U.C.R.S. masonry in C.M. 1:6 proportion	Cum.	1.77
15.	C.R.S. masonry in C.M. 1:5 proportion	Cum.	1.80
16.	C.R.S. masonry in C.M. 1:6 proportion	Cum.	1.50
DAMP PROOF COURSE			
17.	Providing and laying damp proof course 50 mm. thick in (1:2:4)	Sqm.	0.35
18.	Finishing the terrace slab 20 mm. thick	Sqm.	0.20

	in C.M. 1:3 proportion.		
19.	Providing water proofing to W.C. and bath	Sqm.	0.276

1.	2.	3.	4.
20.	Providing water proofing to W.C. and bath including brick bat coba.	Sqm.	4.00
20 A.	Injection Grouting	Lit.	0.03
PLASTERING			
21.	Providing internal cement plaster 6 mm thick single coat in C.M. 1:4	Sqm.	0.045
22.	Providing internal cement plaster 6 mm thick single coat in C.M. 1:3	Sqm.	0.07
23.	Providing internal cement plaster 12mm thick single coat in C.M. 1:5	Sqm.	0.08
24.	-- do -- in C.M. 1:4 proportion	Sqm.	0.10
25.	-- do -- in C.M. 1:3 proportion	Sqm.	0.12
26.	Providing cement plaster 20 mm. thick in single coat in C.M. 1:3	Sqm.	0.19
27.	-- do -- in C.M. 1:5 in two coats	Sqm.	0.13
28.	-- do -- in single coat in C.M. 1:5 proportion	Sqm.	0.13
29.	-- do -- in two coat in C.M. 1:4 proportion	Sqm.	0.15
30.	-- do -- in two coats in C.M. 1:3 proportion	Sqm.	0.19
31.	-- do -- 25 mm. thick in two coats in C.M. 1:4 proportion	Sqm.	0.22
32.	Sand faced plaster in two coats	Sqm.	0.22
33.	Rough cast plaster in two coats in C.M. 1:4 proportion	Sqm.	0.22
34.	Providing flush grooving pointing in	Sqm.	0.03

	C.M. 1:3 for brick work		
35.	-- do -- to stone masonry in C.M. 1:3 proportion	Sqm.	0.025
1.	2.	3.	4.
36.	Providing tuck pointing with C.M. 1:3 proportion	Sqm.	0.05
37.	Providing weathered pointing in C.M. 1:3 for stone masonry	Sqm.	0.04
38.	Providing vee pointing for stone masonry in C.M. 1:3	Sqm.	0.03
39.	Providing fine finish 1.5 mm. thick over green surface.	Sqm.	0.044
PAVING, FLOORING, FINISHING AND DADO			
40.	Providing and laying R.S.H. flooring 25 mm. to 30 mm. on bed of 1:6 C.M. and pointing C.M. 1:3	Sqm.	0.135
41.	-- do -- 40 mm. to 50 mm. -- do --	Sqm.	0.14
42.	-- do -- 50 mm. to 60 mm. -- do --	Sqm.	0.150
43.	Providing and laying polished shahabad stone flooring 25 mm. to 30 mm. thick on bed 1:6 proportion.	Sqm.	0.13
44.	Providing and laying polished tandur stone flooring 25 mm. to 30 mm. thick on bed 1:6 proportion	Sqm.	0.130
45.	-- do -- polished Kotha stone flooring 25 mm. to 30 mm. thick on bed 1:6 proportion.	Sqm.	0.130
46.	Providing and laying skirting and dado of polished shahabad stone 25 to 30 mm. with 1:4 C.M.	Sqm.	0.18
47.	Providing and laying skirting of polished tandur stone 25 to 30 mm. with 1:4 C.M.	Sqm.	0.18

DETAILED SPECIFICATION

48.	Providing and laying C.C. flooring 40 mm. thick with c.c. 1:1½:3	Sqm.	0.36
49.	-- do -- 50 mm. thick -- do --	Sqm.	0.44

1.	2.	3.	4.
50.	Providing and laying flooring of plan cement tiles of 25x25 mm. on bed 1:6 for flooring	Sqm.	0.15
51.	-- do -- for dado and skirting on polished surface 1:4 proportion	Sqm.	0.18
52.	Providing and laying coloured tiles 25 x 25 mm. size.	Sqm.	0.15
53.	-- do -- for dado skirting.	Sqm.	0.18
54.	Providing and laying white glazed tiles 150 x 150 mm. for flooring.	Sqm.	0.22
55.	-- do -- for dado and skirting.	Sqm.	0.21
56.	Providing and laying gray cement base mosaic tiles for flooring 25 x 25 cm.	Sqm.	0.15
57.	-- do -- for dado and skirting	Sqm.	0.18
58.	Providing and laying machine cut white makrana flooring.	Sqm.	0.17
59.	-- do -- for dado -- do --	Sqm.	0.18
60.	Providing and laying in situ marble mosaic tiles 10 mm. thick.		
	a) Gray cement	Sqm.	0.20
	b) White cement	Sqm.	0.13
61.	-- do -- for dado -- do --		
	a) Gray cement	Sqm.	0.20
	b) White cement	Sqm.	0.28
62.	Providing and laying required position flooring of broken china	Sqm.	0.30
63.	Providing and laying polished shahabad stone 25 to 30 mm. thick for tread and riser.	Sqm.	0.18

**Following constant values shall be adopted for
calculating weight/meter or M.S. Bars**

Sr. No.	Bar diameter	Weight in Kg./Rmt.
1.	6 mm. dia	0.22 Kg./Rmt.
2.	8 mm. dia	0.40 Kg./Rmt.
3.	10 mm. dia	0.62 Kg./Rmt.
4.	12 mm. dia	0.89 Kg./Rmt.
5.	16 mm. dia	1.58 Kg./Rmt.
6.	20 mm. dia	2.47 Kg./Rmt.
7.	22 mm. dia	2.98 Kg./Rmt.
8.	25 mm. dia	3.80 Kg./Rmt.
9.	28 mm. dia	4.80 Kg./Rmt.

Note : This cement consumption is given only for guide lines, however 5% variation i.e. on plus side will be considered.

Less cement consumption upto 5% than the theoretical cement consumption will be recovered from the contractor.

**Chief Engineer
Transmission Projects,
M.S.E.T.C.L., Mumbai.**

SIGNATURE OF CONTRACTOR