CHAPTER 8: WATER SUPPLY

List of Relevant Bureau of Indian Standard codes to be followed.

1	IS. 8329	Centrifugally cast ductile iron pressure pipes for water, gas and sewage.
2	IS. 9523	Ductile iron fittings for pressure pipes for water, gas and sewage.
3	IS 11906	Recommendations for cement mortar lining cast iron, mild steel and ductile iron pipes and fittings for transportation of water.
4	IS 12288	Code of practice for laying of ductile iron pipes.
5	IS 5531	Cast iron specials for asbestos cement pressure pipes for water, gas and sewage.
6	IS 4984	High Density Polyethylene (HDPE) pipes for potable water supply, sewage and industrial effluent
7	IS 4985	uPVC pipes for potable water supply.
8	IS 7634	Code of practice for plastic pipe work for potable water supply. Part. 2 - Laying and jointing of polyethylene pipes Part. 3 – Laying and jointing PVC pipes.
9	IS 7834	Injection moulded PVC fittings with solvent cement joints for water supply.
10	IS 8008	Injection moulded HDPE fittings for potable water supplies.
11	IS 8360	Fabricated HDPE fittings for potable water supplies.
12	IS 10124	Fabricated PVC fittings for potable water supplies.
13	IS 12235	Methods of test for unplasticised PVC pipes for potable water supplies.
14	IS 2373	Water meter (bulk type)
15	IS 780	Sluice valves for water works purposes (50 to 300 mm size)
16	IS 2906	Sluice valves for water works purposes (350 to 1200mm size)

8.0 TERMINOLOGY

Ductile Iron

Product by a metallurgical process, which involves addition of magnesium into molten iron of low sulphur content.

Asbestos Cement Pipes:

Pipes made of a mixture of asbestos paste and Cement.

Cast Iron Detachable Joint

A jointing unit of AC pipes comprising two cast iron flanges, a central cast iron collar, two rubber rings and a set of bolts and nuts.

A.C. Coupling Joint

An A.C. Coupling having inside grooves to hold rubber rings and three rubber rings.

8.1 PIPES

Pipes of many materials are available for use in Water Supply works

8.1.1 Cast Iron Pipes (CI Pipes)

The advantages of CI Pipes are good durability, good strength, low cost of maintenance and easy tapping facility for house connections by drilling and inserting a ferrule. The disadvantages are heavy weight, high transport cost and high laying and jointing cost.

8.1.1.1 Types of CI Pipes

Based on the method of manufacture, CI Pipes are of two types – (i) Vertically cast or pit-cast pipes and (ii) Centrifugally cast or spun pipes. Vertically cast pipes are cast using vertical moulds as specified in IS 1537. Spun pipes are cast in accordance with IS 1536. Spun pipes are more compact, free from blow holes, of lesser weight and of smooth inner surface

compared to centrifugally cast pipes. Standard lengths of CI spun pipes are 3.66m, 4.0m, 4.5m, 5.0m and 5.5m. Common sizes available are 80mm, 100mm, 125mm, 150mm, 200mm, 250mm, 300mm, 350mm, 400mm, 450mm, 500mm, 600mm, 700mm, 700mm, 750mm, 800mm, 900mm and 1000mm. Longer sizes can be obtained against special manufacturing. Size referred to is the internal diameters.

Based on the thickness of pipe shell, that provides capacity to withstand working pressure, CI pipes are classified as class LA, A and B. Class LA is taken as the base for evolving the series. Class A and B allow 10% and 20% increases in thickness respectively.

8.1.1.2 Pressure rating of CI pipes

The pressure and working pressure of class LA, A and B pipes are given in the tables below

TABLE 8.1: Test and working pressure of spigot and socket ended spun pipes

Class of Pipe	Test Pressure at works, kg/sq.cm		Test Pressure at site, kg/sq.cm		Maximum working Pressure inclusive of surge pressure, kg/sq.cm	
	Upto 600mm	Above 600mm	Upto 600mm	Above 600mm	Upto 600mm	Above 600mm
LA	35	15	16	15	10	10
A	35	20	20	20	12.5	12.5
B	35	25	25	25	16.0	15.0

TABLE 8.2: Test and working pressure of Flanged spun pipes

Class of Pipe	Test Pressure at works, kg/sq.cm		Test Pressure at site, kg/sq.cm		Maximum working Pressure inclusive of surge pressure, kg/sq.cm	
	Upto 300mm	350 to 600mm	Upto 300mm	350 to 600mm	Upto 300mm	350 to 600mm
B	25	16	25	20	16	16

8.1.1.3 Cast Iron fittings

All cast iron fittings for all types of jointing, the fittings shall conform to IS: 1538. Only one type of fittings shall be used for all classes (LA, A, B etc.) of pipes.

Except otherwise required, all fittings shall be coated externally and internally. Each fitting shall be marked with trade mark of manufacturer, nominal diameter, weight, last two digits of the year of manufacture and ISI certification mark.

8.1.2 Ductile Iron Pipes (DI Pipes)

DI Pipes are centrifugally cast (spun) in accordance with IS 8329. DI Pipes are also called spheroidal graphite iron pipes or nodular pipes. Advantages of DI Pipes over cast iron pipes are greater tensile strength, significant elongation at break, high resistance against breakage due to impact and lighter in mass as compared to cast iron pipes.

DI fittings shall conform to IS 9523. CI fittings in accordance with IS 13382 can also be used in DI pipe lines.

DI pipes are available in standard lengths of 4m, 5m, 5.5m and 6m. Common sizes available are from 80mm to 2000mm. Size referred to is the internal diameter.

8.1.2.1 Classification of DI Pipes

DI Pipes are classified as K7, K8, K9, K10 and K12 depending upon the service conditions and manufacturing process. Test and working pressure of different classes of DI pipes are furnished in **Table 8.3.**

Diameter of Pipe	**Test Pressure at works Kg/cm2 (Mpa)**

Mm	K7	K8	K9	K10	K12
80 - 300	32 (3.2)	40 (4.0)	50 (5.0)		
350 - 600	25 (2.5)	32 (3.2)	40 (4.0)		
700 - 1000	18 (1.8)	25 (2.5)	32 (3.2)		
1100 - 2000	12 (1.2)	18 (1.8)	25 (2.5)		

Note: Maximum working pressure including surge pressure is 50% of the works pressure.

For screwed or welded flanged pipes, the minimum classes based on working pressure criteria are as follows.

TABLE 8.4: Minimum class for DI flanged pipes

Nominal Dia., mm	Screwed on flange minimum				Welded on flange minimum			
	PN-10	PN-16	PN-25	PN-40	PN-10	PN-16	PN-25	PN-40
80-450	K_9	K_9	K_9	K_9	K_9	K_9	K_9	K_9
500-600	K_{10}	K_{10}	K_{10}	K_{10}	K_9	K_9	K_9	K_{10}
700-1200	K_{10}	K_{10}	K_{10}	-	K_9	K_9	K_9	-
1400-2000	K_{10}	K_{10}	-	-	K_9	K_9	-	-

8.1.2.2 Coating.

Pipes shall be protected internally and externally with lining and coating respectively.

8.1.2.2.1 External Coating.

External coating shall be with metallic zinc rich paint not less than 130 grams per square metre with a local minimum of 110 grams per square metre or bitumen coating with mean thickness not less than 70 micro metres or polythene sleeving of density between 910 and 930 kg/cubic metre.

When specified, cement lining with a seal coat of bituminous material shall be given.

8.1.2.2.2 Internal Lining.

By agreement between the manufacturer and the purchaser, the following lining shall be provided to suit the conditions of use.

i. Portland cement lining (IS. 8112 or IS. 45)
ii. Sulphate resisting cement mortar lining (IS. 12330 or IS. 6909)
iii. High alumina cement mortar lining (IS. 6452)
iv. Bituminous paint

8.1.2.2.3 Cement Mortar Lining.

Portland cement mortar lining performs well and expected life is about 50 years in soft water with moderate amount of aggressive carbon dioxide and when pH is in the range of 6 to 9. When mortar lining is exposed to sulphate attack, sulphate resisting cement mortar shall be used. When the water is aggressive (pH between 4 and 6) high alumina cement mortar shall be used. High alumina cement lining also offers excellent resistance to abrasion.

8.1.2.2.4 Method of Lining.

Cement mortar lining is done in the factory by centrifugal process to ensure uniform thickness. With lining ‘C’ value will be 140 for pipes diameter less than 1200mm and 145 for pipes of diameter greater than 1200mm.

8.1.2.3 Marking

Each pipe shall be marked with manufacturer, nominal diameter, class, last 2 digits of the year of manufacture and a short white line at the spigot end of pipe with push button joints.

8.1.2.4 Ductile Iron Fittings

Ductile iron fittings shall conform to IS. 9523.

8.1.3 Steel Pipes

Steel pipes shall be welded pipes, seamless pipes or spiral weld pipes.

8.1.3.1 Mild Steel Pipes

Mild steel tubes and specials shall conform to IS. 1239 for sizes upto 150mm. These are made from tested quality of steel by hot finished seamless, electric resistance welded, high frequency induction welded or hot finished welded. Steel pipes (tubes and sockets) of smaller diameter can be made from solid bar sections by hot or cold drawing process, referred to as seamless pipes. Larger sizes are manufactured by open hearth, electric or basic oxygen welding process. Pipes shall be in random lengths from 4 to 7 metres. Larger pipes shall conform to IS. 3589. Standard Mild Steel pipes are available in sizes 15mm to 500mm and in random lengths 4 metres to 7 metres. The size referred to is the internal diameter. High Test Line Mild Steel Pipes are referred to in terms of outside diameter.

8.1.3.2 Classes of Pipes

Steel pipes are classed as light, medium and heavy, based on the thickness of pipes.

8.1.3.3 Hydraulic Tests at Factory

Each tube of smaller size (upto 150mm) shall be hydraulically tested at manufacturer's works to withstand a pressure of 5MPa (1MPa=10.2 kg/square centimetre=0.102 kg/mm^2=1N/mm^2). Larger pipes shall be tested using the formula P=2St/D where P=Test Pressure in MPa, S=Stress in MPa which shall be taken as 40% of the specified minimum tensile strength, t=Thickness in mm, D=Outside diameter in mm.

8.1.3.4 Galvanising

When tubes are to be galvanized, the zinc coating shall conform to IS. 4736. (Hot dip zinc coatings on steel tubes.)

8.1.3.5 Nominal Diameter

Nominal diameter or nominal bore of steel pipe is the inner diameter of the pipe.

8.1.3.6 Markings

Each pipe shall be marked with manufacturer's name or trade mark, nominal diameter, pipe designation/wall thickness and ISI certification mark.

8.1.3.7 Fittings for Steel Pipes

8.1.3.7.1 Screwed fittings

Malleable iron fittings for steel pipes shall conform to IS 1879. Wrought steel fittings shall conform to IS 1239. Threads to these fittings shall be as per IS 554. Galvanising of the special shall be done as stipulated in IS 1239. The specials are manufactured in three grades – light, medium and heavy. After being screwed, the specials should withstand an internal water pressure of 5MPa without any sign of leakage.

8.1.3.7.2 Plane Ended Specials

In case of plain end fittings, wrought steel butt welding fittings are used.

Flanges may be screwed or welded type. The contact surface may be plain, serrated and grooved for ring joints. The serrated finish shall be of spiral or concentric grooves, usually about 0.4mm deep with 12 serrations per centimetre. The flanges shall conform to IS 6392. The bolts and nuts shall be in accordance with IS 1364.

8.1.3.8 Protection against corrosion

Against internal corrosion, steel pipes shall be given epoxy lining or hot applied coal tar/asphalt lining or rich cement mortar lining at works or in field by centrifuging. Outer coating for underground pipe line shall be in cement – sand guniting or hot applied coal tar asphaltic enamel reinforced with fibre-glass fabric yarn. The protective coating shall be in accordance with IS. 10221.

8.1.4 Asbestos Cement Pipes (A.C. Pipes)

Asbestos Cement Pipes are manufactured from a mixture of asbestos paste and cement pressed by steel rollers. They can be drilled and tapped for connections using saddle piece and ferrule. A.C. Pipes are available in sizes 80mm, 100mm, 125mm, 150mm, 200mm, 250mm, 300mm, 350mm, 400mm, 450mm, 500mm and 600mm. Standard length of pipe is 4 metres.

Advantages of A.C. pipes are non- corrosiveness to most natural soil conditions, good flow characteristics, light weight, easy in cutting, drilling and fitting with C.I. Specials, greater deflection with joints, case of handling and quick laying. Disadvantages are poor capacity to withstand high superimposed load, corrosion by acids and highly septic sewage, erosion by grit particles on steep gradients and high velocities.

8.1.4.1 Classification of pipes

A.C. pipes are classified according to their test pressures as given below.

TABLE 8.5: Class, Test pressure and working pressure of A.C. pipes.

Class of pipe	Test Pressure at works, kg/sq.cm	Working Pressure, kg/sq.cm	
		Pumping	Gravity
Class 5	5.0	2.5	3.3
Class 10	10.0	5.0	6.7
Class 15	15.0	7.5	10.0
Class 20	20.0	10.0	13.3
Class 25	25.0	12.5	16.7

8.1.4.2 Specials

Plain ended cast iron specials conforming to lS.5531 shall be used as specials.

8.1.5 Concrete Pipes

Concrete pipes are manufactured conforming to IS.458, by centrifugal (spun) process. Concrete pipes shall be manufactured with or without reinforcement. These pipes are available in lengths 2, 2.5 and 3metres. Size referred to is the internal diameter.

8.1.5.1 Classification of pipes

Concrete pipes are classified as non–pressure pipes and pressure pipes. Non pressure pipes are referred to as NP and pressure pipes as P. There are 4 classes of non-pressure pipes, used for different purposes, as shown below.

TABLE 8.6: Classification and use of non-pressure concrete pipes.

Class	Description	Use
NP1	Unreinforced	For drainage and irrigation
NP2	Reinforced, light duty	For culverts carrying light traffic
NP3	Reinforced, medium duty	For culverts carrying medium traffic
NP4	Reinforced, heavy duty	For drainage and irrigation use, for culverts carrying heavy traffic

There are 3 classes of pressure pipes used for water supply.

TABLE 8.7: Classification of pressure concrete pipes used for water supply.

Class	Description	Use
P1	Reinforced concrete pipes tested to hydrostatic pressure 0.2 mpa	For use on gravity mains. Working pressure not to exceed 2/3 test pressure. Usable for sewers where water tight joints are required.
P2	Reinforced concrete pipes tested to 0.4 mpa	For use on gravity lines with working pressure 2/3 test pressure and pumping main with working pressure ½ the test

		pressure.
P3	Reinforced concrete pipes tested to 0.6 mpa	For use on gravity lines with working pressure 2/3 test pressure and pumping main with working pressure ½ the test pressure.

8.1.5.2 Sizes available

Class P1 pipes are available in sizes 80, 100, 150, 250, 300, 350, 400, 450, 500, 600, 700, 800, 900, 1000, 1100 and 1200mm. Class P2 available in 80, 100, 150, 200, 250, 300, 350, 400, 450, 500 and 600mm sizes while class P3 are available in 80, 100, 150, 200, 250, 300, 350 and 400mm sizes.

8.1.6 Pre-stressed Concrete Pipes

Reinforced pre-stressed concrete pressure pipes are manufactured in accordance with IS.784. These pipes can be economically used for intermediate pressure in the range 6kg/cm^2 to 20 kg/cm^2 for factory test. Size referred to is the internal diameter.

Pipes are available in lengths given below. Size is referred to the internal diameter.

TABLE 8.8: Internal Diameter and length of pipe.

Internal diameter in mm.	**Length in meter**
80 to 400	4, 5 and 6
450 to 1700	4, 5 and 6

8.1.6.1 Classification of Pipes

No specific classification is available since the pipes can be designed to take care of the desired pressure, by appropriate pre-stressing. Field test pressure shall be 1.5 times the working pressure. Factory testing shall be field test pressure + 2.0 kg/cm2.

8.1.7 Unplasticised Polyvinyl Chloride (uPVC) Pipes

PVC and Polyethylene pipes fall under the general title of Plastic pipes. uPVC pipes are manufactured in accordance with IS:4985. The pipes are produced by extrusion process. The compound for extrusion comprises PVC resin, colouring pigments, opacifiers and heat stabilizers. Advantages of uPVC pipes are resistance to corrosion, light weight, toughness, rigidity, ease of fabrication, economical in laying, jointing and maintenance. Sizes available are 16mm, 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 75mm, 90mm, 110mm, 125mm, 140mm, 160mm, 180mm, 200mm, 225mm and 250mm. uPVC pipes are referred to the outer diameter.

8.1.7.1 Classification of pipes

uPVC pipes are available in working pressure ranges of 2.5, 4, 6, 8 and 10 kg/cm2 at 27°C and classified under the same working pressure.

8.1.7.2 Length of pipe.

U PVC pipes are available in standard length of 6 metres.

8.1.8 High Density Polyethylene Pipes (HDPE pipes)

HDPE pipes shall conform to IS 4984. The pipes are manufactured by extrusion technique.

HDPE pipes are classified on pressure ratings as PN 2 for 0.2 MPa, PN 4 for 0.4 Mpa, PN 6 for 0.6 Mpa, PN 8 for 0.8 Mpa, PN 10 for 1 MPa. The pipes shall be used for a temperature range upto 45^{o}C. The recommended maximum working stress for the material at 27^{o}C in a pipe is 50 kg/sq.cm. The pipes are referred to in terms of outer diameter.

HDPE pipes are flexible and tough, at the same time they are resilient and conform to the topography of the land/trench when laid. They are coilable. The diameter of the coil shall not

be less than 25 times the outside nominal diameter of the pipe without any kinks. These pipes can be easily bent in installations reducing the specials like bend and elbow. They are lighter in weight and easy to carry. They can withstand movement of heavy traffic. They have non-adherent surface, which reject any material that would impede the flow. HDPE pipes are anti-corrosive and have smooth inner surface.

These pipes are commonly available in sizes 20mm, 25mm, 32mm, 40mm, 50mm, 63mm, 75mm, 90mm, 110mm, 125mm, 140mm, 160mm, 180mm, 200mm, 225mm, 250mm, 280mm, 315mm and 355mm. The sizes indicate outer diameter. Pipes will be supplied in coils or straight lengths of 5 to 20 metres. Longer length reduces the number of joints.

Colour of pipes shall be black with 3 blue stripes. Depth of stripes shall not be more than 0.2mm.

The pipes shall be marked with white paint on either side of the pipes. For coils, marking shall be made at both ends and at spacing not exceeding 5 metres in between.

Alternatively marking shall be done hot embossed on white base, every metre throughout the length of the pipe or coil. Marking shall contain the following information.

- Manufacturer's name/ Trade name
- Designation of pipe (Grade of raw material, class of pipe, nominal outside diameter)
- Lot/batch number
- ISI certification mark and
- Raw material manufacturers

The colour used for marking shall be as given below.

TABLE 8.9: Class of pipes and colour of marking

Class of pipe	Class 1 (2 kg/cm^2)	Class 2 (2.5 kg/cm^2)	Class 3 (4 kg/cm^2)	Class 4 (6 kg/cm^2)	Class 5 (10 kg/cm^2)
Colour	Orange	Red	Blue	Green	Yellow

HDPE pipes cannot be located with conventional electronic pipe locators. Therefore proper record of pipe location shall be maintained. Residual chlorine has no/negligible effect on HDPE pipe. These pipes are susceptible to rodent attack. Polyethylene may continue to burn, once ignited.

8.1.8.1 Verification of Dimensions

i) Method of measurement of diameter, thickness and ovality: Outside diameter shall be taken as the average of two measurements taken at right angles for pipes upto 110 mm dia. As an alternative, diameter shall be measured preferably by using a flexible Pi tape or circometer, having an accuracy of not less than 0.1mm.

ii) Thickness shall be measured by a dial vernier or ball ended micrometer. Resulting dimension shall be rounded to 0.1mm. Outside diameter shall be measured at a distance of at least 300 mm from the end of the pipe. In case of dispute, the dimension of pipes shall be measured after conditioning at room temperature for 4 hours.

iii) Ovality: It is the difference between maximum outside diameter and minimum outside diameter at the same cross section at 300mm away from the cut end. For coiled pipes, it shall be measured prior to coiling (or after re-rounding of pipes).

8.1.8.2 Performance requirements

i) Visual appearance: Internal and external surfaces shall be smooth, clean and free from grooving and other defects. Ends shall be square with the axis of pipe. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be

permissible provided that the wall thickness remains within the permissible limits. The outside diameter, thickness, tolerance in thickness and ovality shall be as per relevant IS.

ii) Hydraulic characteristics: When subjected to internal pressure creep rupture test, the pipes shall not show signs of localised swelling, leakage or weeping and shall not burst during the test duration. The temperature, duration of test and induced stress for the test shall be as per details given in the table below:

TABLE 8.10: Type of Test, Temperature, Duration of Test and Induced Stress for Test

Sl. No	Test	Test temp (^{0}C)	Test duration (min holding time) Seconds	Induced Stress (MPa)		
				PE 63	PE 90	PE 110
1	Type test	80	165	3.5	4.6	5.5
2	Acceptance test	80	48	3.8	4.9	5.7

The internal test pressure for the above test shall be calculated by adopting the formula given below

$$P = \frac{2 \times p \times s}{(d - s)}$$

where p=test pressure in MPa
s=minimum wall thickness in mm
d=outside diameter in mm
P=induced stress in MPa as given in the table above

iii) Reversion test: Longitudinal reversion shall not be greater than 3%

iv) Overall migration test: When tested from a composite sample of minimum of 3 pipes as per IS 9845, the overall migration of constituents shall be within the limits specified in IS 10146.

v) Density: Composite sample of minimum of 3 pipes as per IS 7328 shall have a density of 940.3-946.4 kg/ cu m at 27 deg C. The value of density shall not differ from the nominal value by more than 3 kg/cu.m as per clause 5.2.1.1of IS 7328.

vi) Melt flow rate (MFR): Composite sample of minimum of 3 pipes as per IS 2530 at 190 deg C with nominal load of 5 kgf , MFR shall be 0.4 -1.1 g/ 10 minutes and also shall not differ by more than 30% of the material used in manufacturing of pipes. The MFR of the material shall be 0.41-1.10g/10 minutes when tested at 190deg C with nominal load of 5kgpf as determined by method prescribed in 7 of IS 2530. The MFR of the material shall be within +20% of the value declared by the manufacturer.

vii) Carbon black content and dispersion: For composite sample of minimum of 3 samples in accordance with IS 2530, the carbon black content shall be within 2.5+ 0.5%and the dispersion of carbon black shall be satisfactory.

8.1.8.3 Sampling, frequency of tests and criteria for conformity for acceptance tests:

i) Lot: It shall consist of same size, same pressure rating, same grade and manufactured essentially under similar conditions.

The number of samples to be collected for various tests based on the size of lot shall be as per the table given below .The pipes shall be selected at random for sampling. Starting from any pipe in the lot, count them as 1,2,3,4 etc upto ‘r ‘and so on where ‘r’ is the integral part of N/n, N being the number of pipes in the lot and ‘n’ is the number of pipes in the sample. Every R^{th} pipe so counted shall be drawn as to constitute the required sample size.

TABLE 8.11: Sample Size, Acceptance Criteria

Number of pipes in lot	Sample number	Sample size	Cumulative sample size	Acceptance number	Rejection number
1	2	3	4	5	6
Upto 150	First	13	13	0	2
Do	Second	13	26	1	2
151-280	First	20	20	0	3
Do	Second	20	40	3	4
281-500	First	32	32	1	4
Do	Second	32	64	4	5
501-1200	First	50	50	2	5
Do	Second	50	100	6	7
1201-3200	First	80	80	3	7
Do	Second	80	160	8	9
3201-10,000	First	125	125	5	9
Do	Second	125	250	12	13
10,000-35000	First	200	200	7	11
Do	Second	200	400	18	19

ii) Visual and dimensions: They shall be checked from the first sample size. Pipes failing to satisfying any of the requirements shall be considered as defective. The lot is satisfied if the number of defectives found in the first sample are less than or equal to the corresponding number given in column 6 of the table .The lot is defective if the number of defectives is greater than the number in rejection number. If the defectives number is between columns '5'and '6', the second sample of sizes shall be taken and examined .The lot is considered satisfactory, if the number of defectives found in the cumulative sample is less than or equal to the corresponding acceptance number. Otherwise it is considered not satisfactory.

iii) Hydraulic characteristics, reversion, overall migration, MFR and carbon black / dispersion tests:

The lot having satisfied visual and dimensional requirements only shall be taken up for further testing.

A separate sample size for each of the tests shall be taken as stipulated below and selected at random from the sample already examined for visual and dimensional inspection.

No of pipes	Sample size
Upto 150 pipes	3
151-1200	5

All the pipes in the sample shall be tested for requirements .The lot shall be considered satisfactory if none of the samples tested fails.

8.1.9 Medium Density Polyethylene Pipes (MDPE Pipes)

(NOT USED)

8.1.10 Low Density Polyethylene Pipes (LDPE Pipes)

LDPE Pipes shall conform to IS 3076. Manufacturing process is same as that for HDPE pipes.

Classification under pressure ratings and referring to sizes are same as those for HDPE pipes. LDPE pipes are available in sizes ranging from 12mm to 140mm.

Features of LDPE pipes are similar to HDPE pipes.

8.1.11 Glass Reinforced Plastic Pipes (GRP Pipes)

(NOT USED)

8.1.12 Fibre Reinforced Plastic Pipes (FRP Pipes)

(NOT USED)

8.2 TRANSPORTING AND HANDLING PIPES, SPECIALS AND APPURTENANCES

8.2.1 Transporting and handling:

Pipes and fittings must not be dropped, indented, crushed or impacted. Particular care should be taken to avoid scoring, scrapping and abrasion damage. During transportation, loading and unloading, pipes and fittings shall not be allowed to come into contact with any sharp projections, which may cause damage. During transit, pipes and fittings shall be well secured and adequately supported along their length. Pipes and fittings of plastic materials shall be covered during transportation. Scores or scratches to a depth of 10% or more of wall thickness are sufficient to require rejection of the pipes and fittings. Pipes must not be stored or transported where they are exposed to heat sources likely to exceed 700 C e.g., vehicle exhaust gases.

8.2.2 Safety Precautions:

i) PE particles can be abrasive if they enter eyes

ii) Molten PE produced by welding operation will adhere strongly to the skin in the event of accidental contact. Should this occur, the affected part should be flooded with cold water. The molten or solidified material should not be removed from the skin and medical assistance should be obtained even for small burns.

8.3 LAYING, JOINTING AND FIELD TESTING OF PIPES

8.3.1 Handling and Storage Of Pipes- General

8.3.1.1 Pipes and fittings shall be handled and stored in accordance with the manufacturer's recommendations and subject to the approval of the Engineer. Handling operations shall be carried out with care.

8.3.1.2 Pipes and fittings shall be stored on a flat level area and raised above the ground on timber bearers so that the lowest point of any pipe or fitting is not less than 150 mm above the ground. Pipes and fittings supplied either on pallets or crated shall remain on the pallets or in their crates until required.

8.3.1.3 Non-crated pipes shall be stacked to the approval of the Engineer. Spigot and socket pipes shall be stacked so that successive pipe layers have sockets protruding at opposite ends of the stack. Pipe of different sizes and thickness shall be stacked separately.

8.3.1.4 Each pipe and fitting shall be subjected to a visual inspection after off-loading at site and prior to installation.

8.3.1.5 Pipes and fittings damaged during transportation, handling and storage shall be set aside and the damage brought to the attention of the Engineer. Proposals for repair shall be submitted in writing for the Engineer's approval. If in the Engineer's opinion the nature of any damage is such that the condition of a pipe has been impaired and cannot be repaired the pipe concerned shall not be incorporated in the Works

8.3.2 Laying Jointing and Testing

8.3.2.1 General

Setting Out: Before any excavation for water pipeline/chambers is commenced the Contractor shall define the centre line or other agreed reference line of the Works and erect the necessary profiles throughout their full length if so required by the Engineer.

Pipes and fittings shall be examined for damage and carefully brushed out immediately before laying.

The formation of excavations for pipelines shall be dry, even and free of stones and other protrusions. Where exceptionally poor ground conditions are encountered at the trench formation the Contractor shall, at the direction of the Engineer, excavate down to firm ground or 300mm below formation, whichever is the less. The extra-excavation shall be backfilled with either concrete or selected granular material as directed by the Engineer.

Where pipelines are to be laid in trench, the Contractor shall provide, fix and maintain at such points as may be directed by the Engineer properly painted sight rails and boning rods of predetermined measurement for the boning in of individual pipes to correct alignment. The sight rails shall be at a suitable height vertically above the line of pipes or immediately adjacent thereto and there shall at no time be less than three sight rails in position on each length of pipeline under construction to any one gradient.

Pipelines shall be temporarily capped when pipe laying ceases, to prevent the ingress of foreign matter. The Contractor shall ensure that the pipes remain clean and free from dirt and deposits and if required by the Engineer the pipelines shall be cleaned out using approved methods and equipment, which do not damage to the internal lining of the pipes and valve chambers.

Colour coded plastic marker tapes shall be placed over the pipeline even when not separately specified.

Where pipelines are to be constructed in any tunnel heading or duct provided by the Contractor, the minimum clearance between the inside face of the tunnel heading or duct and the pipe shall be 200 mm unless otherwise shown on the Drawings.

The Contractor shall adopt a suitable method of controlling the alignment of a pipeline installed in a tunnel heading or duct to the approval of the Engineer.
Testing: The line of pipes after laying and jointing shall be tested to a pressure at least double that of working pressure, provided that in no case shall the pipes be tested to a less pressure than that equivalent to a head of 40 meters of water and the pipes and joints shall be absolutely watertight. The contractor shall provide the water, appliances and labour for testing the pipes at his own expense.

Regime of testing: The following regime of testing shall be followed through out the period of Contract.

Tests at the start of the Contract.

In house tests shall be conducted as per relevant IS code and the test results submitted together with the request for material approval.

Tests during the Contract Period

Type tests and acceptance tests as stipulated in relevant IS shall be strictly carried out at the factory and acceptability of pipes ascertained before dispatch to site. In addition, field hydrostatic test shall be done and quality of pipes ensured.

8.3.2.2 Cast Iron Pipes

Pipes shall not be thrown from the trucks on hard roads

All pipes, fittings, valves and hydrants shall be carefully lowered into the trench, piece by piece by means of ropes or other tools to prevent damage to them. Pipes of diameter more than 300mm shall be lowered into trenches using chain-pulley blocks.

The pipes shall be inspected for defects by ringing with a light hammer while suspended to detect cracks. If doubt persists, further confirmation may be obtained by passing a little kerosene, which seeps through and shown on the outer surface. Any pipe found unsuitable after inspection and before laying shall be rejected.

The outside of the spigot and inside of the socket shall be wire brushed and wiped clean and dry to make them free from oil and grease before laying. The inner face shall be wiped clean with cloth or cotton waste.

During laying operation, no foreign material like debris, tools, clothes or any other material shall be placed in the pipe.

After placing a length of pipe in the trench, the spigot shall be centered in the socket and the pipe forced home and aligned to the gradient.

Wherever cutting of pipe becomes necessary, like for inserting valves, fittings etc., it shall be done in a neat manner at right angles to the axis of the pipe so as to leave a smooth cut face. Machine cutting shall be adopted. With prior approval of the Engineer, electric arc cutting method may be permitted using a carbon or steel rod, flame cutting shall not be allowed.

On level ground, the socket ends should face upstream, when runs uphill the socket ends shall face the upgrade.

Deflection allowed at any joint shall not exceed the following values.

Lead Joint	2.5 deg
Rubber Joint - (80 to 300mm dia)	5 deg
- (350 to 750mm dia)	4 deg
- (> 750mm dia)	3 deg

Thrust and Anchor blocks shall be designed and suitably provided wherever necessary.

Jointing CI Pipes

CI pipe joints shall be broadly classified into two – (i) Flanged joints and (ii) Socket and Spigot joints

Flanges will be cast monolithically with body in the case of centrifugally cast pipes and screwed on the ends in the case of spun pipes and bolt holes drilled, as per IS 1538. The pipes and/ or specials shall be manufactured with ends to suit the predetermined method of jointing

Flanged Joints

Holes in flanges will be drilled as per IS 1538 for jointing with bolts and nuts, unless specified otherwise. Compressed fibre board or rubber sheet of thickness 1.5mm to 3mm will be used in between flanges, conforming to IS 1638. The fibre board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight shall not be less than 112 grams/ mm thickness/ square metre.

Each bolt shall be tightened a little bit at a time taking care to tighten diametrically opposite bolts alternatively. No spanner other than the standard pattern shall be allowed. Any appliance for lengthening the leverage of any spanner shall be permitted. All flanges with their bolts shall be painted with two coats of tar. The gasket shall be of such width as to fit inside the circle of bolts.

For fitting flanged sluice valves, air valves, hydrants, meters, bends and other specials same type of jointing shall be adopted.

Spigot and socket joints

Spigot and socket joints shall be provided as laid down in IS 3114. Common types of Spigot and socket joints are (i) Molten lead joint, (ii) Lead wool joint, (iii) Tyton joint, (iv) Push-tite joint and (v) Cement joint.

Lead joint (Molten lead)

Lead used for jointing shall conform to IS: 782. Lead is extremely resistant to atmospheric corrosion and is not affected by soil or liquid flowing inside the pipe.

The spigot end of one pipe shall be forced into the socket end of the preceding pipe. Hemp yarn shall be placed around the spigot and driven tightly against the inside base of the socket with suitable yarning tools, layer by layer until tight hemp fills annular space for specified depth. The lead is melted in an iron pan of suitable size in easy reach of the joints to be filled so that the molten lead remain in proper temperature while carrying from melting pan to the joint. The outer end of the socket is closed by means of well kneaded clay leaving the space to be filled with lead as hollow. At the summit of the clay mould through a small opening the molten lead is poured so that the joint is completely filled with molten lead. After the lead has solidified, the clay gasket is removed and the joint caulked with hammer of weight not less than 2kg by hammering up the face of the lead uniformly in series with at least three special caulking tools. Lead run joint shall be finished 3mm behind the socket face.

Advantages of lead joints are that minor repairs could be carried out without putting the pipe line out of service. The disadvantage is that it has a tendency to loosen under vibration due to

lack of elasticity and creeps under high pressure creating leaky joints which require periodic caulking.

Lead and spun yarn required for different sizes of pipes are given below.

TABLE 8.12: Lead and spun yarn for different sizes of pipes

Nominal size of joint, -mm	Lead per joint, kg	Depth of lead joint, mm	Yarn per joint, kg
80	1.8	45	0.10
100	2.2	45	0.18
125	2.6	45	0.20
150	3.4	50	0.20
200	5.0	50	0.30
250	6.1	50	0.35
300	7.2	55	0.48
350	8.4	55	0.60
400	9.5	55	0.75
450	14.0	55	0.95
500	15.0	55	1.00
600	19.0	55	1.20
700	22.0	55	1.35
750	25.0	55	1.45

Lead Wool Joint

Lead wool or lead yarn jointing is adopted when it is inconvenient or dangerous to use molten lead. Lead wool consisting of finely spun lead in continuous strands can be used without heating to fill socket and spigot joints. Hemp yarn shall first be inserted and caulked into the socket and above that the lead wool shall be introduced in strings not less than 6mm thick and caulking repeated with each turn of lead wool. The whole of the lead wool shall be compressed into a dense mass and joint finished flush with the face of the socket. Approximate weight and depth of lead wool for various pipes are given in the table below.

TABLE 8.13: Weight and depth of lead wool for various sizes

Dia. of pipe (mm)	Weight of lead wool (kg)	Depth of lead wool (mm)
80	0.80	19
100	0.90	19
125	1.25	20
150	1.60	23
200	2.05	23
250	2.95	25
300	3.50	25
350	4.65	29
400	5.70	31
450	6.70	32
500	8.30	33
600	10.00	35
700	11.80	36
750	13.60	38
800	15.40	40
900	16.80	40

Tyton Joints

Tyton joints are push on type. The sockets of the pipes to receive tyton joints are specially designed to contain elongated grooved gasket. The inside contour of the socket provides a seat for the circular rubber ring in a modified bulb shaped gasket. An internal ridge in the socket fits into the groove assembly. The socket and spigot ends of the pipes are cleaned and then a thin film of lubricant is applied to the bulb seating inside the socket. The gasket is placed inside the socket with the bulb towards the back of the socket so that the hard rubber heal engages in the retaining groove. If any loop is left, it shall be pressed flat for proper fit of gasket in the groove.

After centering, the spigot shall be inserted far enough into the socket to make contact with the gasket. The spigot end is forced into the socket carefully, compressing the gasket till the spigot end reaches the inner end of the socket using fork tool or pull jack.

Push-tite Joint

Push-tite is specially devised moulded rubber ring gasket to fit the socket configuration suitable for conventional pour joints. The flange shaped mouth of the gasket is made of harder rubber. It provides a strong shoulder for self-centering of the spigot end at the time of assembly. Push-tite will function effectively under all normal working conditions.

Cement Joints

Cement Joints are used for low pressure flows, as in sewers. A closely twisted spun yarn gasket of required diameter in one piece of sufficient length to pass around the pipe and lap at the top shall be thoroughly saturated in cement paste. The gasket shall be laid in the socket circumferentially for the lower third of the socket and covered with cement mortar. The spigot end shall be thoroughly cleaned, inserted and carefully driven home after which a small amount of mortar shall be inserted in the annular space around the entire circumference of the pipe and solidly rammed into the joint with a caulking tool. The remainder of the joint shall then be completely filled with mortar and beveled off at an angle of 45 degree with the outside of the pipe. The joint shall be kept wet with neat gunny bags for 24 hours after making.

Field Testing of pipeline

After laying and jointing, pipe line must be pressure tested to ensure that pipe line joints are sound enough to withstand maximum pressure likely to be developed under working conditions. The test pressure should not be less than the highest pressure of the following:

(i) For gravity pipelines

  a) 1.5 times the maximum sustained operating pressure

  b) 1.5 times the maximum pipe line static pressure

(ii) For pumping mains

  a) Sum of the maximum sustained operating pressure and the maximum surge pressure.

  b) Sum of the maximum pipe line static pressure and the maximum surge pressure.

Under testing, the leakage should not exceed 0.1 litre per millimeter of pipe diameter per kilometer of pipe line per day for each 30 metres pressure head applied. When a pressure drop occurs water shall be pumped to maintain the pressure constant and the quantity of water thus pumped shall be carefully measured. This quantity amounts to leakage.

The test shall be taken as passed if the pipe line withstands the pressure specified above and the leakage is within the specified limit.

8.3.2.3 Ductile Iron Pipes (DI Pipes)

Laying:

Laying procedure for DI pipes is same as that for CI pipes.

Types of Joints

Joints shall be flanged type or push on type.

Flanged Joints

Flanged Joints shall be screwed to the barrel or welded. Flanges shall be fixed at right angles to the axis of the pipes and shall have machined face. For both types, flange drilling shall be as per IS 1538. Screwed on flanges shall be sealed at threaded joint between the pipe and the flange with a suitable sealing compound. Rubber gaskets for flanged joints shall conform to IS 638.

Push–on-Joints

For push on joints, the spigot end shall be suitably chamfered or rounded off for smooth entry of pipe in the socket fitted with gasket. Rubber gasket for push on type shall conform to IS 5382.

Hydrostatic Test

All pipes shall be tested at works at pressure as stipulated in IS. 8329. The pressure shall be applied internally and steadily maintained for a minimum period of 10 seconds. The pipe should not show any sign of leakage, sweating or any other defect.

TABLE 8.14: Test Pressure at works in MPa

Nominal Dia., mm	Screwed on flange minimum			Welded on flange minimum			
	Class K_7	Class K_8	Class K_9, K_{10}, K_{12}	PN-10	PN-16	PN-25	PN-40
80-300	3.2	4.0	5.0	1.6	2.5	3.2	4.0
350-600	2.5	3.2	4.0	1.6	2.5	3.2	4.0
700-1000	1.8	2.5	3.2	1.6	2.5	3.2	-
1100-2000	1.2	1.8	2.5	1.6	2.5	2.5	

8.3.2.4 Steel Pipes

Laying

Steel pipes shall be laid as specified in IS. 5822. Pipes shall be inspected for defects such as protrusion, grooves, dents, notches etc and if found they shall be rectified. Defect free pipes shall be lowered in the trenches. The procedure for lowering varies with the method adopted for coating the pipes. Care shall be taken to see that longitudinal welded joints of consecutive pipes are staggered by at least 30° and shall be kept in upper third of the pipe line. Pipes laid above ground may be allowed to rest on the ground if the soil is not aggressive. The ground should however be dressed to match the curvature of the pipe shell for an arch length subtending an angle of 120° at the centre of the pipe.

For all pipe lines laid above ground provision shall be made to contain expansion and contraction on account of temperature variation. Expansion joints or loops shall be provided at pre-determined points.

Testing

The pipes in test length shall be slowly filled with water and air shall be expelled. The field test pressure shall not be less than the greatest of the following.

a. Maximum sustained operating pressure

b. Maximum static pressure

c. Sum of the maximum of (a) and (b) and surge pressure.

Where the working pressure is less than two-third of the test pressure in the case of gravity main or half the test pressure in the case of pumping main, the test pressure shall be maintained at least for 24 hours.

Further the leakage during the test shall also be within the prescribed limit. If the pressure drops, water shall be pumped in to maintain the test pressure and the quantity of water thus pumped shall be carefully measured. The quantity should not exceed 0.1 lit / millimeter of pipe diameter per kilometer of pipe line length for each 30 metres of head applied.

Jointing.

Following are the types of joints provided in steel pipes.

(a) Threaded joints (Screwed joints)

(b) Sleeved pipes by fillet weld

(c) Plain end pipe by butt weld

(d) Flanged joint (Bolted joints)

Threaded joints are given to the smaller pipes. Threads of all screwed ends and socket (coupling) shall conform to IS. 554. Each screwed joint pipe shall be supplied with one socket as an integral part of the supply. Larger pipes shall have welded joints.

Sleeved pipes with fillet weld shall be as specified in IS. 3589.

Plain end but welding shall be as per IS. 3589.

Flanged joints are used wherever required. The flanges shall conform to IS. 1538.

When tubes are required to be galvanized the zinc coating shall be in accordance with IS. 4736.

8.3.2.5 Not used

8.3.2.6 Concrete Pipes

Jointing

All non-pressure pipes shall have flexible rubber ring joints in accordance with IS.783.

Pressure pipes shall have rigid collar joints, rigid spigot and socket joints or semi flexible spigot and socket joints.

Collar Joints: Collars are 15 to 20 cm wide. A mixture of cement and sand in the ratio 1:1.5 is rammed along with caulking iron to form the joint. The joint shall be kept wet for 10 days for maturing.

8.3.2.7 Prestressed Concrete Pipes (PSC Pipes)

Jointing

Pipes are jointed with rubber gaskets to provide flexible joints as per IS.784. Pipes are provided with spigot and socket ends to enable jointing with rubber gaskets. The rubber gaskets shall conform to IS.5382.

8.3.2.8 Polyethylene Pipes

Storage

Polyethylene pipe packs should be placed on timber bearers approximately 2m c/c. Avoid long term stacking of pipes. Providing proper regard is given to sideways stability (ex: wind forces), packs which are usually 1.2 meters wide may be stacked up to 3m in height for straight pipes. Coils stacked horizontally shall be placed on pallets for convenient lifting or slinging and the height of coils shall be limited to 1.0m in height.

Lifting and unloading

Metal hooks, chains or slings must not be used without padding for lifting coils or pipes. Care shall be taken to avoid injury to personnel when cutting the steel restraining bands on coils.

8.3.2.8.1 Laying

1. In sufficient time before commencement of the Works, the Contractor shall submit for the Engineer's approval the pipe manufacturer's complete and detailed specification for the handling and installation of pipes and fittings in open trench and such other methods of construction of pipeline specified or proposed by the Contractor, irrespective of whether the data was submitted with the tender.
2. The Contractor shall lay pipes in accordance with the approved manufacturer's installation specification as approved by the Engineer after submission and acceptance of appropriate quality control test results.
3. The Contractor shall use a suitable mechanised device to the approval of the Engineer for gauging pipe deflections both before and after laying, in the stages specified.
4. For pipes of less than 600mm diameter, a deflectometer of a form that can be drawn through the pipeline and capable of measuring diametric dimensions both vertically and horizontally shall be provided by the Contractor. It shall be calibrated for each diameter

regularly in the presence of the Engineer to maintain the accuracy of the instrument. The device shall also provide a means of identifying where each deflection measurement was taken along the length of the pipeline. This shall be either in the form of a continuous print out or in the form of a visual display or a remote monitor.

5. When instructed by the Engineer, the Contractor shall also provide pipe deflection measuring equipment in full working order for use of the Engineer or the Employer.

6. The pipes shall be laid and bedded in a granular material as specified elsewhere except where concrete protection is required. Trenches shall be excavated to depth 150 mm below the underside of the pipe.

7. The granular material shall be placed over the full width of the bottom of the trench to the level of the underside of the pipe and shall be compacted as required for that class of bedding material. Suitable depressions shall be made in the bed to accommodate the pipe joints and shall be of minimum width and depth practicable. The trench shall be carefully filled to 300 mm above the crown of the pipe in layers not exceeding 150mm. Particular care shall be taken to ensure that the depressions for the joints are completely filled and that the bedding material is well compacted under the haunches of the pipe over the full length of the pipeline.

8. The Engineer may, from time to time, require that tests are carried out on the bedding to determine the degree of compaction being achieved by the Contractor. Where the Contractor is consistently unable to achieve the required degree of compaction or proves unable to keep pipe deflections to within the acceptable limit then he shall change his method of compaction or use a better class bedding material. The trench shall then be backfilled and compacted to a level 300 mm above the crown of the pipe with selected excavated material free from large stones etc. All filling shall be carefully compacted by a method approved by the Engineer, which shall avoid disturbing the pipes or the joints.

9. Polyethylene pipeline may be laid along the side of the trench and jointed there. Thereafter the jointed pipeline shall be lowered into the trench carefully without causing undue bending. The pipe line shall be laid inside the trench with a slope of about 0.5 m per 100 m of pipe line (pipe line to be laid in a sinuous alignment).

   Permissible radius at changes in direction:

   i) Changes in direction shall be achieved by 'cold bending' at ambient temperature so long as the radius of curvature is not less than the values indicated below.
      - SDR = Ratio of outside diameter and wall thickness
      - Ambient temperature shall be 20 degree C or more

Standard dimension ratio (SDR)	**Radius**
41	40 Dia
42	40 X Dia
33	30 X Dia
26	25 X Dia
<21	20 X Dia

   ii) Fittings shall not be located on bent pipe and kept at least 1 m away from the tangent point

   iii) Thrust blocks shall be provided near connections made from PE to other pipe materials

   iv) Compressible material must be used around the pipe in the concrete surround

8.3.2.8.2 Jointing

1. Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled.

2. Flexible joints of spigot and socket type with a single sealing ring shall be laid with a gap between the spigot end and the shoulder of the socket. The gap, referred to as the initial

jointing allowance, measured parallel to the pipeline shall not be less than 6 mm or greater than 13 mm or as recommended by the pipe manufacturer.

3. In flexible joints incorporating a sleeve coupling with two sealing rings the initial gap between the spigot ends of the pipes shall be as recommended by the manufacturer.

4. For uPVC pipes solvent welded joints with parallel sockets will not be permitted unless made in the manufacturer's workshop.

5. Rubber joint rings which are not locked in position in pipe sockets shall be stored, until needed, in a cool place free from direct sunlight.

6. Spigot and socket flexible joints shall have the annular space between the pipe and socket sealed with an approved joint sealant to prevent the ingress of loose material or concrete.

7. The annular space shall be sealed immediately on completion of a satisfactory initial hydraulic test prior to concreting or backfilling but not prior to the test.

8. Flanged pipes shall incorporate an annular gasket at the joints. In horizontal lengths or pipelines the gaskets shall cover the full face of the flange and shall have holes cut in them corresponding to the bolt holes in the flanges. In pipes laid vertically, a plain ring covering the flange between the bolt circle and the bore of the pipe may be used if desired. Gaskets shall be 3 mm thick and shall be made of first quality rubber incorporating two layers of cotton fabric insertion evenly spaced in the gasket. When flanged joints are to be made the bolts shall be inserted and the nuts turned to finger tightness. Thereafter the final tightening of the nuts shall be effected by spanners in such sequence that diametrically opposite nuts are tightened together.

9. The Contractor shall ensure the patent joints are made strictly in accordance with the manufacturer's Instruction.

10. Butt fusion welding

    Jointing the Polyethylene pipes can be done with Butt-welding equipment with the temperature and pressure recording arrangements. The pipeline may be laid along side the trench and jointed there. Thereafter the jointed pipe line shall be lowered into the trench carefully without causing undue bending. The pipeline shall be laid inside the trench with a slack of about 0.5 m per 100 m of pipeline (pipe line to be laid in a sinuous alignment).

Pipe to be jointed must be of the same wall thickness and the ends must be cut square. Unmatched wall thickness will require machining by chamfering of the greater thickness at an angle of 5 deg or less to give the same thickness. The success of each weld is extremely dependent on cleanliness, temperature control and good equipment, which have been properly maintained. The pipe ends should be dry and free of dust. Mating surfaces must be planed immediately before welding to remove surface material as polyethylene (PE) oxidises on exposure to air. If these prepared surfaces are touched, there is a risk of contamination.

The timing of the welding sequence is most important if consistent quality of weld is to be obtained. Times for the simultaneous heating of the pipe ends against the hot plate (mirror), mirror removal, the pressing of the melted pipe ends together to give the required amount and shape of bead material and finally the cooling time whilst maintaining pressure are all of critical importance.

If the pipe temperature is not uniform (e.g.: when welding is carried out in direct sunlight), an uneven pipe wall temperature will exist which could affect the uniformity of the weld. This temperature difference must be equalized by shielding the weld zone well in advance of making the joint. Covers on the ends of pipes remote from the weld will prevent cooling air from passing through the pipe interior and assist in keeping weld zone temperatures uniform.

The temperature of the hot plate will be in the range 200+ 10 deg C (takes about 30 minutes for electrical heating and more for blow torch) with the higher temperature recommended for PE80 to PE I00 welds. When welding is being performed in windy conditions, the temperature may need to be raised slightly to compensate for air-cooling. If the temperature is too high, there is a risk of thermal degradation of the PE resulting in a weak joint. If it is too low, it causes a weak joint due to insufficient melted material. The temperature of the hot plate must therefore be checked regularly. For detecting the correct temperature, crayon chalk shall be used. Around 200 deg C, the colour of crayon dot on the mirror changes within 2 seconds. The dot made shall be thin and if not, time taken will be more indicating a wrong temperature. It is important that the correct heating, jointing and cooling times be used. Excessive heating time

will have the same effect as a temperature which is too high and possibly cause thermal degradation .Too short a heating time will result in insufficient melted material .The heating, jointing and cooling time should not vary significantly from the times shown in the table below. Otherwise the joint will not develop full strength. Longer cooling times are however permissible. Excessive pressure will squeeze the melted PE out of the joint and weaken it. However the jointing procedure to be adopted and equipment to be used shall be submitted by the Contractor to the Engineer for approval and shall conduct jointing on the approved method.

TABLE 8.15: Heating, Jointing And Cooling Times

Wall thickness (mm)	Initial bead width (mm)	Soak time t2 (sec)	Max t3&t4 (sec)			Min t 5 (minutes)	Final bead width (mm)		Min T6 (Minutes)
			SDR				Min	Max	
			41	17	9				
2	1	30	4	3	3	5	4	6	11
4	1	60	5	4	3	7	5	8	12
6	1	90	5	4	4	9	6	9	13
8	1	120	6	4	4	11	7	10	14
10	1	150	7	5	4	13	8	12	15
12	1	180	8	5	4	15	9	13	16

NOTE:

1. t3 must be as short as possible eg: a delay of only 3 sec can cause a temperature drop of 15deg C or more
2. t2: time of contact between the plate and pipe ends after relieving the pressure p2.
3. Excessive pressure will squeeze the melted PE out of the joint and weaken it

Butt fusion procedure:

i. Clamp the pipes in the butt fusion machine

ii. If practicable keep the brand markings in line

iii. Wipe the pipe ends, inside and out, with a clean cloth to remove water, dirt, muck etc.

iv. Align the pipe ends and clamp in place

v. Plane both ends until they are perfectly square

vi. Remove the plastic shavings from the vicinity of pipe ends without touching the prepared surface as any contamination at this stage will be detrimental to the welding process

vii. Bring together the two pipe ends and ensure they are aligned

viii. Check the hot plate (mirror) temperature (range 200-240deg C) and make certain the surfaces are clean. It is good practice to make `dummy ` welds daily, prior to welding sessions as a means of cleaning the mirror. That is, the weld procedure should be taken to the heat soak stage, when the process can be aborted .The hot plate surfaces must not be touched with metal implements or tools. A damaged or dirty mirror will result in a poor joint.

ix. Move the pipe ends into contact with the hot plate and a steady pressure of about 2kg / sq cm (P1) while a uniform bead forms around the circumference of both pipe ends. This procedure is to ensure that the entire face of the pipe heats uniformly through positive contact with the mirror.

x. When a satisfactory bead height has formed, relieve the pressure but maintain contact pressure between the plate and pipe ends of 0.5 kg/ sq cm (P2) until the recommended time t2 (heat soak time) has elapsed

xi. Back the pipe ends away from the mirror. When removing the mirror, make sure it is not wiped across the molten pipe ends

xii. Bring the melted pipe ends together within the period t3 and allow the recommended pressure of 2-3 kg/ sq cm (P3) to build up within a time period of t4. This pressure should be applied by building up gradually to avoid squeezing out too much of the melt and held for a time of t5 .Do not disturb the joint during the required cooling time of at least t6.

xiii. Relax the contact pressure and carefully remove the clamps only after ensuring the joint has fully solidified. Do not stress the joint or debead until the required cooling time has elapsed

8.4 QUALITY CONTROL

Visual inspection of joints

i) The beads should be uniform and symmetrical without any sharp notches. Refer the butt fusion weld section profiles given below which are useful to check the quality of joints.

ii) Inspection of Bead after removal: Use an approved bead removal tool to remove the bead. Do not remove bead by chipping or chiselling. Examine the underside of bead. It shall be solid and rounded with a broad root. Hollow beads with a thin root or curled edges should be rejected. When the bead is bent to reverse the curvature, there should be no sign of any slits or fissures (given below)

Melt area assessment

The joint being tested is cut transversely into a strip approximately 20 mm wide and 150mm long. A small flame played on the exposed cut edge of the weld will cause differential shrinkage of the fusion melt and the parent pipe .The pattern thus created will illustrate whether too much pressure has been applied and thus squeezed out most of the melt

Tensile Strength

The test specimens are to be prepared as given in Indian standards.

Condition the specimens in air at 20+2 deg C for < 12 hours for pipes of wall thickness upto and including 12.7mm or < 24 hours for pipes of wall thickness over 12.7mm

Test specimen containing the weld zone shall not fail to a stress which must not be less than 0.8 of that of the virgin parent pipe .The test is performed with the bead removed.

A normal pressure test on a welded pipe sample at 80 deg C should meet the requirements for pipe which does not contain weld material

The grip separation rate should be 50 mm/min +10%

Note the failure stress and mode of failure (ductile, tearing or brittle failure)

Acceptance criteria

If all specimens are visually sound and separate in a ductile manner, the welding can be judged as satisfactory. If the specimens exhibit brittle separation modes, the welds of the batch require further investigation. Number of samples to be tested is given below

Pipe size(mm)	Min number of samples
> 90 <110	2
> 110 <180	4
>180 < 315	6
>315	7

Field Testing Of Pipe Line

a) The normal procedure of testing is not applicable to PE pipes because they exhibit strain creep and stress relaxation. When PE pipes are sealed for testing, there will be reduction in pressure over time (or pressure decay) even in a leak free system, as a

result of the creep characteristics of the material. If air is in the pipe line, it would be compressed as the test pressure built up, and then later expanded with very little pressure loss. Hence attention shall be paid to eliminate air pockets.

b) It is desirable to cover the joints before testing. The pipe line shall be filled and pressure tested from the lowest point. After filling, the pipe line shall be left to stabilise at its temperature for a minimum period of 3 hours (preferably delay testing until the following day)

The test pressure shall be 1.3 times the rated pressure of pipes. Apply the pressure by continuously pumping at a constant rate. If the relation between pressure and time is not linear, it indicates presence of considerable amount of air in the pipe line. Then terminate the test and take action to remove air. If there is no air entrapped, continue pumping till the pressure reaches the test pressure (P2). Isolate the pipe line and allow the pressure to reduce. Use the pressure loading time (T_L) to achieve test pressure as a reference. Record the pressure at predetermined times from the moment of valve closure. As PE relaxes, apply a correction factor of 0.4 t L.

Take a first reading of pressure P1 at t1 where t1= T_L

Take a second reading of pressure P2 at t2 =7TL (approx)

Correct times as follows

T1c=t1+0.4TL

T2c=t2+0.4TL

Calculate the slope n1= log P1-log P2

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logt2c- log t1c

For a good water tight pipe line, n1 < 0.04—0.05 for buried pipe line

< 0.08---0.10 for above ground pipe line

If the value of n1 is less than the above values, remove air and take a third reading of pressure of P3 at t3= 15 TL. Correct the time as t3c= t3+ 0.4 TL

Calculate n2= logP2—logP3

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logt3c—logt2c

Calculate the predicted pressure by adopting the following formula

$$P = P_L \left[\frac{2.5Xt}{tl} + 1 \right]^{-n}$$

where, P= predicted pressure after time t

P L= test pressure (at start of test when the test pressure is first reached)

T =time (from reaching the test pressure)

T L= loading time

N= 0.04—0.05 for buried pipe

0.08---0.10 for above ground pipe

If the actual pressure recorded is found to vary significantly from the predicted value, draw a graph showing the relationship between log pressure (on Y axis) and log time (on X axis). If the graph shows an increasing slope with time i.e. the actual recorded pressures are less than the predicted pressures, leakage is probable. If the graph shows a decreasing slope with time, ie the actual recorded pressures are greater than the predicted pressures; air entrapment is the likely cause. If the slope is linear but between the slopes identified (0.04-0.05 and 0.08-0.10) it indicates poor backfill compaction but not a failed test.

In the event of a retest being required on the pipeline, this shall be done not earlier than 5 times the previous total test period.

Suitable metal plates shall be used to support the PE flanges to enable them to be bolted together. In most cases, sealing is improved by incorporating a natural or synthetic rubber gasket between PE pipes. HDPE stub ends shall be used at the joint.

c) Each test length shall be a maximum of 200 meters

8.5 INSTALLATION OF UNDERGROUND SERVICES WARNING TAPE

8.5.1 Services protection tapes shall be installed above all water pipeline mains constructed or exposed under this Contract excluding individual service connections.

8.5.2 For pipeline with top of the pipe barrel more than 900mm below finished surface level the tape shall be placed over the centerline of the pipe line at 600mm below finished surface level during backfilling and compaction operation. For pipelines with less than 900mm cover to the top of the pipe barrel the tape shall be placed over the centerline of the pipe at 300mm above the top of the pipe barrel during backfilling, compaction and reinstatement operations.

8.5.3 The tape shall be continuous over pipelines and at joints between tapes from separate rolls the joint shall be lapped a minimum of one metre.

8.6 CONCRETING AROUND PIPELINES

8.6.1 Concrete Bed Or Bed And Surround

8.6.1.1 Pipes may be encased in concrete wherever necessary with provision for a mechanical key such as a welded thrust flange. Compressible material at least 3mm thick and at approximately 150mm from the face of concrete into the concrete shall be provided around pipes at the entry point and exit point to eliminate any potential sharp edges from rubbing against the pipe wall. Pipeline shall not be filled with water until the concrete has developed sufficient strength. Where concreting to pipelines is specified a blinding layer of concrete Class 10 shall be placed over the full width of the trench or heading to comply with the following requirements.

TABLE 8.16: Requirement for Blinding Layer of Concrete

	PIPE NOMINAL BORE mm			
	Up to			Above
	900	700 to 1200	1000	1200
Minimum thickness of blinding layer (mm)	75	75	75	100
Minimum extent of blinding each side of pipe barrel (mm)	150	150	230	300
Minimum clearance between blinding and pipe barrel (mm)	80	150	230	300
Minimum clearance between blinding and underside of pipe socket (mm)	25	25	25	25

8.6.1.2 Concreting to the pipeline shall be either bed or bed and surround as shown on the drawings and shall be of concrete M 20 along such lengths as are shown on the Drawings or ordered by the Engineer.

8.6.1.3 When support of excavations is provided building paper shall be placed against that support before concreting to facilitate withdrawal of support.

8.6.1.4 In the case of spigot and socket pipes with flexible joints the concrete at each joint shall be interrupted in a vertical plane at the edge of the socket by a strip of fibreboard or other material approved by the Engineer and of the following thickness:-

8.6.1.5 The protection and filling of headings shall be of concrete Class 25 for a thickness of 13 mm for pipes upto 300 mm nominal bore 25 mm for nominal bore from 300 mm to 600 mm, 38 mm for 600 to 1200 mm and 50 mm for nominal bore 1200 mm to 2000 mm.

8.6.1.6 The annulus of the pipe socket shall be sealed with an approved sealant, clay or tape to prevent the ingress of concrete in the joint.

8.6.2 Concrete Slab Protection - uPVC AND GRP Pipes

Where concrete slab protection to uPVC and GRP pipelines is specified such protection shall extend a minimum of 200mm either side of the pipe trench as dug. The slab shall be of reinforced concrete M25 as shown in the drawings or ordered by the Engineer.

8.6.3 Pipes Through Structures

8.6.3.1 Unless otherwise shown on the Drawings where pipes pass through a concrete wall or structure they shall be protected with a surround of concrete class 30 integral with the external face (s) of the structure. For pipes of less than 500 mm diameter the surround shall extend from the wall or structure by 300 mm and the width and depth of the surround beyond the outside face of the pipe at its horizontal and vertical diameters shall be a minimum of 300 mm or as otherwise indicated on the Drawings. For pipes of 500 mm diameter or greater the surround shall extend from the wall or structure by 500 mm and the width and depth of the surround beyond the outside face of the pipe at its horizontal and vertical diameters shall be 500 mm or as otherwise indicated on the Drawings.

8.6.3.2 Where the Engineer permits openings to be left in concrete wall for the subsequent fitting and concreting of pipework and fittings, the soffit of the openings shall be inclined away from the packing face at not less than one in four to the horizontal. The periphery of the openings shall be formed as specified for the construction joints. After placing the pipe or fitting the remaining void shall be carefully packed with concrete of appropriate class, every care being taken to produce a watertight joint. The concrete shall be retained by formwork, which shall be built up as concrete filling proceeds. The Contractor shall ascertain from the suppliers of prefabricated or manufactured goods any special fixing instructions and shall refer them to the Engineer for approval.

8.6.3.3 Where fixing bolts are positioned by means of a template they shall be supported and braced to remain in perfect alignment during the setting of the concrete or grout. Where it is necessary to drill for fixing the holes shall be to the minimum size necessary and they shall be grouted solid with a free-flowing non-shrink grout approved by the Engineer. Where boxing out for horizontal bolts or fittings is provided the boxing out - and refilling shall be as specified above for pipes and fittings through walls.

8.6.3.4 In fixing penstocks or flanges to concrete or blockwork the gate or door shall be in the closed position. The frame shall be supported against the face of the concrete or blockwork and the nuts tightened by hand. The space between the wall and the frame shall be filled solid with a non-shrink grout or a hard setting butyl mastic not in strip form.

After the hardening of the mortar or mastic the nuts shall be properly tightened in a sequence to prevent any distortion of the frame and ensure equal bearing against the wall. Aluminium penstocks or fittings shall be bedded in a hard setting mastic.

8.6.3.5 Care must be taken to protect faces and other working parts from mortar and other droppings.

8.6.3.6 Except where otherwise specified when a metal is fixed to a metal or any other surface the metal surfaces in contact shall be painted on site with two coats of bituminous paint immediately prior to fixing. Where it is necessary to joint dissimilar metal such as aluminium to steel or cast iron the two surfaces shall be separated by an approved insulation not less than 1.5 mm thick.

8.6.3.7 Under no circumstances shall aluminium be built into wet concrete or be fixed to fresh concrete. Where aluminium or ferrous structural members are built into block work or concrete the contact surfaces shall be first painted with two coats of bituminous paint.

8.6.3.8 HDPE pipes passing through a water retaining concrete wall or structure shall have a grit-bonded key formed with silica sand on the external surfaces of the pipes along the entire embedded length. All excess sand shall be removed.

8.6.3.9 On spigot and socket pipelines a socket or coupler shall be installed flush with the outside face of the concrete surround unless otherwise shown on the Drawings.

8.6.3.10 The first pipe that is clear of concrete surround beyond the external face of a concrete wall or structure shall be a short length of either spigot and socket or double spigot to suit the flow direction and pipe material. The effective length of this pipe shall be 1.5 times the nominal bore or 600mm which ever is the greater.

8.6.3.11 Any over excavation adjacent to a structure and beneath the formation level of a pipe trench to be constructed by the contractor or to be constructed by others to make connection to a plugged or capped pipe laid by the contractor shall be backfilled to the formation level of the pipe trench with concrete Class 20. This concrete shall extend to the limit of the over excavation along the line of the pipe trench and across the full width of the pipe trench shown on the Drawings or to the limit of the excavation whichever is least.

8.6.4 Thrust Blocks

8.6.4.1 At every bend and junction on pressure pipelines the Contractor shall construct a thrust block in concrete M20. The contractor shall prepare the thrust block drawings and shall get approval of the **Engineer**.

8.6.4.2 The additional excavation required to obtain a firm thrust face against undisturbed ground shall be made after the thrust block is cured. The concrete backfill to the excavation shall be placed the same day as the additional excavation is carried out.

8.6.4.3 No pressure is to be applied to thrust blocks until concrete has matured.

8.6.5 Anchorage at Valves

Near valves, anchorage shall be provided to minimise the turning movement during operating of valves.

8.6.6 Granular Material For Bedding To Pipelines

Granular bedding material for pipe, unless otherwise specified, shall consist of free-draining hard, clean, chemically suitable sand of grain size between 1.00mm and 4.5mm.

8.7 CLEANLINESS

The interior of the pipes must be carefully freed from all dust as the work proceeds, for which purpose a disc plate or brush sufficiently long to pass two or more joints from the end of pipe last laid shall be continuously drawn forward as the pipes are laid. The ends of the pipes must be securely protected during the progress of the work. The pipes laid shall not be made receptacle either for tools, hookahs, clothes or of any other matter during the progress of works.

8.8 VALVES

8.8.1 General

8.8.1.1 Flanges of valves shall be drilled to IS. 1538. A complete set of bolts and nuts and one gasket shall be supplied to each flange.

8.8.1.2 The valves shall be capable of withstanding the specified test pressures of the pipeline and be suitable for the conveyance of water of specified quality.

8.8.1.3 All valves shall be protected for corrosive environment.

8.8.2 Sluice Valves

8.8.2.1 Sluice valves shall comply with IS 14846 and be flanged unless otherwise stated and be tested to the requirements of Class 1.

8.8.2.2 Maximum Differential Pressure and Maximum Working Pressure shall be as per relevant IS standards.

8.8.2.3 Sluice valves shall be of the double-flanged cast iron wedge-gate type and shall have non-rising spindles unless otherwise specified or shown on the Drawings. They shall have a cast iron body with renewable gunmetal faces on body and wedge and bolt-on cast iron bonnet. Rising stem valves shall also incorporate a combined yoke.

8.8.2.4 Where sluice valves above 350 mm bore are mounted with the spindle in the horizontal place the valve body shall be fitted with renewable gunmetal machined gage slides and the gates with renewable hard bronze shoes accurately machined to reduce sliding friction.

8.8.2.5 A sluice valve above 500 mm bore (300 mm if power actuated) shall be provided with jacking screws and valves above 350 mm bore where mounted in a horizontal pipeline shall be provided with feet.

8.8.2.6 Unless otherwise specified each valve shall be provided with a suitable hand wheel of adequate diameter for the duty required and gearing shall be supplied where necessary to ensure that the required operating force applied by hand to the rim of the wheel does not exceed 25Kgf.

8.8.2.7 Hand wheels shall have smooth rims and the direction of closing which shall be clockwise shall be cast on them. Vandal and weatherproof clear polycarbonate tube covers shall be securely fitted to protect the threads of rising stems and spindles and tubes shall be clearly and permanently engraved to indicate the position of the valve.

8.8.2.8 Valve stems shall be of gorged aluminium bronze or stainless steel machined all over and with a machine cut robust trapezoidal or square form thread operating in a gunmetal nut.

8.8.2.9 Stem seals shall be of the stuffing box and gland form arranged for easy replacement of packing and shall be accessible for maintenance without removal of the valve from service.

8.8.2.10 Extension spindles headstocks and foot brackets shall be provided where specified. Where possible providing the valve is not subject to submergence. The extension spindle shall be of the non-rising type and a cast iron bridle piece or similar shall be incorporated on valves of the rising spindle type for this purpose. Where rising stem valves are subject to submergence the extension spindle shall also be of the rising type with the threaded portion positioned above top water level. Extended spindle installations shall include all necessary brackets intermediate supports etc.

8.8.2.11 Headstocks for non-rising spindle installations shall incorporate a valve position indicator.

8.8.2.12 Extension spindles shall be of stainless steel or manganese steel and shall conform with the requirements of valve stems with the exception of non-threaded sections which may be of mild steel. Extension spindle couplings shall be of the muff type and shall be drilled and provided with a nut and bolt for securing the spindle to the valve stem, which shall likewise be drilled to accept the bolt.

8.8.2.13 Extended spindle installations of the rising type shall be provided with thrust tubes between valve and headstock in order to absorb the thrust in both directions of operation for valves of 300 mm bore and above and for all motorised/actuator operated valves. Thrust tubes shall incorporate all necessary fixing brackets and spindle guide plates.

8.8.2.14 Where valves are required to be operated by the keys spindle caps shall be fitted. The caps shall be drilled and each provided with nut and bolt for securing to the spindle which shall likewise be drilled to accept the bolt. Where caps are fitted they shall be supplied complete with operating key.

8.8.2.15 All hand wheels, headstocks, foot brackets, guide brackets and thrust tubes shall be of cast iron.

8.8.2.16 Fixing nuts and bolts supplied by the manufacturer shall be as specified in the appropriate clauses of relevant IS.

8.8.2.17 Valves shall carry identification marks and/or plates in accordance with the Indian Standard and those for use on process plant shall carry additional brass plate carrying valve identification and a brief description of its function.

8.8.2.18 Valves shall be sized such that the velocity through the valve when fully open does not exceed 2.25 metres per second at the rated flow. They shall have flanges to IS. 1538 and shall be capable of withstanding the same test pressures as the pipeline on which they operate. All nuts and studs subject to vibration shall be fitted with spring washers or locking tabs.

8.8.2.19 All valves shall be coated with solvent free coal tar epoxy resistant to mineral acid which has pH $\leq$ 2.

8.8.2.20 All materials used in the manufacture of the valves shall conform to the following minimum standards: -

Cast Iron*	BS 1452	Grade 220
Gunmetal	BS 1400	Grade LG2
Aluminium Bronze	BS 2872	Grade Ca104
Stainless Steel	BS 970: Part 1	Grade 316531
Manganese Steel	BS 970: Part 1	Grade 150 M19

*Spheroidal Graphite Iron to ISO 1083 may be used as an alternative to Cast Iron for waterworks standard valves to BS 5163.

8.8.3 Reflux Valves (Non-Return Valves)

8.8.3.1 Reflux valves shall comply with IS 5312 and be double flanged cast iron unless otherwise specified. They shall be resilient seated and be of the quick acting single door type designed to minimise slam on closure by means of heavy gunmetal faced doors weighted as necessary. The valves shall be fitted with renewable gunmetal door sealing faces which shall be positively fixed. The door hinge pin/shaft shall extend through a sealing gland on the side of the body and be fitted with an external lever to permit back flushing. Glands shall be of the stuffing-box type with the exception that for valves below 450mm bore they may be of the O ring type. The valve door shall be weighed to suite the application and the lever shall be of heavy duty type designed for the additional of external weights should these be required at some future date.

8.8.3.2 All reflux valves shall be suitable for operating in the horizontal plane unless otherwise specified.

8.8.3.3 Covers shall be provided to allow ample access for cleaning and service and shall be supplied complete with tapped bosses fitted with air release cocks. Valves above 350mm bore shall be provided with feet.

8.8.3.4 The design of the valve body shall be such that there is adequate clearance around and the back of the door to minimise jamming by rags and debris. Stops shall be proved to limit the back lift of the door and shall be positioned to prevent fouling.

8.8.3.5 The hinge pin/shaft shall be stainless steel and preferably square in section to ensure positive location of the door. If circular shafts are utilised the back flushing lever shall be located on squared section the diagonal dimension of which shall be equivalent to the full diameter of the shaft. Both door and lever shall be positively and securely fixed to the hinge pin/shaft. Grub screws pins (parallel or taper) or clamps will not be acceptable. All internal fixing devices shall be of stainless steel.

8.8.3.6 Valves shall carry identification marks and/or plates.

8.8.3.7 Valves shall be sized such that the velocity through the valve when fully open does not exceed 2.25 m/sec at the rated flow. All nuts and studs subject to vibration shall be fitted with spring washers or locking tabs.

8.8.3.8 All valves shall be prepared and painted in accordance with Engineers instructions.

8.8.4 Air Release Valves

8.8.4.1 Air release, or Air valves as they are usually known, shall be of double orifice pattern with grey or ductile cast iron bodies. The inlet flange shall be faced and drilled in accordance with IS.1538.

8.8.4.2 The valves shall be adequately sized for the release of gas from the pipeline (or other container) without restriction of rate of fillings or flow due to back pressure and also to allow admission of air during pipeline emptying at a rate sufficient to prevent excessive depression of pressure in the pipe.

8.8.4.3 Valves shall be designed to prevent the operating elements being in contact with the pipeline liquid by approved means such as the provision of an auxiliary float and chamber sufficiently large to isolate the orifice valves and seats throughout the rated operational range.

In applications where the pipeline characteristics may lead to liquid column separation with consequent possibility of surge a vented non-return valve shall be provided which allows air to enter freely on separation by controls and expulsion of air/gas as the liquid column rejoins.

In applications where the hydraulic conditions are such that pressures fall below atmospheric pressure during normal operation and where air inflow at that time could induce surge conditions an air inflow check valve shall be incorporated.

Fixing nuts and bolts supplied by the manufacturer shall be as specified in the appropriate clauses herein.

8.8.4.4 All air and gas relief valves and associated isolating valves shall be works tested and capable of withstanding the same test pressures as the pipeline or vessel on which they operate.

8.8.4.5 All valves and operating linkage shall be prepared and painted in accordance with Engineers instructions.

8.8.4.6 All materials used in the manufacture of the valves shall conform to the following minimum standards.

Float chamber	Grey Cast Iron to BS 1452
Flange and Cover	Grade 220 or Spheroidal Graphite Iron to BS 2789
Liquid Float	Copper, polycarbonate and approved equivalent
Air valve Float and Guide	Polycarbonate or approved equivalent
Orifices Guides and Mechanisms	Stainless steel to BS 970: Part 1

8.8.4.7 Testing

All valves supplied shall be tested at factory and all tests passed in the presence of the Engineer nominated by the client, as per relevant IS code. Requests for acceptance of materials shall be enclosed with a copy of such test results.

8.9 FLOWMETER

8.9.1 General

The flow meter shall be of Electromagnetic type complete with primary head and signal converter cum flow indicator as integral. Also a remote indicator for flow rate and totalization shall be provided at the pump house. The detailed specifications of the flow meter shall be as follows:

8.9.2 Material of Construction and other features:

Measuring tube: SS

Liner: Hard Rubber/Neoprene/Polyurethene

Electrode: Has

telloy C4

Connecting Flanges: Carbon Steel

Earthing Ring: SS316

Coil housing: Sheet metal with epoxy coat.

Insulation class of field coils shall be of ‘F’ class. The electrodes shall be of self cleaning, surface polished type.

Type of Protection: IP67, NEMA6

Accuracy: 0.5% of measured value

Power supply: 230V AC, 50Hz

Output: 4-20mA Analog isolated.

Coil supply: Pulsed DC supply from the converter

Cable connection: ½" NPT of SS 304, Double compression

8.9.3 Flow range

Flow meters installed should be having a flow range upto 25% excess over the calculated flow rate at each concerned location.

Note:

1. The contractor shall install the flow meter appropriately as per manufacturers recommendations and as directed by the Engineer in the rising main close to the Pump House.
2. Scope of the work shall include cutting the pipe, providing and welding suitable size flanges on the existing pipe at suitable locations. Power supply connections to the Flow meter shall be made using proper size cables in suitable length. Separate indicator shall be provided in the Pump House for monitoring the flow.
3. The flow meter shall be provided with grounding rings.
4. Additional flow indicator shall be provided inside the pump house at a suitable position as directed by the Engineer in charge. Suitable size and length of cable and accessories shall be included in the scope.

8.9.4 Testing

The meter shall be calibrated and tested as per relevant Codes and certificates shall be submitted for approval. The manufacturer's Test certificate shall be provided for approval of the Engineer. The flow meter shall be subjected to inspection.

8.10VALVE CHAMBERS AND METER HOUSES

All the sluice valves, air valves and scour valves shall be protected by valve chambers constructed as specified in relevant drawings. The chambers shall be provided with an access hole and the hole covered with manhole covers of size 600mm x 600mm. The manhole covers shall be of heavy duty for the chambers located on roads over which vehicular traffic can be anticipated and for others the covers shall be of medium duty. Ladder or foot rests shall be provided so that access into the valve chamber through the access hole is easy. Outside of the valve chamber shall be coated with 2 coats of bituminous paint. Inside of the valve chamber shall be protected with cement colour first quality emulsion paint. The price quoted should be inclusive of all works including earthwork excavation, backfilling, construction of RCC chamber, formwork, manhole cover, etc all complete as specified in specifications and drawings.

8.10.1 Protection to Water Meters

Bulk water meters shall be protected in a meter house or concrete chamber with adequate protection to the water meter, but enabling easy reading of the meter, as directed by the Engineer

8.10.2 Protection against Corrosion

All corrosive parts such as specials and valves shall be protected against corrosion with 3 coats of anticorrosive paint. Wherever salt content is present in soil, such corrosive parts shall be protected with 3 layers of bituminous coating and leak proof wrapping with polythene sheets

8.11 SUPPLYING AND FIXING VENTS

Vents of diameter 150 mm or as specified / directed by the Engineer shall be provided in the roof of all storage reservoirs. If more than one compartment is available, each compartment shall be provided with vents. One vent pipe of minimum 150 mm diameter shall be provided for every 50 sq. metre plan area, or part there of in any compartment. The vents shall be of cast iron and shall have wall casting base so that it can be fixed in cover slab. The vents shall be fixed vertically and shall have double out lets each forming a semi circle with the stem. Each out let shall be curved in opposite direction of the other out let. Vents fitted at ground level shall have sufficient stem length so and the out let will have clearance of at least 50 cms between the out let opening of the vent top of reservoir cover slab to prevent entry of frogs and worms. In other cases the clearance shall be 30 cms. The vents shall be painted with two coats of black paint or tar. The outlets of the vents shall be fitted with brass mosquito proof netting.

Measurement:
The vents shall be measured in numbers.
Rate:
Rate shall include labour, cost and conveyance of all materials, fixing in concrete slab at the time of casting, painting, etc. complete for the finished work. The brass mosquito proof netting will be measured separately.

8.12 RUBBER PACKING

Flanged joints shall be provided with rubber packing sheet in between flanges and tightening with bolts and nuts. Rubber packing used for jointing flanges shall conform to IS 1638. The packing used shall be of such width that the sheet fits exactly with the flange width.

Measurement:
Measured in Kg. correct to 10 grams. This will be covered under items concerned unless specified otherwise.
Rate:
Rate includes labour for cutting, cost and conveyance, placing in position etc. complete for the finished work.

8.13 M S BOLTS AND NUTS

M S bolts and nuts used for flanged joints in pipelines shall conform to IS-1363 with ends of bolts threaded to required length. Inside of nut shall be threaded to suit bolt threads.

The bolts should be provided with steel washers, tapered or otherwise, of suitable shape to give the head and nut of the bolt a satisfactory bearing. The thread portion of each bolt shall project through the nut at least for 10 mm.

Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. No bolt shall be stressed beyond elastic limit and no spanner other than the standard pattern shall be allowed nor shall any appliance for lengthening the leverage of any spanner be permitted. The flanges and bolts and nuts shall be painted with two coats of paint or tar, as directed by the Engineer.
Measurement:
Bolts and nuts will be measured in Kg, correct to 10 grams. Washers will no be measured.
Rate :
Rate will be inclusive of cost, conveyance and 2 coats of painting, labour and required number of steel washers for the finished work.

8.14 PIG LEAD

Pig lead shall be 99.99% pure conforming to IS.782.

Measurement :
Pig lead will include cost, conveyance to store, storage, conveyance from store to site etc. complete.

8.15 WATER LEVEL INDICATOR

A water level indicator shall be provided and fixed, reading depth of water in metre in intervals of 10 cm. The system shall consist of noncorrodable materials and shall be simple and easy to maintain. The water level shall be provided and fixed as approved by the Engineer. The indicator shall be full scale up to 4.00 meter and ratio type above 4.00 m height. Alternatively mono metric gauge or electronic water level indicator can be offered. The reading shall give precision of 1 cm.

Measurement:
Level Indicator will be measured in numbers.
Rate:
Rate will include cost, conveyance and erection for the finished work.

8.16 LIGHTNING ARRESTOR

Copper Lightning Arrestor shall be provided at the highest level on the roof of the tank as specified in IS.2309. Position and height of the lightning arrestor shall be such that the whole structure shall be enclosed within a cone having its apex at top of the arrestor and generated by a line inclined at 60º to the vertical. The copper lightning conductor shall be of copper tape 20 mm x 3 mm size. It shall be fixed on side and top of the structures using porcelain cleats at an interval of one metre in such a way that it will not have any contact with the structure. The copper rod used for supporting the conical spike at the top shall be of 1.50 m long and 20 mm dia. The earth pit shall be provided with copper plate of 3 mm thick and 0.81 sq. metre surface area clamped with G.I. Pipes of 40 mm dia and 3 meter long. The top end of the pipe will be fitted with a funnel and projected above the ground.

Measurement:
Lightning arrester shall be measured in numbers.
Cost:
Cost shall include labour, cost and conveyance of all components, errection etc. complete for the finished work.

8.17 FIRE HYDRANTS

Fire hydrants shall be of "Pillar or Post Hydrant" type. It will stand above ground like a post 1.00 m high and connected to the water main underground. It shall consist of a sluice valve, a duck foot bend, 65 mm dia post with one or more outlets at the top of the post, in addition to the branching from the water main. Multiple out lets may be provided on mains of diameter 300 mm and above as directed by the Engineer. The posts shall be painted in red. The hydrant shall comprise a flanged sluice valve (conforming to IS.780, a flanged socket tail piece (conforming to IS.1538), one double flanged duck foot bend, a 63 mm screwed out let, a loose cap and a wrought iron chain. Fire Hydrants shall be provided at all round junctions and street crossings in locations convenient for fire fighting, as directed by the Engineer and at intervals of about 100 meters.

Measurement:
Fire Hydrants will be measured in numbers.
Cost:
The cost of Fire Hydrants will include labour for installation Cost and conveyance all components concrete pedestal for duck foot bend etc. complete for the finished work.

8.18 BALL VALVES / FLOAT VALVES

The Ball valves shall be of cast iron body with bronze liner and gun metal seat ring. It shall conform to IS.1703.

Measurement:
Ball Valves will be measured in number.
Cost:
Cost of Ball Valve will include labour, cost and conveyance of the valve and positioning the ball so that the valve will be closed fully when the tank is full for the finished work.

8.19 SCOUR VALVE / WASH OUT VALVE

Scour Valves are installed on branching from the water pipe line with a tangential Tee. A sluice valve of branch size will be fitted. Scour water shall be discharged into a clean open drain or a natural water body. A duck foot bend shall be used on the out let side. The duck foot bend shall be anchored to a concrete pedestal. Discharge of scoured water shall be through a goose neck or inverted 'J' the out let point shall be about 30 cms above the high water level in the receiving drain or water body. The water should never be let out into a sewer manhole directly. It there is any chance for erosion near the discharge point due to large quantity of water at high velocity, protection shall be provided by way of gabion mattresses. Size of the scour value shall be half the diameter of main pipe plus 25mm.

Measurement:
Scouring arrangements will be measured in numbers.
Cost:

Cost of Scour Valves will include labour for installation, cost and conveyance of double flanged sluice valve, tangential tee on the main pipeline, duck foot bend, extension pipes, goose neck, protection against scouring at out let point, anchoring duck foot bend etc. complete, for the finished work. Manhole housing the valve will be measured separately.

8.20 ELSR and Sump

The execution work of ELSR and Sump shall conform to the following standards specifications and codes of practice of I.S.I.

IS: 456	Code of practice for plain and reinforced concrete (latest edition)
IS: 875	Code of practice for structural safety of building, loading standards (latest edition)
IS: 3370 Part I to IV	Code of practice for concrete structures for storage of liquids (latest edition)
IS: 1893	Criteria for Earth quake resistant Design of structures (latest edition)

10% the payment of ELSR /Sump shall not be payable till satisfactory water tightness test is given for all water retaining structures and till that work shall be treated as complete.

8.21 LIST OF MANDATORY TESTS

Following are the mandatory tests to be conducted at appropriate stages of the work

TABLE 8.17

Item	Test	Field / Laboratory test	Sample size
Pipes	Type tests and Acceptance tests	Laboratory Tests	As per relevant IS
Jointing materials	Acceptance tests	Laboratory Tests	- do -
Pipe lines	Pressure tests	Field hydraulic pressure Tests	- do -
Valves	Acceptance tests	Laboratory Tests	- do -
Water meters	Acceptance tests	Laboratory Tests	- do -

8.22 TRIAL RUN

The trial run shall consist of a period of three month of operation for complete jobs of water supply scheme. The contractor shall provide the skilled plant operator/pump operators, supervisors along with other service staffs for this duration of trial run after completion of the total work. The contractor's staffs shall train the staffs/persons nominated by the Engineer during this period. The contractor shall run the plant round the clock during this period and shall maintain a logbook to ascertain the quality and quantity of water, consumption of power and chemicals if any. Any shortcomings in quality quantity of water shall be corrected by the contractor adopting proper correction measures and as per direction of Engineer.

CHAPTER 9-ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS-ELECTRICAL WORKS.

1.0 GENERAL

1.1. The Electrical work will be carried out generally in accordance with the General Specifications for Electrical works Part – I, 2005 in Central Government buildings (CPWD) while complying in all respects with the requirement of the latest Indian Electricity Rules in force from time to time.

1.2. The Electrical work will be carried out simultaneously with the building work and will be continued till it is completed satisfactorily along with the completion of essential portions of Building work.

1.3. If any minor alterations are found necessary, the Contractor will have to do the same within the Tendered rates.

1.4. The work will be carried out in the best workmanlike manner and any defect in the work or changes in the design etc., if pointed out, shall be carried out by the contractor without any extra charge.

1.5. The contractor shall employ adequate labour to complete the work within the stipulated time and will make his own arrangement for housing labour and storage of materials &etc. A whole time Electrical Supervisor/Engineer shall be employed by the Contractor who will remain at site of work to receive orders or any other instructions from the Engineer-in- charge.

1.6. Any material supplied by the Employer if damaged, in any way during cartage or execution of work or otherwise, shall be made good by the contractor at his own cost.

1.7. During the progress of work, completed portions of the building may be occupied and put to use by the Employer but contractor will remain fully responsible for maintenance of the Electrical installations till the entire work covered by this contract is satisfactorily completed by him and taken over by the Employer.

1.1.1 SAMPLES

Samples will be submitted by the contractor according to the specifications / list of approve make. Any deviations from the specifications will have the written consent of the Client/Construction Manager and Engineer-in-charge.

1.1.2 PROGRESS AND TIME OF COMPLETION:

a) The work will commence immediately after the contractor receives instructions to proceed.
b) The contractor will work in cooperation with the building contractor and other contractors and shall arrange to place his conduits in the masonry and concrete work as the building or other work, Because of delay in laying of conduits or otherwise shall be the

responsibility of the Electrical contractor and will make him liable for damages, if any, by the Employer.

c) The contractor shall in consultation with the Engineer-in-charge/ Consultants draw up a time schedule on commencement of the work. This time schedule will be strictly adhered to.

1.1.3 COMPLETION TESTS:

On completion of the installations the following tests shall be carried out:-

1. Insulation resistance test.

2. Polarity test of switch.

3. Earth continuity test.

1. Insulation Resistance:

The insulation resistance will be measured by applying between earth and the whole system of conductors or any section thereof with all fuses in place and all switches closed, and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together, a direct current pressure provided that it need not exceed 500 volts for medium voltage circuit. Where the supply is derived from the three wire D.C. or a poly phase A.C. system, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all connectors connected to the neutral or to the other pole or phase conductors of the supply with all lamps in position and its value shall be not less than that specified in sub-clause below:

The insulation resistance in Mega ohms measured as above shall not be less than 50 Mega ohms divided by the number of outlets or when FR PVC insulated cables are used for wiring 12.5 Mega ohms divided by number of outlets.

Where a whole installation is being tested, a lower value than that given by the formula, subject to a minimum of Mega ohms is acceptable.

A preliminary and similar test may be made before lamps etc. are installed in this event the insulation resistance to earth should not be less than 100 Mega ohms divided by the number of outlets or when FR PVC insulated cables are used for wring 25 Mega ohms divided by the number of outlets.

The term “OUTLET” includes every point along with every switch except that a switch combined with a socket outlet, appliance of light fitting is regarded as one outlet. Control rheostat, heating and power appliances and electric signs may, if required, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or framework, and all live parts of each rheostat, appliance and sign, shall be not less than half a mega ohms.

2. Polarity test of switch:

a) In a two wire installation a test shall be made to verify that all switches in every circuit have been fitted in the same conductor throughout & such conductor shall be labeled or marked for connection to the phase conductor or to the non-earthed conductor of the supply.

b) In a three wire or four wire installation, a test shall be made to verify that every non- linked single pole switch is fitted in a conductor which is labeled or marked for connection to one of the phase conductor of the supply.

c) The installation shall be connected to the supply for testing. A test lamp, one lead of which is connected to earth, shall test the terminals of all switches. Glowing of test lamp to its full brilliance when the switch is in “ON” position irrespective of appliance in position or not shall indicate that the switch is connected to the right polarity.

3. Testing of earth continuity Path:

The earth continuity conductor including metal conduits and metallic envelops of cable in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance of earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one Ohm.

The contractor shall notify in writing to the Employer about the completion of the work, within 7 days from the date of this notification, the Engineer-in-charge shall send their representative to remain present at the time of carrying out of the tests by the Contractor. The contractor will fix up this date in consultation with the Employer/Client/Construction Manager s for such tests.

Should the above tests not comply with the limits & requirements as above the contractor shall rectify the faults until the required results are obtained.

The contractor shall be responsible for providing the necessary instruments and subsidiary earths for carrying out the tests. The Contractor without any extra charge will carry out the above tests.

1.1.4 DEFECTS LIABILITY PERIOD & MAINTENANCE:

The completed installation inclusive of wiring, light fittings, and fan shall not be final until the expiry of the defects liability period stated from taking over of Installations by the clients. During the period, the Contractor shall be liable for:-

a) The replacements of any defective parts that may develop in goods/items of his own manufacture or supplied by him.
b) The rectification of all the defects arising out of defective workmanship of the contractor.
c) Bringing to the notice of the Employer any defect arising in materials supplied by the Employer. The employer shall provide replacement of such materials.
d) Until the installation is finally taken over, the Contractor shall have the right of entry to the premises, at his own risk and expenses, for maintaining the installation in proper order. To facilitate maintenance the contractor should clearly indicate the detail distribution diagram on every switchgear, D.B., SDB, MBs, and Feeder Pillars etc.

1.1.5 POSITION OF LIGHTING & DISTRIBUTION BOARDS & SWITCHGEARS

a) The recommended positions of the lighting points control switches, distribution boards and switchgears etc., as shown on the layout drawings will be generally adhered to.

b) Should there be any discrepancy or incomplete description, ambiguity or omission in the drawings and other documents whether original or supplementary, forming the contract, completion or maintenance of the installation, the contractor shall immediately on discovering the same draw attention of the Employer.

c) Prior to the installation of lighting, fan and plug points and the distribution boards, switches etc., final positions shall be ascertained by the Contractor with the Employer.

d) The dimensions and other details of the electrical drawings shall be compared with the civil drawings at site before executions of the work.

1.1.6 PAINTING & MARKING

All exposed steel work not actually embedded in building construction (viz. conduits, junction boxes, switchboards DBs, MBs etc.) will be painted with one coat of primer and two coats of synthetic enamel paint to shades approved by the Employer/Client/Construction Manager . The paint will match the existing shades of walls wherever instructed. The contractor without extra charge will do this work. All

switchgears, MBs, SDBs and final DBs etc. shall be properly painted labeled and numbered as required by the Employer/Client/Construction Manager.

1.1.7 Wherever recessed fittings are required to be provided the Electrical Contractor shall be responsible for informing the building contractor to keep necessary recesses in the slab/false ceiling.

2.0 PANEL MAIN DISTRIBUTION BOARDS/ SUB DISTRIBUTION BOARDS

2.01 GENERAL

Main Distribution Board/ Sub Distribution Boards shall be metal clad totally enclosed, rigid floor mounted air insulated. Cubicle type for use on 415 volts, 3 phase, 50 cycle system. System shall be suitable for fault withstand capacity of 50KA RMS or as specified / Indicated in BOQ symmetrical Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

2.02 STANDARDS

2.02.1 The equipment shall be designed to conform to the requirements of:-

I. IS: 8623 -Factory Built Assemblies of switchgear and control gear
ii. IS: 4237 - General requirements for switchgear and control gear for voltages not exceeding 1000 volts.
iii. IS: 2147 - Degree of protection provided by enclosures for low voltage switchgear and control gear.
iv. IS: 375 - Marking and arrangement of bus bars.

2.02.2 Individual equipment housed in the Main Sub Distribution Board shall conform to the following IS Specifications.

I. Moulded case circuit breaker - IS 13947/I E-947.

ii. H.RC Fuse links - IS 2208-1962 or IS 9224-1979
iii. Current Transformers - IS 2705
iv. Voltage Transformers - IS 3156
v. Relays - IS 3231
vi. Indicating Instruments - IS 1248
vii. Integrating Instruments - IS 722
viii. Control switches & Push Buttons - IS 6875
ix. Auxiliary Contractors - IS 2959

2.03 CONSTRUCTION

All panels and Main Distribution / Sub Distribution Board shall be metal enclosed, indoor, floor mounted free standing type made up of the required vertical section, which when coupled together shall form continuous dead front Distribution Board. Main Distribution Board/ Sub Distribution Board shall be dust and damp protected. Panels & Main Distribution Board shall be extensible on both sides by the addition of side section after removal of end covers. Panels Main Distribution Board/ Sub Distribution Board shall be fabricated with a framed structure with rolled/ folded sheet steel channel section of minimum 3mm thickness, doors and covers shall be of minimum 2mm thick sheet steel shroud and partitions shall be of exterior of Main Distribution Board/ Sub Distribution shall be smoothly finished, leveled and free from flaws. The corners are to be rounded. Front and rear doors to be fitted with dust excluding neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured Between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearances to be maintained after taking into account connecting bolts, clamps etc.

I. Between phases - 32 mm
ii. Between phases and neutral - 26 mm
iii. Between phases and earth - 26 mm
iv. Between neutral and earth - 26 mm

All insulating materials used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as fuse switch/ fuse switch unit/ moulded case circuit breakers shall be arranged in multi-tier formation. The design of the Main Distribution Board/ Sub Distribution shall be such that each fuse switch/ switch fuse units/ MCCB shall be fully compartmentalised.

Insulated barriers shall be provided with in a vertical section and between adjacent sections to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/ covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access. The panel shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables. For each cable there shall be separate cable gland plate of detachable type at the bottom and/ or top of the panel as required. Gland plate shall be 3mm thick.

2.03 METAL TREATMENT & FINISH

All metal work used in the construction of the panels and main Distribution Board/ Sub Distribution Board should have undergone a rigorous metal treatment process as follows:-

I. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphate process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating. v. Drying with compressed air in a dust free atmosphere.
vi. Primer coating with two coats of a highly corrosion resistant primer, applied wet on wet and stove dried under strictly controlled conditions of temperature and time.
vii. A finishing coat of stoving synthetic enamel paint of gray colour.

2.04 BUSBARS.

The bus bars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of grade E-91E of IS-5082.

The bus bars shall be suitable braced with non-hygroscopic SMC supports to provide a through 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creep age distances shall be provided on the bus bar system to minimize possibilities of fault. The main phase bus bars shall have continuous current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity upto 200Amp. For higher capacities the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with FR PVC sleeves.

The Main Distribution Board /Sub Distribution Board shall be designed that the cables are not directly terminated on the terminals of switch fuse/ fuse switch/MCCB. but are terminated on cable termination links. Capacity of aluminum bus bars shall be considered as 1.0 Amp per sq.mm of cross section area of the bus bar.

2.06 MOULDED CASE CIRCUIT BREAKERS

2.06.1 GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Main/ sub distribution board wherever specified. MCCBs shall be suitable either for single phase AC 230 volts or there phase 415 volts.

2.06.2 FRAME SIZES

The MCCBs shall have the following frame sizes subject to meeting the fault level:

a. Up to 100A rating ..... 100A frame.
b. From 125 to 225 .....225A frame.
c. From 225 to 400 .....400A frame.
d. Above 400A .....600A frame.

2.06.3 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/ quick break, trip-free type. The operating handle shall have suitable `ON', `OFF' and `tripped' indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static type provided in each pole and connected by a common trip bars such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic or static tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contact tips shall be made of suitable air resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

2.06.4 TESTING

a) Original test certificate of the MCCB as per Indian Standard (IS) 315-C-8370 shall be furnished.

b) Pre-commissioning tests on the MV panel incorporating the MCCB shall be done as per standard.

2.07 MEASURING INSTRUMENTS FOR METERING

2.07.1 GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248.The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5.The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10oCto+50oC.All meters shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

2.07.2. AMMETERS.

Ammeters shall be moving iron or moving coil type. The moving part assembly shall be with jewel bearing. The jewel bearing shall be mounted on a spring to prevent damage to pivot due to vibrations and shocks, the ammeters shall be manufactured and calibrated as per the latest edition of IS: 1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The

scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

2.07.3 VOLTMETERS

Voltmeter shall be of moving iron or moving coil type. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

2.07.4 -Deleted

2.07.5. MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt, consumption, provided with series resistor where necessary, and with translucent lamps covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

2.07.6 CABLE TERMINATION.

Cable entries and terminals shall be provided in the Main/Sub distribution board to suit the number; type and size of aluminum conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working as the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rates short circuit currents without damage and without causing secondary faults.

2.07.7 CONTROL WIRING

All control wiring shall be carried out with 110/660 V grade single core FR PVC cable conforming to IS:694/ IS: 8130 potential standard copper conductors of minimum 1.5 sq.mm for potential circuits and 2.5 sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately by numbering ferrules at end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

2.07.8 TERMINAL BLOCKS

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminal. Terminal blocks shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

2.08 LABELS

Labels shall be anodized aluminum, with white engraving on black background. They shall be properly secured with fasteners.

2.09. TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted to the Project Manager.

2.10 TESTING AND COMMISSIONING

Commissioning checks and tests shall be including all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/ setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts. b) Interlocking function check.
c) Insulation test: when measured with 500V meggar, the insulation Resistance shall not be less than 100 mega ohms.
d) Trip tests & protection gear test.

3.00 DISTRIBUTION BOARDS

Distribution Board shall be double door type with extended loose wire box at the top and suitable for flush installation. All distribution boars shall be of three phase (415 Volts) or single phase (240 Volts) type with incoming isolator or MCB and / or ELCB as in Schedule of quantities. Distribution boards shall contain plug in or bolted type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick made & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS: 8828-1978. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Phase barrier shall be fitted and all live parts shall be screened from the front simple clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stoved enamel, colour light grey. A circuit identification card in clear plastic cover shall be provided for each distribution board.

3.01 Miniatrue Circuit Breakers for lighting circuits shall be of "B" series where as `C' series MCB's shall be invariably used for motor loads, halogen lamps fitting, sodium/ mercury discharge lamps and for all power circuits. All miniature circuit breakers shall be of 9KA rated rupturing capacity.

3**.01 EARTH LEAKAGE CIRCUIT BREAKER/ RESIDUAL CURRENT CIRCUIT BREAKERS.**
Earth leakage circuit breaker shall be current operated type and of 100 mA sensitivity unless otherwise stated. For single phase distribution. ELCB shall be housed within the DB box. For three phase distribution board, either the ELCB shall be housed in the same box or in a separate box & shall be width & depth of D.B. box. ELCB box shall be of same finish. Height of ELCB box shall be sufficient to accommodate ELCB & termination of incoming & outgoing wires.

4.00 FR PVC/GALVANISED CONDUIT AND WIRING SYSTEM

4.01 TYPE AND SIZE OF CONDUIT

All conduit pipes shall be ISI marked to medium grade./ solid drawn or reamed by welding finished with stove enameled surface (where called for Galvanized conduits shall be used for data cables etc, as per Schedule of quantities. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of FR PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used. FR PVC conduits shall confirm to ISI marked to medium grade. And all accessories and cementing etc. shall be as per manufacturers specification.

4.02 CONDUIT JOINTS

Conduit pipes shall be joined by means of threaded couplers and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories.

Cut ends of conduit pipe shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

4.03 PROTECTION AGAINST CONDENSATION

The layout of conduit should be such that any condensation or seating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

4.04 PAINTING OF CONDUIT AND ACCESSORIES

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted with two coats of approved enameled paint or aluminum paint as required to match the finish of surrounding wall, trusses etc.

4.05 FIXING OF CONDUITS

4.05.1 SURFACE CONDUIT

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one meter but on either side of the couplers or bends, similar fittings, saddles shall be fixed at a distance of
30cm formtthe centre of such fittings. The saddles should not be less than 24 gauge for conduits upto 25mm and not less than 20gauge for larger diameter conduits. The corresponding widths shall be 19mmx25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. The same shall be secured by means of special clamps made of MS. Where it is not possible to drill
holes in the trusses members suitable clamps with bolts and nuts shall be used.

For 25mm diameter conduit width of clip shall be 19mm and of 20 SWQG. For conduit of 32mm and above, width of clip shall be 25mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling framework or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-in-charge.

4.05.2 RECESS/ CONCEALED CONDUIT

The chase in the wall shall be neatly made and of ample dimension to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after creation of conduit. In case of exposed brick/ rubble masonry work special care shall taken to fix the conduit and accessories in the position along with the building work. Work of chasing the wall, fixing the conduit in chases and burying the conduit in mortar before plastering shall form part of point wiring work. The conduit pipe shall be fixed by means of stamples or by means of saddles not more than
60ccm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with treated with some approved preservative compound to secure protection against rust. Suitable periodical inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Where the length of conduit run is more than 10 meters, then circular junction box shall be provided.

4.06 OUTLET BOXES & COVERS

The switch box shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized mild steel. Upto 20x30cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20x30cm size shall be of 16 SWG. The metallic boxes shall be painted with anti-corrosive paint before erection. Clear depth of the box shall not be less than 60mm. All fitting shall be fitted in flush pattern. Phenolic laminated sheet of approved shade shall be used for switch box covers. These shall be of 3mm thick synthetic phenolic resin bonded laminated sheet as base material and confirm to grade P-1 OF IS 2036-1994.

4.07 SWITCHES

All 5/6 and 15/16 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on suitable modular plate cover. All 5/6 Amp socket shall be 3-pin type. All 15/16 Amp socket shall be 6-

pin type suitable for 15/16Amp. All switches sockets, telephone and TV outlets controlling the lights or fans shall be connected to the phase wire of the circuit.

4.08 FLUSH COVER PLATE

All switches, sockets, telephone and TV outlets etc. shall be fixed on deluxe plate cover suitable modular plate cover unless otherwise called for in drawings or BOQ. Flush cover plate shall be secured to the box with counter sunk brass screws & cup washers.

4.09 WALL SOCKET PLATE

All 6 and 16amp socket outlet shall be 3 and 6 pin respectively. Each outlet shall have a switch located beside the socket preferable on the same flush cover plate. The earth terminal of the socket shall be connected to the earth wire.

4.10 WIRING

All internal wiring shall be carried out with FR PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/ fan. A light/ fan switchboard may have more than on a circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point of in light/ fan switchboards. A separate earth wire shall be point wiring, Red colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FR PVC insulated wire for RYB phase wire respectively and black colour FR PVC insulated wire for the neutral wires. FR PVC insulated copper wire shall be used as Earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications mentioned above.

4.11 JOINTS

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

4.12 MAINS AND SUBMAINS

Mains and sub mains cable where called for shall be of the rated capacity and approved make. Every main and sub main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the submain & main cables. Cost of junction box/ drawn box is deemed to be included in the rates of submain wiring. A independent earth wire of proper rating shall be provided for every submain. Three-phase submain shall be provided with two-earth wire.

Where mains and Sub-mains cables are connected to the switchgear, sufficient extra lengths of submain and mains cable shall be provided to facilitate easy connections and maintenance for termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed. The submain wiring shall be inclusive of the termination with crimped cable sockets at both ends.

4.13 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

4.14 COLOUR CODE FOR CIRUIT & SUBMIAN WIRING

Colour code for circuit & submain installation shall be Red, Yellow, Blue for three phases. Black for neutral and green only for earth in case of insulated earth wire.

4.15 CLASSIFICATION OF POINTS

Wiring shall be carried out with following sizes of FR PVC insulated stranded single core copper conductor wire /cable.

i.	Light point	-	1.5 sq.mm
ii.	Ceiling/Cabin/Exhaust fan point	-	1.5 sq.mm
iii.	Call bell point	-	1.5 sq.mm
iv.	Plug Point (5 A.S.S. outlet)	-	4.0 sq.mm
v.	Circuit Wiring	-	2.5 sq.mm
vi.	General Power point	-	4.0 sq.mm
vii.	Power Point for A.C. Unit	-	6.0 sq.mm
viii.	Power point for Geyser, Drinking		

Water coolers & hand dryers - 4.0 sq.mm

4.16 TELEPHONE WIRE/ CABLES

Separate conduits shall be provided for internal telephone wiring of telephone system commencing from tag block. Each telephone outlet shall be wired with 2 pair telephone cable from the tag block. All telephone wires shall be of 0.5mm dia or as specified in BOQ annealed tinned high conductivity copper conductor FR PVC insulated & FR PVC sheathed grey conforming to ITD specification SWS 113 B & C. Multiplier FR PVC insulated cables laid in conduit shall be provided for connecting various tag blocks. Telephone cables used for external connections shall be armored. These cables shall be laid directly in ground or in pipe etc. as called for else where.

Following number of 2 pair wires/cables shall be drawn in various sizes of conduits as listed below.

20mm conduit - Upto 3 cables

25mm conduit - more than 3 upto 6 cable

4.17 Maximum number of wires that can be taken in any conduit shall be as per the Table given below:-

FR PVC INSULATED 650/110V GRADE ALUMINIUM/COPPER CONDUCTOR CABLE CONFORMING TO IS 694-1990

The columns headed `S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle or more than 15 degrees. The columns headed `B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

Conduit sizes are the nominal external diameters.

5.00 LIGHTING FIXTURE AND FANS

5.01 General

a) All Light fittings, Fans & Fixtures shall be subject to approval prior to its procurement. The contractor shall supply and install lighting fixtures including lamps, tubes starters, accessories fixing hardware necessary for installations, as shown on the Drawings as required and as herein specified.

b) All fixtures shall be delivered to the building complete with suspension accessories, canopies, hickeys casing, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes etc. all wired and assembled as indicated.

c) Full size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule shall be submitted to the Engineer for approval.

d) Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening.

e) Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the drawings.

f) Fixtures shall bear manufacture's name and the factory inspection label.

g) Fixtures shall be complete wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.
h) Relamping the fixture shall be possible without having to remove the fixture from its place. i) Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.

5.02 CONSTRUCTION

a)Fixtures shall be constructed of 0.5 mm thick steel minimum. If other metals are used they shall be of the required thickness to have at least the same mechanical strength. Cast portions of fixtures shall be not less than 1.5 mm thick.

b)Metal parts of the fixture, shall be completely free from burrs and tool marks. Solder shall not be used as a mechanical fastening device on any part of the fixture. Fixture joints shall be welded and ground smooth.

c)Fixtures with visible frame shall have concealed hinges and catches.

d) Recessed fixtures shall be constructed so as to fit into ceiling without distorting either the fixture or the ceiling. Plaster rings shall be provided for plaster ceilings. The Contractor shall coordinate the dimensions with the false ceiling tile dimensions.

e) Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining devices to prevent the diffuser from moving.

f) All plastic diffusers shall be of acrylic, unless otherwise noted.

g) Incandescent fixtures shall be equipped with prcelain medium base with nickel-plated shells.

h) Fluorescent fixtures shall be provided with white lamp holders.

i) Industrial type fluorescent fixtures shall have type lamp holders.

5.03 FINISH

a) All hardware shall be bonderised, cadmium plated, given a corrosion-resistant phosphate treatment of other approved rust inhibiting prime coat, to provided a rust proof base before application of finish. Finish shall be baked enamel.

b) Non-reflecting surfaces such as fixtures frames and trims, shall be finished with baked enamel paint, unless other-wise specified. The colour of the paint shall be as indicated on the Drawings or as directed later by the Engineer-in charge.

c) Light reflecting surfaces shall be finished with baked white enamel paint having 3 reflection factor of not less than 855.

d) All parts of the reflector shall be completely covered by the finish and free from irregularities.

e) Unpainted surfaces shall be finished with a clear lacquer except for anodized of "Azac" surfaces.

f)After finish has been applied and cured, it shall be capable of withstanding lcm radius bend without showing sings of cracking, peeling or loosening from the base metal.

g) Finish shall be capable of withstanding 72 hours exposure to an ultra-violet RS sun lamp placed 10cm from the surface without discoloration, hardening, or warping and shall retain the same reflection characteristics after exposure.

5.04 WIRING

a) Fluorescent fixtures shall be wired with not smaller than 1.5 sq.mm asbestos- covered wire.
No splice or tap shall be located within an arm, stem or chain. ire shall be continuous from splice in outlet box of the building wiring system to lamp socket or to ballast terminals.

b) Wiring within incandescent fixtures and for connection to the branch circuit wiring up to the outlet box of lighting point shall not be less than 1.5 sq.mm silicone rubber insulated wire. (150 Deg C temperature).

5.05 INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer.
Pendent fixtures within the same room or area shall be installed plumb and at uniform height from the finished floor. Adjustment of height shall be made during installation. Flush mounted recessed fixtures shall be installed so as to completely eliminate leakage of light within the fixtures and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud I the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with no-ferrous metal screws finished to match the fixtures.

5.06 LAMPS-GENERAL

Lamp shall be supplied and installed in all lighting fixtures listed in the Schedule of lighting Fixtures on the drawings.
Lamps used for temporary lighting service shall not be used in the final lamping of fixture units. Lamps for permanent installation shall not be placed in the fixtures, until so directed by the
Engineer-in-charge and this shall be accomplished directly before the building areas are ready for occupancy by the Client.

5.07 LAMPS-FLUORESCENT

Lamps shall be of hot electrodes, preheated, normal start type. Lamps shall have bi-pin bases and a minimum specified rated life.
Unless otherwise indicated on the Drawings, Lamps shall have the coluir rendering features and lumens/ watt output of lajps with WHITE colour designation as manufactured by OEM

5.08 LAMPS –INCANDESCENT

Incandescent lamps shall be inside frosted type. Lamps shall have minimum approximate rated life of 750 hours

5.09 BALLAST-FLUORESCENT

- Only single and / or two-lamp ballast shall used in any one fixture. Ballast shall conform to IS 1534 (Part-I) 1977.
- Ballasts shall be high power factor type.
- Ballasts shall have manufacturers lowest sound level ad case temperature rise rating. Ballasts shall be special cool operated type.
- Ballasts for indoor fixtures shall be protected by an integral thermal automatic resettling protective unit which shall disconnect the ballast in the event of overheating.
- Ballasts shall be of the same manufacture as the lamps.

5.10 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the Engineer. All un- operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer.

5.11 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/ roof member. Contractor to ensure that provision are kept at appropriate stage all locations shown on the drawing. Fan box with MS hook is to be provided by electrical contractor. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with standard regulator. Regulator shall be suitable for 240 volts A.c. volts A.C supply 50 Hz and shall be of continuous duty type.

5.12 EXHAUST FANS

Exhaust fans shall be heavy-duty type with double ball bearing & conforming to IS 23412-11967. Exhaust fan shall be complete with copper wound motor, capacitor, louvers/ shutter, frame & mounting bracket. Exhaust fan shall be suitable for operation on 240 volts single phase A.C. supply.

6.00 L.T. CABLES

6.01 GENERAL

LT Cables shall be supplied, inspected laid tested and commissioned in accordance with drawings specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing be strictly followed.

6.02 MATERIAL

The L.T.Cables shall be XLPE insulated FR PVC sheathed aluminium conductor armored cable conforming to IS: 7098 (part II) 1985. The cable shall be laid directly in ground, pipes, masonry ducts, cable tray surface of wall etc. as shown on drawings.

6.03 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

6.04 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoiding of cable joints. The apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

7.0 RISING MAINS

7.1The rising mains shall be supplied in convenient sections to suit the building to form a vertical straight run. Each section shall be provided with a number of wall straps preferably one meter apart for fixing the trunking to the wall. It should be provided with front and rear sheet steel cover plates so that it forms a totally enclosed vermin and dust proof metal clad construction of 1.6/2mm thick absolutely flat sheet steel, vermin proof breathers shall be provided in each section to dissipate heat, and to prevent any possibility of an electrical fault due to the presence of vermin.

i). Construction: The bus bars shall be made from rectangular section of high conductivity electrolytic grade aluminum. The current density in the bus bars shall not exceed 1.0 ampere / mm2. Neutral bar shall have cross section equal to phase bars. In each vertical run the bus bars shall rest rigidly on a thrust pad at the bottom thereby allowing expansion of the bars upwards. Suitable expansion joints shall be provided. Top of the mains shall be closed by a suitable blank end cover. It must be possible to extend the mains at a later date.

ii).Adapter boxes and tap off boxes shall be provided on rising main enclosure to tap TPN connections of ratings specified in schedule. These shall be without MCCB fitting and shall be provided with detachable

end plates with provision of rectangular holes for solid aluminum strip connections (insulated with colored insulating tape or strip to distinguish each strip) to I/C MCCBS fixed on rising mains.
iii).Wherever rising mains pass through floors, a fireproof barrier shall be provided.
Iv).Provision shall be made to ensure earth continuity between adjacent sections and for earthing the complete run of each rising main.
V).Ratings: The rising mains shall be of 400 amp standard ratings for normal supply Bus bars shall be individually insulated with red, yellow, blue and black insulating sleeves to indicate phased and neutral.
vi).Metal Treatment : The sheet steel parts shall be given a rigorous rust proofing treatment which shall comprise alkaline degreasing, descaling in dilute sulphuric acid and a phosphating process followed by two coats of filler oxide primer and one coat of paint of approved shade. Final coat of paint shall be applied just before erection.

7.2 ERECTION OF RISING MAINS

i).The rising main sections shall be thoroughly examined and cleaned before erection. The rising mains shall be erected in straight vertical line. Position of anchoring points on the wall shall be accurately marked and 10mm dia G.I rag bolts shall be grouted to a depth of 75mm into the wall. All nuts shall be G.I and hexagonal. Spring steel washer shall be fixed under each nut.

ii).All sections of the rising main shall be so fixed that there is no mechanical strain on them. Electric connection between bars and earth continuity of the enclosure shall be ensured between sections.

iii).Any damage to the bars or the enclosure / chamber of a section shall be made good to the entire satisfaction of consultant before such section is re-erected.

iv).The upper end of the rising mains shall be fixed with blanking off cap.

v).The adapter boxes to tap the rising mains shall be fixed so that contacts on the adapter make a sound connection with the bars, and adapter cover is intimately connected to the rising mains chamber to ensure earth continuity. The height at which adapters are fixed on the rising mains above the floor level shall be such that solid strip connections from adapters to I/C switch fuse units fixed on the rising mains are as direct and as short as possible subject to approval of the consultant.

vi).All steelwork shall be made rust free anti painted with two coats of oxide paint followed by two coats of enamel paint of approved shade.

8.0 UNDER GROUND L.T CABLES
8.1 GENERAL
MV cables shall be supplied inspected laid tested and commissioned in accordance With drawings, specifications, relevant Indian Standards Specifications and cable Manufacturer's instructions. The cable shall be delivered at site in original drums with Manufacturers name clearly written on the drum. The recommendation of the cable manufacturer with regard to joining and sealing shall be strictly followed.
8.2 MATERIAL
The MV cable shall be FR PVC insulated Aluminum conductor armored cable conforming to IS:1554–1988(Part–I) laid in trenches/ ducts as shown on drawings.
8.3 All cables shall be inspected upon receipt at site and checked for any damage during transit.
8.4 JOINTS IN CABLES
The contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of joining cables. This apportioning shall be got approved by the Client/Construction Manager before the cables are cut to lengths strait joints are prohibited.

8.5 LAYING CABLES
Cables shall be laid by skilled and experience workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks the drums shall be unrolled and cables run over wooden rollers in trenches at intervals no exceeding 2 meters. Cables shall be laid at depth of 0.7 meters below ground level. A cushion of sand, not less than 80mm shall be provided both above and below the cable and joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main. The cable shall first be laid in excavated trench

80mm layer of sand and shall be spread over the cable. The cable then shall be lifted and placed over the sand bed. The second layer of 80mm sand shall then be sprayed over the cable. The relative position f the cables, laid in the same trench shall be preserved and the cables shall not cross each other as far as possible at all changes in directions in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than 12 times the diameter of cable, minimum 3 meters long lop shall be provided at both sides of every straight joint and 3 meters at each end of cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colour shall be wrapped just below the sockets for phase identification.

8.6 PROTECTION OF CABLES

The cables shall be protected by bricks on the top layer of the sand for the full length of underground cable. Where more than one cable is running in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Running them through Hume Pipes of suitable size shall protect Cables under road crossings and any other places subject to heavy traffic. The depth of the Hume Pipe shall be 1 meter below the finished floor level

8.7 EXCAVATION AND BACK FILL

All excavation and back fill including timbering, shoring and pumping quired for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceed 150mm.Each layer shall be properly rammed and consolidated before laying the next layer. The contractor shall restore all surface, road ways, side walks, curbs, walls of other works cut by excavation to their original condition, satisfactory to the owner's representative.

8.8 TESTING OF CABLES

Prior of burying of cables, following tests shall be carried out :
a).Insulation test between phases and phase and earth for each length of cable before and after jointing.
On completion of cable laying work, the following test shall be conducted in the presence of the owner's representative.
a). Insulation resistance test (sectional and overall)
b). Continuity Resistance Test c). Sheathing continuity test
d). Earth test
All tests shall be carried out in accordance with relevant Indian Standard Code of Practice and Indian Electricity Rules. the contractor shall provide necessary instruments, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Client/Construction Manager / Consultant.

9.0 EARTHING

9.1 GENERAL

All the concurrent metal parts of electrical installation shall be earthed properly. All material conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to CPWD General Specifications for Earthing work shall conform to internal –
2005 and Indian Electricity Rules 1956 amended upto date and in the regulations of the local Electricity supply authority.

9.2 Earthing Conductor

Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward upto outlet points shall also be of bare copper. Earth continuity conductor connecting Man and Sub Distribution boards to earth electrode shall be with galvanized MS strip.

9.3 Sizing of earthing conductor

All fan regulator, 5 and 15 Amp outlet points, switch boxes shall be earthed with earth wire as specified in bills of quantities. Separate earth wire shall be drawn alongwith each circuit. From main/sub distribution board to distribution board, earth continuity conductor shall be as mentioned in bills of quantities. Single phase distribution boards shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors. Earthing of main switch board and sub- switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury and corrosion by providing GI pipe.
GI pipe shall be of medium class 40mm dia and 4.5 meter in length or as specified in bills of quantities. Galvanizing of the pipe shall conform to relevant Indian Standards.

GI pipe electrode shall be cut tapered at the bottom and provided with boles of 12mm dia drilled not less than 7.5cm from each other upto 2 meter of length from bottom. The
electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2 metres from the building. The location of the earth electrode will be such that the soil
has reasonable chance of remaining moist as far as possible. Masonry chamber of size
300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS
frame and cover having locking arrangement at the top.

9.4 Plate Earth electrode

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimension.

i). GI Plate electrode : 600mm x 600mm x 6mm thick
ii). Copper plate electrode : 600mmx600mmx 3mm thick

The electrode shall be made buried in ground with is faces vertical and not less Than 3 meters below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the Watering funnel attachment shall be housed in masonry enclosure of not less than 300x 300x300m deep. A cast iron or MS frame with cover having locking arrangement shall be provided at top of meters from the building care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building. In such cases electrode may be further away from the building.

9.5 Artificial Treatment of Soil

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance of earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulfate, salt and soft coke or charcoal in suitable proportions.

9.6 Resistance to earth

The resistance to earthing system shall not exceed 2 ohm

10.0 Drawing / Procurement & Inspection of Equipment

10.1 Based on the tender drawings and the equipment / scheme finally selected, the contractor shall supply layout, cable line diagrams etc. required for the satisfactory and complete installation of the total electrical power supply and distribution system as envisaged in the tender. Some of the important drawings / details to be submitted for approval are given below:

a). General arrangement drawings of switchgear, panels ducts etc.

b). Wiring diagram, schematic diagram sand control diagrams for equipment, Switchgear, PCC and the whole system. Schedule and termination details Shall also be provided.

c). Building plan, elevation / section and details including the layout of plant, equipment, switchgear, bus-ducts and related services like chimney, cooling systems, fuel handling system etc. with dimensions based on the equipment finally selected.

d). Details of all foundations, cable ducts, cable protections pipes and other civil works e). Complete schedule of LT cables and instrument/ control cables
f). Layout plan showing the co-ordinates routing for power cables, control / instrument cables and other cables as required, co-ordinated with other services like water supply line, drainage / sewerage line, fire lines, mechanical service pipe line etc. The sectional details, road-crossing details etc. shall also be given at different locations.

g). Technical catalogue for all equipment, switchgear, cables & material including a complete write up/details of operation, interlocks & controls etc.

i). Operation and maintenance manuals along with list of spare parts for all equipment. Switchgear cables and materials etc.

k). A detailed explanatory note giving the details of operational sequence, time period and safety aspects etc,

10.2 Procurement & Inspection of Equipment

Approved list of makes and vendors are given at Annexure 'A'. The ENC reserves the right to check and verify makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same all equipment's materials supplied shall be brand new and shall be procured directly from the manufacturers dealers or authorized agents. Engineer- In-charge shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, assembly testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded alongwith the call for carrying out the inspection at the manufacturer's work.

Based on the inspection certificate, Engineer- In-charge reserves the right to carry out the inspection at mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

CHAPTER-10- ROAD WORKS

A. Work shall be carried out as per the Ministry of Road Transport and Highways (MORT & H) Specification. Specification for Road and Bridges works (5th revision).

B. For items whose specifications are not given in MORT&H specifications for road and bridge works, then State PWD Specification, BIS specification or sound Engineering practice, as determined by the Engineer in that order should be followed.

C. Technical and General conditions given in document shall also be followed as particular specification certain conditions regarding street lighting shall also be followed.

TECHNICAL CONDITIONS

1. A register in prescribed form showing day to day receipt, consumption and balance of cement at site of work will be maintained at the work/test site by the department, which shall invariably be signed by the contractor or his authorized representative in token of its correctness.

2. A field lab, at his own cost will be established by the contractor at site of work and all the required equipment including cube testing machine of suitable quality **and consumable** shall be provided by the contractor as required for various quality control tests subject to approval of Engineer-in-charge. Nothing shall be payable to the contractor towards equipment/day to day expenditure. Technical staff will belong to the Deptt. and ministerial staff shall be supplied by him

3. Strict control on all operations of work shall be exercised to ensure that the work is of the proper as envisaged in the specifications and design. Although the tests to be performed for quality control and their minimum frequency will be in accordance with accepted norms, in which respect the MORT & H specifications for road and bridge works latest Edition will be referred to.

4. For testing of materials for bridge construction, relevant I.S specification shall be referred to and department will have the discretion to get the sample tested from the reputed testing Laboratory. Testing charges shall be borne by the agency.

5. For testing the strength of the finished products like cement concrete, masonry, bearing and also the workmanship to be ensured in the various construction works of bridges, reference shall be made to the relevant clauses of IRC bridges codes.

6. The frequency of testing shall generally conform to what has been stipulated in the codes, but this shall be increased beyond the stipulated minimum frequency, if frequent deficiencies in quality of works are noticed in particular location by the Engineer.

7. Proper and pucca reference pillars for fixing the longitudinal center line of the bridge and transverse center lines of the piers shall be made before starting the work. The main point about these reference pillars is that they shall be so located as not to be disturbed during construction or during floods and shall last till the work is completed.
8. To have proper control on the proportion of various aggregates of cement concrete mix, weight batching instead of volumetric batching shall be adopted.

9. Where the concrete has been specified in terms of strength, the concrete mix shall be specifically designed and contractor shall satisfy Engineer-in-charge through laboratory test results that the concrete is of specified strength and quality, ensuring at the same time that the concrete mix so designed is no leaner than a nominal mix, if same has been specified.

a. The job mix formula/Mix designed for CC work, etc. will be done from IIT/NIT/NABL Accredited Labs

10. The following basic records, in addition to what might be considered necessary, shall be kept at site and be made available to the inspecting officers.

a. Record of placement of concrete and test cubes shall be maintained in the following form:

Date	**Time of Start**	**Time of Completion**	**Unit/Member concreted**	**Bulking of sand if any**	**Extra sand used to take care of bulking**
1.	**2.**	**3.**	**4.**	**5.**	**6.**
Water Cement Ratio Mix 7.					
Water content of course aggregate	**Water contents of fine aggregate**	**Extra water added**	**Total water content**	**Water cement ratio**	
(i)	**(ii)**	**(iii)**	**(iv)**	**(v)**	
Slump of concrete	**Sources of supply of cement and batch No.**	**Whether the batch of cement tested or not**	**Identification number of concrete cube taken**	**7 days cube Strength as specified as per actual test**	
8.	**9.**	**10.**	**11.**	**12.**	
28 days cube Strength as specified / as per actual test	**Sign of J.E.**	**Sign of SDE**	**Sign of Contractor**	**Remarks of Engineer-in-Charge.**	
13.	**14.**	**15.**	**16.**	**17.**	

b. Record of test for controlling the quality of concrete such as grading, analysis of Aggregates, silt content of fine aggregates, water content of fine aggregates, water content of coarse aggregate etc.

c. Record of test results on samples of mild steel. For steel, high tensile steel.

d. Record of cement tests for different consignment/batches/sources of supply. e. CPM/PERT chart, original and as revised/updated.

MATERIALS AND WORKS TEST REGISTER.

1. A register on prescribed proforma showing test results of materials and work tests will be maintained at the site of work by the department and every entry there of, shall invariably be signed by the contractor or his authorized representatives in token of its correctness.

2. Concrete of any mix ordinary or controlled shall be regularly tested as per Indian Roads Congress (IRC) standard and only such concrete will be accepted which conforms to the standards laid down in IRC 21-2000 standard specifications and code or practice for roads and bridges. The concrete declared below standard by the Engineer shall be replaced by the contractor simultaneously taking care of safely and soundness of other members or adjoining part of the same member entirely at his own risk and cost.

3. Whenever test cubes are taken these should be suitably numbered and there should be corresponding markings on the individual components, or portions of the components to enable the identification of the unit from which the sample for test cubes was obtained. In this respect, for all the bridge works on the National Highways, a new register should be regularly entered. A span should be designate by mark 'S' and the number below it shall indicate the number of span and the beams should be designated by mark 'B' and should be numbered as 1,2,3 from the up-stream end. Thus the marking as S4, B3 will indicate that this pertains to the span No. 4 from left side while facing downstream side and beam No. 3 from the up-stream side. The cubes should also be serially numbered in the register.

4. The sampling of the concrete and testing of cubes should be done with the full knowledge of the contractor and the signatures of contractor or contractor's representative should be taken in the space specified for it.

5. Whenever the result of the cube tests carried out after three or seven days show a strength, which is not satisfactory, the Engineer of the bridge work should draw the attention of the contractor in writing to the possibility of the concrete not attaining the prescribed standards at the end of 28 days. He may also be warned not to proceed further with the work as the 28 days strength of concrete may show sub- standard results. Another notice should be given to the contractor if the prescribed standard strength has not been attained. The unit of which the sub-standard work forms part becomes liable to rejection.

6. When the cube tests persistently point to a concrete strength lower than that specified, a change in the proportions of concrete for subsequent batches must be given serious thought.

7. In case, however, the concrete strength falls below the required designed strength but its use can be permitted under IRC-21 -2000 of the IRC Bridge code section-iii, the unit may be accepted at the discretion of the Engineer and the information that it complies with the code should be placed on record in the remarks column of the register after obtaining the approval of the Superintending Engineer.

8. For all works concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working conditions and so maintained throughout the construction, Mixing shall be continued till materials are uniformly distributed & uniform colour of the entire mass is obtained and each individual particle of the course aggregates shows complete coating of mortar containing its proportionate amount of cement. In no case shall mixing be done for less than two minutes after all ingredients have been put into the mixer.

9. Works strength tests shall be made in accordance with IS-516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The samples of concrete shall be taken on each day of concreting and cubes shall be made at the rate of one for every 5 cubic meters of concrete or a part thereof, however, If concreting done in a day is less than 15 cubic meters the minimum numbers of cubes can be reduced to 6 with specific permission of the Engineer.

10. Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimen may be suitably increased as deemed necessary by the Engineer when procedure of tests given above reveals a poor quality of the concrete and in other special cases.

11. Acceptance criteria of the concrete will be as per the provisions of IRC 21-2000.

12. Design mix concrete shall be designed on the basis of preliminary test, in accordance with IRC

13. 21-2000. The proportions for ingredients chosen shall be such that concrete has adequate workability for the conditions prevailing of the work in question and can be shown to the satisfaction of the Engineer that supply of properly graded aggregate of uniform quality can be maintained till the completion of the work. Grading of aggregates in different sizes and blending them in the right proportions, as required **should be carried out**.

14. Steel reinforcement shall be protected at all times from injury when placed in work. It should be free from scale, paints, oil or other substance. All rust and scale, should be removed and cleaned by a satisfactory method to the approval of the Engineer. All steel reinforcement shall be accurately placed in position as shown in the drawings and firmly held during the placing and setting of the concrete. When splicing of reinforcement is necessary, the splices shall be staggered as far as possible subject to approval of Engineer-in-charge.The bars shall be lapped accurately in accordance with the codal provisions. Welding of reinforcement steel shall not be resorted to unless approved by the Engineer, in exceptional cases.

15. All material brought by the contractor to the site of work shall be open to suitable tests by the Engineer in accordance with the approved method. The contractor shall afford all such facilities as the Engineer may require for collecting and forwarding all such samples and shall hold the material represented by the sample until tests have been made and material found as per standard. The contractor will supply the material approved by the Engineer and the cost of testing charges will be borne by the agency.

16. The contractor shall supply to the Engineer concrete cubes free of cost and in sizes and quantity as provided for in IRC-21-2000 during the execution of the work. All expenses incurred in respect of preparation and testing of specimen, whether at the work site in the laboratory including carriage to and from etc shall be borne by the contractor.The samples will be taken by contractor in the presence of an authorized representative of the Engineer.

17. 43 grade O.P.C ISI marked cement approved by Engineer shall be used confirming to IS:8002

18. For reinforcement steel Fe-500 grade TMT Bars conforming to relevant IS code shall be used.

19. Agency will produce to the Engineer, the originals bills of cement and steel etc. in token of proof purchase of material along with quality control test certificate of manufactures.

20. Agency will get the material tested from any laboratory (approved) as directed and whenever required by Engineer and all liability of testing shall be borne by the agency.

21. Bitumen, Cement and steel shall be arranged by the agency.

ADDITIONAL CONDITIONS

1. Before laying any construction layer of GSB, sub grade or base course, earth work on berms, if it is to be done by the agency against this agreement, should be completed in all respect simultaneously. Before taking work of any next layer, earth work on berms should be completed. Payment of any layer will be released only when earth work on berms are completed.
2. No compensation for any damages caused to the earthwork by rains, floods or any other natural calamities shall be paid to the contractor. The contractor shall have to make good all such damages at his own cost as per direction of Engineer.
3. The final payment of the tenderer will not be paid until and unless he furnishes to the satisfaction of the Engineer, proof from revenue authority that the price of earth used for the work having been fully paid to the owner of the land from which the earth was removed by the contractor from his (owner) land for the work and to indemnify against all the losses, damages, cost of land expenses which the Govt. suffer or incur as a result of such claim.
4. The earthwork has to be carried out in continuous stretches according to the directions of the Engineer.
5. Level should be taken and entered in measurement book before commencing the work at an interval not exceeding 15 meters and after finishing the work complete in all respect as per MORT&H specification. The finished work will be checked longitudinally as well as in cross section for computing the quantity of earth work as per Clause No. 113.3 of MORT&H (road wing) specification (4th revision) or 2001/latest edition
6. The contractor shall make arrangement at his own cost for at least two numbers of modern leveling instruments (wild type) for the purpose of carrying out leveling operation failing which the same shall be arranged by the Engineer at his risk and cost.
7. The agency to whom the work is allotted will have to produce original vouchers for all quantities in lieu of purchase of bitumen from refinery, steel, cement and bricks from the original manufacturer or other authorized dealers / distributors to

the entire satisfaction of the Engineer for ascertaining the genuineness of material. Attested copy of voucher will have to be submitted along with bills.

8. In case of embankment with Fly Ash, the contractor shall take special care to keep the surface wet at all times so that the Fly Ash does not get mixed up with the atmosphere thus causing poor visibility besides health hazards. If the contractor does not comply with this provision, the Engineer shall make necessary arrangement after giving appropriate notice to the contractor, for keeping the fly ash surface wet and the contractor shall pay the expenses incurred on demand or otherwise the same shall be recovered by Engineer from bills due to the contractor.

ADDITIONAL CONDITIONS FOR BITUMINOUS WORK

1. The contractor will quote the rate of Bitumen Macadam item with 3.4% of Bitumen contents for upto 75mm thick and 3.3% for 80mm to 100mm thick by weight of total mixture. Nothing extra will be paid if Job Mix formula warrants more bitumen contents. If density as per Job Mix formula comes out to be less than 2.2gm/CC, rate will reduce accordingly & if is more than 2.2gm/CC nothing extra will be paid.

2. The contract unit rate for SDBC item shall be as specified in Clause 507.9 of MoRT&H specification (4th revision), except that the rate shall include the provision of bitumen @ 5.0 percent, by weight of total mixture. Nothing extra will be paid if job mix formula warrants more bitumen contents. If density was per Job Mix formula comes out to be less than 2.29gm/CC, rate will reduced accordingly & if is more than 2.29gm/CC nothing extra will be paid.

3. The contract unit rate for DBM item shall be as specified in Clause 505.9 except that the rate shall include the provision of bitumen content @ 4% for 75mm to 100mm thick DBM and 4.5% upto 75mm thick by weight of total mixture. Nothing extra will be paid if job mix formula warrants more bitumen contents. If density as per job mix formula comes out to be less than 2.30 gm/CC, rate will be reduced accordingly and if it is more than 2.30 gm/CC nothing extra will be paid.

4. The contract unit rate for BC item shall be as specified in Clause 507.9 of MoRT&H specification (5th revision), except that the rate shall include the provision of bitumen @ 5.4 percent for 30-40mm thick and 5.2% for 50mm thick, by weight of total mixture Nothing extra will be paid if job mix formula warrants more bitumen contents. If density as per job mix formula comes out to be less 2.30 gm/CC, rate will be reduced accordingly and if it is more than 2.30 gm/CC nothing extra will be paid.

5. The agency to whom the work is allotted will have to produce original vouchers for all quantities in lieu of purchase of bitumen from refinery steel, cement, and bricks from the original manufacturer or other authorized dealers/distributors to the entire satisfaction of the Engineer for ascertaining the genuineness of material. Attested copy of voucher will have to be submitted along with bills.

6. The documentary proof of procurement of bitumen from refinery as per requirement prescribed in the MORT&H specification/technical note of MORT&H and IRC special publication No. 53 from the reputed source and test result from CRRI will be produced by the agency.

7. The Job mix formula will be got tested IIT/NIT/NABL Accredited Testing Labs and testing charges will be borne by the agency. Nothing shall be paid on this account.

8. After filling the depression of the existing road surface and before applying tack coat, the existing levels of the road, surface and after construction shall be taken jointly by the authorized representative of the contractor and Engineer at grid of point at 10 mtrs. Centre to centre longitudinally in straight reaches but5 meter at curves as per Clause No. 113.3 of MORT&H specification. The cubic contents of the mix laid compacted and finished shall be computed on the basis of the initial and final levels as per formula approved by the Engineer.

   The contractor shall provide, install, maintain and operate at his own cost in good working condition a weigh bridge of suitable capacity at site of the hot mix plant under the direction of Engineer or his representative.

   Each truck before loading of the mix shall be weighted on the weigh bridge and its weight shall be recorded in the measurement book under the signature of authorized representative of the contractor and of the Engineer. The truck shall be again be weighed on the weight bridge after loading of the mix and its weight recorded as per prescribed proforma.

   The volume shall then the worked out by dividing the weight of the mix laid on particular stretch of the road with average field density of the very particular stretch. For this purpose the average density for the stretch shall determined by the actual determination of field density by core cutter method. The test will be carried out at the rate of minimum of one test per 700 sqm area as prescribed in MORT&H specification.

For purpose of payment, volume worked out by actual levels as laid down in para 8 (a) and determination of volume by density methods as per Para (b) and theoretical volume with designated thickness and area will be considered and the lowest value of the three shall be shall be adopted.

In case the contractor/Engineer feels that there are substantial undulation at site and additional material is to be consumed on account of this and if there is a provision in the estimate undulation/leveling course, the contractor will submit a case/claim to the Engineer with for full justification along with supporting data i.e. leveling/surveying done at site etc. before execution and Engineer will get the same approved from Employer before execution.

9. Unloading of bitumen at plant site will be done in the presence of representative of Engineer. The day to day receipt and issue account of bitumen shall be maintained by the representative of Engineer and signed daily by the contractor or his authorized representative on the performa appearing on subsequent pages.

10. The Hot Mix Plant will be so located subject to the approval of the Engineer involving such lead in transportation of the mix so as to avoid its segregation and temperature drop beyond specified limits. The maximum lead should not be more than 25 km.

11. The contractor shall carry out the survey of existing road and submit the proposal for improvement of riding quality including the existing level and final level at his own cost and shall get it approved from the concerned Superintending Engineer in writing before commencing the work.

12. When the work under one agreement is being executed, the contractor shall not undertake any other work from same hot mix plant without written permission of the Engineer and shall also make separate arrangement of bitumen for that work.

PEB WORK

BASIC BUILDINGS DESCRIPTION :

Sr. No.	Primary Processing Centre	
1	Frame type	Clear –rigid frame
2	Width	As per Drawing
3	Length	As per Drawing
4	Eave height	As per Drawing
5	Bay spacing	As per Tender Drawing
6	Bracing	CROSS ROD BRACING + PORTAL BRACING
7	Roof Sheeting	Supply, fabricate and erect roofing with galvanized sheet(pre-painted AL-Zn alloy colour coated steel)(0.5mmTCT) flashing with profiled support system including fixtures and fastenings as per drawing and specifications
8	Wall cladding	Supply, fabricate and erect roofing with galvanized sheet(pre-painted AL-Zn alloy colour coated steel)(0.5mmTCT) flashing with profiled support system including fixtures and fastenings as per drawing and specifications
9	Insulation	Fibreglass insulation having thickness 50 mm with MS wire mesh facing reinforced aluminium foil having density 16 Kg/Cu.m
11	Turbo Ventilators	600mm. Dia, stainless steel with ball bearing
13	Cage ladder	2 No.
14	Roll up door Manual	As per Drawing
15	Load Considerations	The load considerations of the Refrigeration components, hanging loads, docks, all other applicable loads are also to be considered.
16	Minimum Structural Steel	40 MT (Bidder must design the PEB with all applicable, vet and submit the PEB design after successful vetting)

*For further detail kindly refer the Tender drawings.

- Profiled Eaves Gutters shall be Considered
- Downspouts shall be Considered, up to FFL
- Column & roofing structure so designed shall not allow pigeon sitting (to avoid Pigeon / Birds habitation.)
- Painting Includes Two coats of synthetic enamel on site & one coat red oxide at factory to all primary & secondary members.
- Cage ladder with a small platform at top to go up to the roof for maintenance.
- All structural steel members shall be made free from rust, grease / grime, welding wastes, sharp edges using polishing & shot blasting and immediately spray painted using one coat of zinc chromites antirust primer and Two coats of synthetic enamel oil paint It shall be the responsibility of the contractor to get the shade of paint approved from employer at appropriate time.
- Spacing of purlins to support Roofing sheets shall not be more than 1.2m c/c
- Gutters, gable ,corner flashing shall be profiled and adequately sized, box shaped and shall be made out of 26 G profiled colour coated galvanized steel.
- Bidders to provide option of using screw less, continuous, joint less, crimping type sheeting.

- **SPECIFICATION OF MATERIALS**
- Built Up Members: Grade 50 confirming to ASTM A572 materials having min. yield stress of 345N/mm2.
- HOT ROLLED Members: IS 2062 Grade A.
- Web to flange welds of Built Up members are Single side fillet welds by continuous automatic
- SAW process, unless noted otherwise except for crane beams(Double side weld)
- All primary members shall have at least one welded splice.
- Secondary: Light gauge cold formed sections having min. yield stress of 345 N/mm2 .
- Anchor bolts, Brace or Sag Rods: Material having min. yield stress of 240 N/mm2..
- Bolts and Nuts : High tensile conforming to ASTM A-325M for primaries and ordinary ASTM A307M for Secondary.
- Sheeting conforming to ASTM A792M (or) AS1397, Coating AZ150.For Trapezoidal Y.S 550 N/MM2,
- **Primary Built up members :**
- Cleaning: Sweep Blasting
- Primer: 1 coat of Red Oxide DFT 30 microns
- The Anchor Bolts shall be Black Steel.
- Secondary Cold Formed members shall be 120GSM
- **ROOF SHEETING**

  single skin Galvalume 26g painted Galvalume
- **WALL SHEETING**
- single skin Galvalume 26g painted (STD Color)
- Insulation Fibreglass 50mm thk. 16 Kg/m3 density with Aluminium facing for roof area.

1. BUILDING ADDITIONS: NA

2. STANDARD PRODUCT SPECIFICATIONS

A Standard System shall be made up of primary members, secondary members, connections, roof sheeting, wall sheeting, sheeting fasteners, sealer, closures, ridge caps, flashing and trim, gutters and downspouts.

PRIMARY MEMBERS:

Primary structural framing shall include the transverse rigid frames, lean-to-rafters and columns, canopy rafters, interior columns (beam and column frames), bearing frame rafters and corner columns and end wall wind columns.

SECONDARY MEMBERS:

Secondary structural framing shall include the purlins, girts, eave struts, wind bracing, flange bracing, base angles, clips and other miscellaneous structural parts.

PAINT OF STRUCTURAL MEMBERS:

All structural members shall be cleaned by wire brushing to remove dirt, grease, oil and loose mill scale and given one shop coat of red oxide, air drying & two coats of synthetic enamel on site.

CONNECTIONS:

All field connections shall be bolted (Unless otherwise noted). Primary bolted connections shall be furnished with high strength bolts conforming to the physical specifications of ASTM A325 (or equivalent). Secondary bolted connections shall be furnished with machine bolts

PHYSICAL SPECIFICATIONS OF STRUCTURAL MEMBERS:

Members fabricated from plate or bar stock shall have flanges and webs joined on one side of the web by a continuous welding process and will conform to the physical specifications of ASTM A 570 (Grade 50) or equivalent and having a minimum yield strength of 50,000 P.S.I. (345 MPa). Members fabricated by cold forming process shall conform to the physical specifications of ASTM A570 (Grade 50) or equivalent and having a minimum yield strength of 50,000 P.S.I (345 MPa). Members fabricated from hot rolled structural shapes shall conform to the physical specifications of ASTM A572 (Grade 36) or equivalent and having a minimum yield strength of 36,000 P.S.I. (250 MPa). Rod and angle bracing shall conform to the physical specifications of ASTM A36 (or equivalent) and having a minimum yield strength of 36,000 P.S.I. (250 MPa). Roof and wall cladding shall conform to the physical specifications of ASTM A 653 (or equivalent) and having a minimum yield strength of 50,000 P.S.I. (345 MPa). All other miscellaneous secondary members shall have minimum yield strength of 36,000 P.S.I. (250 MPa).

ROOF SHEETING / WALL SHEETING :

BASE METAL:
Providing and fixing trapezoidal profile sheeting having high crest height of 28mm at 196mm c/c with a cover width of 980mm. In between the two crests there are two additional small ribs to provide extra strength to the sheet. The side lap is provided with anti-siphoning flute for perfect water tightness.
The base steel shall be Bare / Colour coated Galvalume / Zincalume steel, made out of 0.50mm TCT (Total Coated Thickness) having tensile strength of 550mpa. The steel will have a metallurgical coating of 150gsm of aluminium and zinc alloy (both sides inclusive) comprising of 55% aluminium + 43.5% zinc + 1.5% silicon as per ASTM A-446 Grade E / ASTM A-792 OR AS: 397.
The profiled sheets shall be supplied up to 12 Mt long in single sheet to minimize the longitudinal joints.

COLOUR COATING :
The organic coating will consist of 20 - 25 microns of Silicon Modified Polyester / Super polyester paint inclusive of 5 - 7 microns of corrosion inhibiting primer. The reverse side will be as per manufacturer's standard backer coat.

SHEETING FASTENERS :

Standard fasteners shall be No. 14, Type A, self tapping sheet metal screws with metal and neoprene washers. All screws shall have hexagonal heads and made of zinc plated steel.
Fasteners to be used will be self-drilling self- tapping type of the best quality as per AS-3566 Class 3 approved, which should compatible to be used with Galvalume / Zincalume steel sheets.

SEALER / ROPE SEAL :

This is to be applied around Skylights and self flashing windows. Sealer shall be 6mm wide x 5mm thick, asbestos fiber filled pressure sensitive Butyl tape. The sealer shall be non asphaltic, non shrinking non drying and non toxic and shall have superior adhesion to metals, plastics and painted surfaces at temperatures from - 51 deg.'C' to + 104 deg. 'C'.

CLOSURES / FILLER STRIPS :

Solid or closed cell E.T.P. (Ethylene Polypropylene Terpolymer) closures matching the profile of the panel shall be installed along the eaves, rake and other locations specified on LCPL drawings.

RIDGE CAP:

A formed panel matching the material color, slope and profile of adjoining Kolor Metal roof panels.

FLASHING AND TRIM :

Flashing and/or trim shall be furnished at the rake, corners, and eaves, framed openings and wherever necessary to provide weather tightness and finished appearance. Color shall be white for rake and eave flashings and color of wall for corner flashings unless otherwise specified by client. Material shall be 26 G thick conforming to the physical specifications of ASTM A446 Grade C or equivalent and having minimum yield strength of 36,000 P.S.I. (265 MPa).
These shall be formed out of the same substrate and corresponding thickness as that of the roofing / cladding sheets and shall be supplied in standard lengths of 2.5mm or as directed in the required shapes and girths and fixed by means of hex-head mechanically galvanized stitching screws with EPDM washers.

EAVE GUTTERS AND DOWNSPOUTS:

Eave gutters shall be box shaped, color coated, and 0.5mm nominal thickness (26 gauges) galvanized steel. The outside face of the gutter shall be supported with color coated 0.5mm nominal thickness (26 gauges) galvanized straps to the eave member at a maximum spacing of 3m. Downspouts shall be rectangular shaped, color coated 0.5mm nominal thickness (26 gauges) galvanized steel. Downspouts shall have a 45 degree elbow at the bottom and shall be supported by attachment to the wall covering at 3.0m maximum spacing.

STRUCTURAL FASTENERS:

Primary structural connections are made with electro galvanized (silver) high strength bolts Gr. 8.8 steel conforming to IS 3757. Purlins & girts are connected to their supporting members by machine bolts Gr. 4.6 steel conforming to IS 1363 electro-galvanized (yellow). Anchor bolts are made of rods conforming to ASTM F1554 with minimum yield strength of 250 MPa. Roof & wall panels are fastened by No. 12 carbon steel self-drilling screws hot-dip galvanized with polymer coated finish with an integral washer head to which an EPDM Elastomeric layer is bonded.

POLYCARBONATE SHEET.

• Impact Strength

The impact strength of solid PC sheet is 200 times that of glass.

• Light Weight
the weight of solid PC sheet is only about half of glass, and the weight of hollow PC sheet is only about one twelfth at the same thickness.

• Transparency
The light transmission of 3mm solid PC sheet is 88%, and the light transmission of 6mm hollow PC sheet is 80%.

• UV-Protection
PC sheet is co-extruded with a high-density ultra violet ray absorbent to fight against ultra violet ray, while keeping the PC sheet from decoloring.

• Resistance to weather
PC sheet have good weather ability, it can maintain excellent properties in a wide temperature range from -40°C to +120°C.

• Inhibiting Condensation
When outdoor temperature is 0°C, indoor temperature is 23°C, PC sheet will not get condensation even with relative humidity as high as 80%.
• Thermal Insulation.
The K-value of glass is 1.2 times that of solid PC sheet and is 1.7 times that of hollow pc sheet. So PC sheet can prevent heat loss and save more energy.

• Sound insulation.
The hollow from and polycarbonate resin offer significant advantage to the sound insulation.

• Flame Resistance.
Through testing by National Center for Quality Supervision & Testing of Fire Building Materials, each behavior of the material conforms to the standard of difficult-flammability material. PC sheet is rated Class B1 according to QB8624-1997.

• Easy Installation
PC sheet can be bent while hot or cold. It is possible to construct curved roofs and windows. The minimum radius of curvature of PC sheet is 175 times of its thickness.

• Technical data:

Impact strength (J/m): 850
Light transmission (%): 88
Specific gravity (g/cm3): 1.2
Coefficient of thermal expansion (mm/moC): 0.065
Servide temperature (°C): -40°C to +120°C
Heat conductivity (W/m2oC): 2.3-3.9
Tensile strength (N/mm2): ≥60
Flexural strength (N/mm2): 100
Modulus of elasticity (Mpa): 2400
Tensile street at break (Mpa): ≥65
Elongation at break (%): >100
Specific heat (KJ/kg•K): 1.17
Heat deflection temperature (°C): 140
Effect of soundproof (10mm hollow): decay 20db

3. List of Approved Makes

A Structural

Steel Authority of India.
Essar Steel
TISCO
Jindal

B Paint

Asian Paints
Berger Paints
ICI Paints/ICI India Ltd.
Shalimar Paints
Nerolac Paints

C Welding Consumable

Advani Oerlikon Ltd
Essab
D&H

D Polycarbonate sheet

GE
Jindal

E Galvalume sheet

JSW Steel
TATA Bluescope
Bhushan Steel Ltd.
Steel Authority of India Ltd.

Manufacturers Test Reports for Structural Steel, Radiographic/Utrasonic Test reports for welded joints, Paint Quality Test, Roofing & Cladding Galvalume Sheets, Turbo ventilators to be submitted along with the materials while procuring on construction site.

SPECIAL SPECIFICATIONS

CONTENTS

1.1 SITE OFFICE FOR THE ENGINEER

1.1.1 Provision of Site Office

The successful Tenderer is to provide and maintain a site office at a location approved by the Engineer / Construction Manager in consultation with the Employer, within 15 days from the date of issue of Notice to Proceed.

1.1.2 Furnishing of the Site Office for the Engineer

A separate Engineers office as specified in the contract data shall be provided. This Engineers office shall be of standard quality and furnished. The maintenance of this Engineers office is also the responsibility of contractor. If the same is not handed over a penalty amount of Rs. 5000 may be deducted from Contractor's Bill.

1.1.3 Surveying Equipment

1.1.3.1 The Contractor shall provide at the site, at his own expense, set of surveying and measuring equipments as specified in the contract data. The set shall be used by the Contractor for requirement at site and also shall be made available from the commencement of contract for the use of the Engineer's Representative. The set shall consist of the following instruments:

1.1.3.2 All equipment shall be supplied with their tripods, staff and such other equipment/item as the Engineer's Representative may require for the measuring, or setting -out of the work.

1.1.3.3 The Contractor shall be solely responsible for the maintenance of all such instruments and equipment and shall ensure they are, at all times, in good repair and adjustment. All equipment other than expendable items shall revert to the Contractor upon completion of the works.

1.1.3.4 The Contractor shall provide the Engineer, throughout the Contract period, with all necessary assistants and chainmen to assist with surveying work. The assistant shall keep the survey equipment in good order.

1.2 LABORATORY AND LABORATORY TESTING

1.2.1 Description

1.2.1.1 Testing of materials and completed work shall be carried out by a site laboratory established and allocated exclusively for that purpose, all testing shall be carried out under the direction and supervision of the Engineer's staff. All tests shall be performed in strict accordance with the appropriate Indian Standards or other standards as approved by the Engineer.

1.2.1.2 Any testing relating to the Works as required by the Engineer which cannot be carried out in the site laboratory shall be carried out at the Contractor's expense, at an independent laboratory approved by the Engineer.

1.2.1.3 The provision of laboratory facilities on site, as specified, shall in no way relieve Contractor of the responsibility for providing additional laboratory space and testing equipment as necessary in order to control materials at mixing plants and elsewhere and enable him to fulfil his obligations under the Contract.

1.2.1.4 If for any verson a laboratory cannot be setup at site, all the tests shall be got done in a laboratory approved by the Engineer.

1.2.2 Laboratory Building

1.2.2.1 The Contractor shall provide, furnish, equip, keep clean and maintain to the satisfaction of the Engineer a laboratory building of a floor area not less than 30sq.m. The building shall be provided with electrical power, potable water, drainage, and shall have adequate daylight and artificial lighting.

1.2.2.2 The Laboratory shall be adequately staffed by the contractor with materials technicians and assistants in the numbers deemed necessary by the Engineer so that no interruption of unnecessary delay shall occur to construction activities due to delays in sampling or testing, in-site or in the laboratory, as

required by the Contract. The testing equipment provided in the laboratory shall be sufficient but not limited to carry out the following tests;

(a) modified Proctor compaction tests

(b) Field Density tests using core cutter and sand replacement methods

(c) Crushing strength of 150mm size concrete cubes.

(d) Sieve analysis

(e) Slump tests

The Contractor shall, at the Commencement of the Contract, submit a detailed list of the equipment he is proposing to provide showing for each item its type and model, serial number, manufacturer's name and year of manufacture for the Engineer's approval.

The testing of the works by the Engineer, in no way, absolves the Contractor from his responsibilities to carry out his own testing of the quality of his works and the materials used.

1.2.2.3 The laboratory building and equipment shall be used exclusively for the purposes for which they are intended and shall, together with all equipment, all samples and records, be open to inspection by the Engineer during all working hours.

1.2.2.4 The laboratory shall be fully operational within 15 days of commencement of Contract and remain so until all work in the opinion of the Engineer is complete. A sum of Rs. 5000/ day will be deducted from the money due to the Contractor for each day over the 15 day limit, for failure on the part of the Contractor to provide the laboratory to the Engineer's satisfaction. At the end of Construction the laboratory building with furniture and equipment shall revert to the Contractor. The laboratory shall not, however, be removed from site without the prior consent of the Engineer.

1.2.2.5 If in case the tests are to be done in an approved laboratory, such an approval shall be obtained from the Engineer within 15 days of commencement of Contract; in such cases the Clause 1.2.2.4 will not apply.

1.2.2.6 2 Vernier Callipers and 2 Screw Gauges having 0.01 mm least count shall be made always available at site by the Contractor

1.2.2.7 After removal of the laboratory the Contractor shall clean and level the site removing all foundations, drain water pipes and other services installed for the laboratory and return the ground to its original condition.

1.2.3 Contractor's Senior Materials Technician

1.2.3.1 The Contractor shall provide a full-time senior materials technician to be responsible for the day-to-day activities of the laboratory and for site testing. He shall be directly and solely responsible to the Engineer or designated members of his staff. The senior materials technician shall have not less than ten years experience of the testing of earthworks and pavement materials and their construction, including asphalt concrete, and of concrete for structures, and shall be fully converse with the testing of materials as per latest Indian Standards. The experience and qualifications of the senior materials technician shall be to the approval of the Engineer.

1.2.4 Sample

1.2.4.1 The Contractor shall submit samples of all materials and goods for inclusion in the works to the Engineer and only those approved by the Engineer and to the standards specified elsewhere in the Contract may be ordered for supply. Samples shall be submitted promptly in order not to delay the works.

All work executed shall be of equal standard in all respects to the approved samples and the Engineer may reject any work which, in his opinion, does not comply with the approved samples.

1.3 SITE SURVEYS, SETTING OUT AND DESIGN DETAILING

1.3.1 Description

The Contractor shall be responsible for the true and proper setting-out of the works in relation to the lines and levels of reference given by the Engineer or shown on the Drawings and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour used in connection therewith.

He shall carry out a detailed survey of the site in advance of his commencement of Construction work, and shall supply full details to the Engineer as specified in the following sub clauses.

All setting out and levelling shall be based on permanent Benchmarks obtained from the Local Authority.

1.3.2 Existing levels and Layouts

1.3.2.1 Before commencing operations of any section of the works, the Contractor shall survey all existing detail in that section, in plan and in level and shall plot the results in such detail and to such scales as shall be to the satisfaction of the Engineer. These survey plots shall be supplied to the Engineer at least two weeks in advance of the search for services specified in the specification and, in any event, at least four weeks before the intended commencement of construction on the section. Unless otherwise instructed by the Engineer the detailed survey plots will be supplied in 1:200 scale and printed on high quality transparent draughting medium as approved by the Engineer.

1.3.2.2 In addition to the requirements of Sub - clause 1.3.2.1 above, horizontal control lines shall be marked out by pegs at intervals of not more than 20m and the lines traversed with theodolite by steel band or by any other method acceptable to the Engineer. The alignments established shall be referenced by pegs offset at suitable distance on each side of the horizontal control lines. These offset pegs shall be painted in a conspicuous colour.

1.3.2.3 Cross sections of the existing ground and of the ground after completion of earthworks shall be taken at intervals not exceeding 20m along the horizontal control lines in an approved and acceptable manner.

1.3.3 Bench Marks and Survey Points

1.3.3.1 As the work proceeds, the contractor shall establish, at suitable location, substantial permanent benchmarks, clear of the works, from which, all subsequent setting out and levelling shall be carried out. The location of the benchmarks shall be agreed with the Engineer before they are established.

1.3.3.2 Benchmarks shall be constructed in class 20/20 concrete, with minimum dimensions of 0.3m x 0.3m, the upper surface being approximately 50mm above ground level. A 20mm diameter mild steel rod, not less than 300mm in length, shall be cast into the concrete so that it projects about 10mm above the centre of the surface of the concrete. The concrete surface shall be clearly engraved with the reference number of the benchmark. The co-ordinates and level of each benchmark shall be determined in metres to 3 decimal places.

1.3.3.3 The Contractor shall check co-ordinates and levels of benchmarks at monthly intervals and immediately notify the Engineer of any discrepancies.

1.3.4 Survey, Design, Working and Shop Drawings

1.3.4.1 The Contractor should note that the Drawings and Quantities in the Tender Documents, whilst detailed, have to be considered as preliminary, and only provide and indication of the locations, layouts and scope of works. The locations, layout and scope of works may be altered and in such cases the Contractor shall not be entitled to any claim whatsoever for such alterations over and above the measured works or measured variations at the tendered rates except in accordance with the provisions of relevant Clauses of the Conditions of Contract.

1.3.4.2 Subject to the above limitation, design detail will be provided by the Engineer in advance of the Contractor’s intended commencement of construction as indicated in his approved construction programme or as otherwise agreed with the Engineer.

1.3.4.3 Should any Contractor's proposals for the any specialised items differ in entirely or substantially from that of the Engineer's or should it affect another component of the element or item of work beyond permissible variations from it, then the Contractor shall, at his own cost, be responsible for redesign to provide a complete acceptable system before approval of any part thereof. For such works, the Contractor shall furnish, at his own expense, the Engineer with copies of all design calculation, sketches, working drawings and similar information in as much detail as the Engineer may reasonable require for his full information and subsequent approval.

Such approval of the Contractor's design shall not relieve the Contractor from any of his duties, responsibilities or obligations under the Contract.

The above design work to be undertaken by the Contractor or his approved subcontractor shall be in accordance with f current practice generally using accepted design techniques in accordance to international standards or as specified in the relevant Tender Document all to the approval of the Engineer.

1.3.4.4 Contractor shall prepare the working drawings/shop drawings and documents, including diagrams and schedules shall show the details of proposals for the execution of the works and shall include everything necessary for the following purposes :

To illustrate in detail the arrangement of the various section of the works and to identify the various components.

To integrate the various sections of the works.

The shop drawings required shall include but not be limited to the following

General layout drawings for equipment and like items as deemed necessary by the Engineer.

a) Detailed layout drawings all lift stations and pumping stations, showing the connection of mechanical and electrical services, ducting, paper work, conduit, cable tray and trunking together with earthing system

b) Detailed layout drawings showing sections such as through ceiling voids and vertical shafts.

c) System diagrams, circuit diagrams and wiring diagrams for all installations and equipment.

d) The drawings, specifications and technical information for materials and equipment of building components such as doors, windows etc.

1.3.4.5 Working drawings and documents shall be made available in sufficient time in order to maintain the Programme of Work on site.

The Contractor shall liase with the Engineer for the period required for any approval, which shall be a maximum of two weeks.

The Contractor shall ensure that all items to be ordered by him can be accommodated in the positions shown on the drawings and for taking all necessary dimensions on site together with any supporting information which may be necessary for preparing working drawings.

Materials or equipment shall be ordered nor construction of the associated works be commenced until such approval has been obtained from the Engineer.

The Contractor shall be deemed to have obtained a full and proper understanding of the Engineer's design and design intents and to have satisfied himself with their accuracy and suitability. In this respect, the Engineer will meet all reasonable requests made by the Contractor in furnishing design information and the like to he Contractor. No claim in respect of lack of knowledge will be admissible.

1.3.5 Construction Levels

Before commencement of construction, the Contractor shall conduct a detailed topographic survey of each road in the project and submit to the Engineer, for approval, the following:

(a) Tabulated control levels to which the works are to be referred to. Co-ordinates of each salient point shall be determined in metres to 3 decimal places.

(b) Plan of the proposed road showing the location of the asphalt carriageway. The drawing shall clearly indicate the location of the boundary walls wherever available. Where boundary walls are not available the survey should show the extent of the right of way of the road. The existing services, as determined by site excavation, should also be marked up on these plans.

(c) Profile of the existing road as directed by the Engineer

(d) In the dual carriageway, profile shall be drawn for both carriageways.

1.4 SOIL INVESTIGATION AND REPORT

1.4.1 A soil investigation has been undertaken during the Design phase. However in case additional investigations are required during the course of construction the Contractor shall be advised of such requirement and the Contractor shall promptly carry out such investigations as advised by the Engineer.

1.5 PROGRESS PHOTOGRAPHS

1.5.1 The Contractor shall submit to the Engineer each month, throughout the period of the Contract, progress photographs as mentioned in the General conditions of the contract, taken at the direction of the Engineer. The camera used for this purpose shall be such that the date is printed out.

1.5.2 In addition copies of previously selected progress photographs and mounted in three separate and suitable albums shall also be delivered to the Engineer on the Preliminary Handing-over of the works. The arrangements for the progress photographs are subject to the approval of the Engineer and shall be discussed at as early a date as possible so that complete coverage can be assured.

1.6 NOTICE BOARDS

The Contractor shall provide, erect and maintain for the duration of the contract, two steel framed timber notice boards for the works, in location approved by SPV and the Engineer's Representative.

Notice Boards shall have a block board panel size of around 3m as detailed on the Drawings or equally approved. Prior to sign writing, the board shall be painted with two coats of white oil based paint back and front. The board shall be supported above the ground on steel struts painted matt black and fixed into concrete foundations, all to the approval of the Engineer. The sign shall be painted by a skilled sign writer to show the details described in the Contract. The Contractor is responsible for obtaining all necessary approvals for the erection of these notice boards.

Under no circumstances, shall sub-contractor's or supplier's name boards be fixed on hoarding or elsewhere on site.

1.7 ADVERTISING

1.7.1 Neither the Contractor nor any of those in his employment shall give information concerning the works for publication in any form without the written approval of the Engineer.

1.7.2 Neither the Contractor nor any of his sub-contractors shall erect placards or advertisements within the site other than the notice boards permitted under the relevant Clauses.

1.8 SITE SAFETY

1.8.1 Site Safety

In order to improve the general vehicular traffic condition and to guarantee public safety from and around the work the Contractor shall provide all labour, and materials, and construct and maintain temporary traffic diversions through out the construction activities, to the directive and approval of the Engineer. It is therefore recognised that there is a particular responsibility placed upon the Contractor to take special precautions for public safety and to minimise the scale and extent of disruption. Plans for diversion shall always be submitted to the Engineer for prior approval.

1.8.2 Safety on Site

1.8.2.1 The Contractor shall ensure that the works are carried out in a safe manner. According to internationally accepted guidelines on safe working procedures and to the satisfaction of the Engineer.

1.8.2.2 The following requirements shall be complied with by the Contractor:

a) Excavation - All excavations shall be adequately supported to avoid collapses and effective safety barriers shall be erected with warning signs and devises around all open excavations to the satisfaction of the Engineer.

Struts and walling shall not be used as ladders and for the purpose of access to the base of excavation the Contractor shall provide proper ladders which shall be suitably secured.

Reflective wearing shall be worn by all workmen on or close to a highway and, where necessary, temporary road signs and cones shall be provided to ensure a safe working area.

b) Protective Clothing - The Contractor shall ensure that all personnel on site are supplied with the necessary protective clothing such as safety helmets, goggles, face masks, ear muffs, gloves, boots, etc. which are required for the operations being performed.

c) Scaffolding - Suitable and sufficient scaffolds shall be provided and properly maintained for all work that cannot safely be carried out from the ground or from part of the structure or from a ladder.

Every scaffold shall be of good construction, of suitable and sound material and of adequate strength for the purpose for which it is used. Unless designed as an independent structure, every scaffold shall be rigidly connected to a part of the structure which is of sufficient strength to afford safe support. Protective headgear shall always be worn.

d) Lifting Device - Every rope, chain, pulley, bloc, hook, winch, crane or other lifting gear used for raising or lowering loads of as a means of suspending them shall be of good construction, sound material, adequate strength and free from defects. They shall be properly maintained and tested at regular intervals by a competent person, who shall be to the approval of the Engineer.

e) Working in existing manholes etc. , - Checks shall be carried out before entry to ensure that the atmosphere is fir for respiration and no smoking naked lights or flames are to be permitted in any sewer, manhole of chambers or adjacent to them when these are open

The equipment which shall be made available shall include but not limited to:

a) Gas detector lamps with lead acetate papers.

b) Lifting harness with ropes

c) Handlamps with spare batteries

d) First aid kit.

e) Protective head gear.

f) Rubber Gloves.

g) Breathing apparatus.

1.8.2.3 Throughout the period of the Contract, the Contractor shall provide safety helmets and high reflectivity jackets to all Consultant's staff and visitors. Barriers must be provided to all excavations for the safety of the public and flagmen must be used for all items of plant for the safety of the operatives, supervision staff and members of the public.

1.8.3 Vehicular Movement

1.8.3.1 Before commencing the works, the Contractor shall consult with and obtain from the Employer and the Engineer their requirements for temporary safety signs, road markings, lighting and other measures necessary to ensure the safety of the public, and shall comply with these requirements will not relieve the Contractor of his obligations under the Contract. The Contractor shall also take a No Objection Certificate from Consultants supervising other Contracts in the area, get details of newly installed and temporary services and obtain access requirements for other contractors.

1.8.3.2 The Contractor shall deploy, as a full time member of his site staff for the duration of the contract, whose duties shall include the production and implementation of safety management schemes. Qualification and experience of the safety management staff shall be subject to the approval of the Engineer.

1.8.3.3 Throughout the Contract, the Contractor shall maintain vehicular and personnel access to all parts within the site at all time.

Adequate warming and direction signs are to be erected wherever necessary and diversions are to be maintained in good condition to the satisfaction of the Engineer.

1.8.3.4 Temporary diversions shall be constructed and maintained to the standards approved by the Engineer. Upon completion of the Permanent works, the temporary diversions shall be removed and the site restored to the satisfaction of the Engineer.

1.8.3.5 All diversions and safet sign boards must be constructed and maintained to the highest standards with regular washing of cones and daily maintenance of flashing lights. The signs and cones should be self-stabilising, and if extra stability is required only small sandbags should be used.

1.8.3.6 All stockpiles of material to be used in the works must be fenced off and all unsuitable material must be removed from site on a daily basis and not stockpiled on site.

1.8.3.7 Payment for safety management shall be considered as included in the various pay items of B.O.Q. deductions to be made, from moneys due to the Contractor, for failure on the part of the Contractor to provide adequately for safety and for the accommodation of safety management plan.

1.9 SERVICES

1.9.1 Contractor to establish location of Services

Before the Contractor may proceed with the Works in any given area he is required to establish the precise location of all services in that area as executed by other contractors.

1.10 AS BUILT RECORDS

1.10.1 On or before the completion of the works, at the direction of the Engineer, the Contractor shall prepare detailed drawings and other records, as required, of the works executed. The Contractor is required to submit the soft copy as well as two hard copies of the as built records to the scale advised by the Engineer.

1.11 PROGRAMME OF WORKS

1.11.1 In respect of the programme of works required under Clause 17 of the General Conditions of Contract the following specific requirements shall apply: -

- The works shall be programmed in such a way as to minimise disruption to other works
- Works shall not be carried out simultaneously over large areas of the site but shall be sequenced so that all operations likely to cause disruption to other works shall be undertaken and completed in discrete area before commencement of operations in other areas.
- Works, which, by their nature, will create disruption and / or obstructions to other works, shall be programmed to be undertaken in a continuous sequence of events from the initial disruption until the restoration of access without and significant delay between operations.

1.11.2 The Contractor's Programme of Works, submitted in accordance with Clause 17 of the Conditions of Contract, shall be subject to the approval of the Engineer and of Employer, the Contractor has not properly achieved the objectives of the programme, then they may require the Contractor to revise his Programme and the Contractor shall do so forth, for this reason the Contractor is advised to liaise closely with the Engineer during the production of his Programme.

1.11.3 The Contractor should note that when a phase or phases of the works is/are programmed to be completed before commencement of another phase, the Contractor may not commence work on the later phase until the former phase is completed, even if the former phase overruns its allocated construction time, without the specific permission of the Engineer's Representative.

1.11.4 In addition to the Works Programme required under Clause 17 of the Conditions of Contract, the Contractor shall produce individual programmes for each element of the works likely to cause significant disruption to other works, for the approval of the Engineer and prior to commencement of the element of the works, clearly showing the sequencing of construction operations is such a manner as to minimise the duration of the disruption.

1.11.5 The Contractor shall note that different work in various parts of site by other contractors may be in progress or may commence during the Contract Period. It will be the Contractor's responsibility to liase with contractors on adjacent sites in order to ensure the detail progress. The Contractor's Programme will be phased and will make full allowance for the need for a co-operative timing with adjacent contractors.

1.12 CONTRACTOR'S OFFICES, YARD, STORES AND PLANT AREA

1.12.1 The Contractor's main office shall be located in the general vicinity of the Engineer's office, on land to be provided, by the Contractor, for the duration of the project. The Contractor's main office shall be used for the purposes of administering the Project but may not be used for the storage of construction materials nor for storage or maintenance of plant and shall not be allowed to become unsightly.

1.12.2 The Contractor's other offices, yard, stores and plant area shall be provided, by the Contractor, at location(s) to the approval of the Employer. The Contractor shall be responsible for all associated expenses including rents, assessments or temporary occupation license fees, establishment, running and maintenance costs, the supply of all services, as well as the obtaining of any appropriate No Objection Certificates.

1.12.3 Within 7 days of the Commencement date of the Contract, the Contractor shall submit, for the approval of the Engineer, a drawing showing detailed plans for his offices, yard, stores and plant area, together with al sanitary arrangements, and for the supply of water and electricity. Until the Engineer has given his approval in writing, no construction of any of the Contractor's facilities shall commence. The area shall be fenced in accordance with the Engineer's approval.

1.12.4 The Contractor shall not be permitted to erect temporary building or structures elsewhere without the specific permission in writing of the Engineer, including approval of the dimensions and specifications of such buildings or structures and their location.

1.12.5 The Contractor shall take all steps necessary as directed by the Engineer to minimise or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted to be sited at any location which shall cause nuisance to any building or other installation, whether complete or under construction, site offices, camps, or other similar buildings.

1.12.6 Under no circumstances shall overnight accommodation be permitted on site except for Site watchman in carrying out their duties.

1.12.7 Throughout the period of the Contract, the Contractor shall maintain the area of his operation within the limits of the site in a clean, tidy and safe condition by arranging materials and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the site as it accumulates.

1.12.8 The Contractor shall satisfy himself as to the means of access to the site and other relative items affecting him, his sub-contractors and suppliers.

1.12.9 Upon completion of the Contract, or, in the case of facilities required by the Contractor during the Period of Maintenance, on completion of the period of maintenance the Contractor shall remove all buildings and other facilities from the site including all foundations and services, clean and level the site and restore the ground to its original condition.

2.1 SITE PREPARATION

2.1.1 General

The Contractor shall maintain close liaison with the Engineer and the Employer and shall obtain their approval prior to removal of any service installation. Where external Service Authority installations are to be removed, they shall be removed after the existing facilities have been

relocated and commissioned or after they have been redundant and after any electrical supply has been made safe by the Authority or the Contractor whichever is appropriate.

"Site clearance" shall include the demolition/removal of all plants, bushes, underground structure, foundations, manholes, chambers, drains, septic tanks, cesspits, soak away, pipelines, undergrowth, trees (of any girth), tree stumps, buildings, services, rubbish and debris which are required to be cleared to construct the Works. Site clearance as directed by the Engineer shall include clearing and grubbing for the road corridor. The rate shall include for backfilling with suitable material all voids created by the removal of above mentioned items.

It is deemed that except for the items mentioned in this bill, costs of all other works in connection with site clearance are included in various pay items of other bills.

2.1.2 Removal of Trees

a) General

1. This item consists of the removal of trees of any girth, their disposal as instructed by the Employer and Engineer and the backfilling of the hole left after uprooting the tree.

2. If any tree is conflicting with the road works then Contractor shall inform the Consultant.

Removal of trees shall be performed only after written approval from the Employer.

b) Measurement and Payment

Payment under this item shall be made per unit of trees removed.

The unit price shall constitute full compensation for the removal, hauling, disposing off of the tree of any girth as described herein and as directed by the Engineer and for all material, labour equipment, supplies and incidentals necessary to complete the Work.

No payment shall be made for the removal of bushes, stumps, roots etc., whose cost is considered as included in other pay items of the bill.

2.1.3 Removal of Fence

a) General

The Contractor shall take down existing fencing and gates within the Contract Right-of-Way as shown on the Drawings or as directed by the Engineer and shall ensure the provision of suitable terminal posts, tensions, tie wires, lengths of fencing or whatever is necessary to ensure the integrity of the remaining lengths of fencing and stop the entry of animals should the remaining fenced area be under cultivation or a plantation.

Prior to removal, the fencing is to be inspected by the Engineer to assess its suitability for re-use.

Sections of fencing designated by the Engineer as suitable for re-use shall be dismantled, removed and stored in a manner approved by the Engineer to leave all parts of the fencing system suitable for re-use and late re-erection as directed by the Engineer.

b) Measurement and Payment

Payment under this Item shall be made per linear metre of fence removed.

The unit price shall constitute full compensation for the works described herein and as directed by the Engineer and for all material, labour, equipment, supplies and incidentals necessary to complete the Works.

2.1.4 Removal of Concrete Structures

a) General

The Contractor shall remove wholly or in part and satisfactorily dispose of all structures (manhole, slabs, walls, building or any other concrete structure) as indicated on the Drawings or directed by the Engineer, and which are not specifically described under a separate Clause of this Specifications.

All material removed and all structures demolished shall be removed from the Work Site, hauled away and disposed off in approved disposal area and as approved by the Engineer.

The voids or depression which are the result of the demolition of structures shall be backfilled with borrow material as approved by the Engineer. Backfilling material shall be placed in horizontal layers of over 15 cm in depth and compacted to not less than 98%.

b) Measurement and Payment

Payment for the removal and disposal of all structures and related obstructions as described above will be at the cubic metre rate included in the Bill of Quantities which shall include all labour and equipment to demolish, remove the obstructions as building materials, concrete, debris etc., loading, hauling irrespective of haulage distance, disposing off all materials removed, and backfilling with borrow material and depression of voids, as indicated on the Drawing, specified herein and as directed by the Engineer.

LIST OF APPROVED MAKES/AGENCIES

FOR WORKS COVERED UNDER THIS CONTRACT

(A) All materials and products used in the work shall conform to the relevant standards/ specifications and shall be of approved make and design. Lists of approved manufacturers/ vendors for Civil works, Plumbing works, Fire fighting & Fire Alarm works, Electrical works etc. is given herein below. The approval of a manufacturer/ vendor shall be given only after review of the sample/specimen by the Engineer-in-charge. The complete system and installation shall also be in conformity with the "Applicable Codes Standards and Publications".

(B) List of Approved makes for Products, Materials and specialist agencies is given below. Other equivalent manufacturers may be considered with prior approval; however the decision of the Engineer-in-charge shall be final.

CIVIL WORKS

SL. NO.	ITEM	MAKE
1	GREY CEMENT	ACC, AMBUJA, JK UltraTech, OR OTHER BRAND WITH APPROVAL OF ENGINEER INCHARGE.
2	WHITE CEMENT	JK, BIRLA OR EQUIVALENT
3	REINFORCEMENT/STRUCTURAL STEEL	SAIL, TISCO, RINL, JINDAL
4	ANTI-TERMITE TREATMENT	PEST CONTROL INDIA LTD, PEST CON INDIA, PEST CONTROL INCORPORATED, OR ANY OTHER AGENCY TO BE APPROVED BY THE ENGINEER IN CHARGE
5	CONCRETE ADDITIVE	FOSROC, STP, CICO-TL, SIKA, PIDILITE
6	FLUSH DOORS	GREEN, DURO, CENTURY, MAYUR, JAYNA, ARCHID PLY, ALPRO
7	FIRE CHECK DOORS	GLOBAL FIRE PROTECTION COMPANY, RADIENT SAFE FIRE DOORS, GODREJ
8	PLYWOOD / BLOCK BOARD / SOFT BOARD	ANCHOR, DURO, MAYUR, GREEN LAM, CENTURY, ARCHID PLY, ALPRO
9	PRELAMINATED PARTICLE BOARD	ACTION TESA, NOVAPAN, ANCHOR, MERINO, GREEN LAM, CENTRURY, ARCHID PLY
10	LAMINATES	CENTURY, ROYAL CHALLENGE, MERINO,GREEN LAMP, ARCHID LAM
11	ADHESIVE FOR WOOD WORK	DUNLOP, FEVICOL, VAMICOL, PIDILITE
12 a)	POLYRETHANE SEALANT	MBT, CHOKSEY,PIDILITE
b)	SILICON SEALANT	DOWN CORNING, ALSTONE OR EQUIVALENT
13	POLYETHELENE BOARD	SUPREME OR EQUIVALENT
14 a.	ALUMINIUM EXTRUSIONS	JINDAL, HINDALCO, NARMADA, BHARUKA, INDAL, MAHAVIR OR EQUIVALENT
b.	STAINLESS STEEL	SALEM, JINDAL OR EQUIVALENT
c.	EXPANSION, FASTENERS	FISCHER, HILTI, ANCHORS, AXEL
15	Structural Steel	TATA, Jindal, SAIL

SL. NO.	ITEM	MAKE
15	FLOAT GLASS	MODI GUARD, SAINT GOBAIN, ASAHI, ATUL
16	CERAMIC TILES	NITCO, KAJARIA, SOMANY, JOHNSON, SUNHEART, VARMORA
17	VITRIFIED PORCELINE TILES	NAVEEN DIAMOND TILES, NITCO, JOHNSON, MARBITO BRAND, RAK, KAJARIA, VARMORA, CT TILES
18	INTERLOCK TILES/GRASS PAVER BLOCKS/ KERB STONE	DALAL TILES, UNISTONE, MODERN OR EQUIVALENT
19	TERRAZZO TILES	NITCO, MODERN, A-1, NTC, DALAL TILES OR EQUIVALENT AS PER ISI SPECIFICATION
20 a)	CEMENT CONCRETE TILES	UNISTONE, ULTRA, DALAL TILES OR EQUIVALENT
b)	HANDMADE CERAMIC TILES	RAJA, ARIHANT, JAIN
21	ROOF WATER PROOFING	NINA CONCRETE SYSTEM PVT. LTD, C R S ASSOCIATES AND ENGINEERS PVT.LTD, CREATIONS,PIDILITE
22	PAINT	NEROLAC, JOHNSON & NICHOLSON, BERGER, ASIAN PAINTS, SHALIMAR
23	TEXTURED COATING	UNITILE, SPECTRUM, HERITAGE OR EQUIVALENT
24	DOOR FITTINGS	GODREJ, DOORSET, OZONE, INDOBRASS
25	LOCKS AND HANDLES	EVERITE, GODREJ, HARRISON, INDOBRASS
26	NON METALLIC HARDENER COMPOUND	FOSROC, S TP, PIDILITE, CICO
27	ROLLING SHUTTER	RAMA, PRAKASH, SANJEEV OR EQUIVALENT AS PER CPWD SPECIFICATIONS.
28	DOOR CLOSER	DOORSET, EVERITE, GARNISH, INDOBRASS
29	FLOOR DOOR SPRING	D-LINE,OZONE,DOORSET,EVERITE,INDOBRASS
30	HDF LAMINATED BOARD	ARMSTRONG, BVG, EGO FLOORS, SQUARE FOOT, ACTION TESA
31	EXPANSION FASTENERS	HILTI, FIHSER, GKW, AXEL
32	FASTENERS	HILTI, FIHSER, GKW, AXEL
33	GYPSUM CEILING	INDIA GYPSUM, LAFARGE
34	CALCIUM SILICATE BOARD FALSE CEILING	AEROLITE, HYLUX
35	PATCH FITTING	DORMA, GEZE, OZONE OR AS APPROVED
36	WORK STATION AND MODULAR FURNITURE	GODREJ, BP ERGO, FEATHERLIGHT, WIPRO
37	BLINDS	VISTA, MAX, ARMSTRONG
38	ADHESIVE	FEVICOL, VEMICOL OR EQUIVALENT
39	FURNITURE HARDWARE	UNIQUE, HATTICH INDIA, EBCO, EARL BEHARI.
40	LACQUERED GLASS	SAINT GOBIN, ASAHI, ATUL
41	MELAMINE POLISH	ASIAN PAINT, BERGER, SHALIMAR

	ELECTRICAL WORKS LIST OF APPROVED MAKES	
1	Switch Fuse Unit (HRC Type)	Schnider/GE/L&T/Siemens/C&S/Havells/MDS
2	MCB's, MCCBs, RCCBs, ELCB's & MCB DBs	Legrand / ABB / L&T /Siemens / Havells / C&S / Schneider / GE / Hagger / Anchor / Standard / Action
3	LT XLPE Aluminium Armoured cables upto 1100v	Plaza/Skytone/ National/Ralison/PYTEX/Paragon/ KEI
4	HT XLPE Aluminium Armoured cables upto 11000V	Skytone/ National/INCAB/ Nicco
5	Air Circuit Breakers	Schneider/ GE /L & T/Siemens
6	Terminals	Elmex /Technoplast
7	Lugs	Dowells/ Ismal
8	Glands	Gripwell/ Comet
9	Indicating lamps	L &T/ Siemens/Technique
10	Power factor correction relay	Syntron/ Avomec/Sigma
11	Indicating Instruments	Automatic Electric/ Rishab
12	KWH Meters	L&T/HPL SOCOMEC
13	Current Transformers	Automatic Electric/ Kappa
14	Selector Switches	Salzer-L&T/ Kaycee
15	Change over switches	HH Elecon/HPL
16	11 KV VCB/RMU Panel	Crompton/ABB/Siemens/Areva
17	Power Transformers	Crompton/ Kirloskar/ABB/Siemens
18	HT Jointing Kits	Raychem/ Mahindra/Denson/Cabseal
19	DG Sets- Engine.	Kirloskar/Cummins/Caterpillar/Mitsubishi
20	Alternator	Kirloskar /Stamford./Crompton/Mitsubishi
21	LT Panels, Fidder Pillars etc.	Ambit, Trikolite/KEPL/Madhu elect./SPC/ Amptech/ USHA Power/Precision System Control
22	Power Capacitors	Crompton/Siemens Apcos/Khatou
23	HRC Fuse Base & HRC Fuses	L&T/GE/Schneider/HPL
24	Sound Proof Acoustic Enclosures	DG suppliers
25	Lighting Fittings & Luminaries	Crompton/Philips/Wipro/BAJAJ/Havell's
26	PVC insulated 1.1KV grade copper wires	Plaza/Pytex/National/Ralison/RKG/Finolex/Polycb / Batra-Henlay/Havells
27	Piano/Modular Type Sockets & Switches	Roma(Anchor)/Legrand/MK/Crabtree/ Philips/ Clipsal/North West
28	Steel/PVC Conduit	BEC/AKG/ATUL/STEEL KRAFT/RKG
29	Ceiling/Wall/Exhaust fans	Crompton /Almonard /Bajaj/Usha/Orient
30	External lights	Bajaj/ Philips/ Decon/K-Lite/Metal Coat

S. No.	Details of Materials / Equipments	Manufacturer's Name
1	G.I./M.S pipes.	Jindal Hissar, Tata or equivalent
2	G.I. pipes fittings.	Unik or equivalent
3	G.M. / Forged brass valves	Zoloto / Leader or equivalent
4	Sluice Valves, Non return valve	Kirloskar , Micon, Weir BDK, Advanced or equivalent
5	Valves	Kartar/Zoloto/Leader /C& R/Advance or equivalent
6	`Y' strainer	Emerald Enterprises / Zoloto or equivalent
7	Level Controller & Indicator (Water)	Technika / Minilec or equivalent
8	Paints	Asian Paints
9	Pressure Gauge	H Guru. Gauges Bourdon, GIC or equivalent
10	Flexible Rubber Expansion Joint	Kanwal Easyflex, Resistoflex or equivalent
11	Pumps	Kirloskar, Sam Turbo, KSB, Kishor, Grundfos, Johnson or equivalent
12	Fire Fighting Equipments	Minimax, Newage or equivalent
13	Welding Rods	Advani/Victor or equivalent
14	GI Hangers	Chilly/GMGR or equivalent
15	Rubber hose pipe	Deep Jyoti or equivalent
16	Underground Pipe Protection	IWC or equivalent
17	UPVC/ PVC Pipes	Supreme, Jindal, Jain Pipes, Ori Plast or as Approved or equivalent
18	HDPE Pipe	Supreme, Jain Pipe, Apollo or equivalent
19	RCC Pipes	Hindusthan Hume Pipe or equivalent
20	Ball Valves	Audco, Zoloto or equivalent
21	Ball Cocks	Audco, Zoloto or equivalent
22	CI Manhole Cover	Necco or equivalent
23	PVC Tanks	Sintex or equivalent
24	Air Valve	Indian, Amatic or equivalent
25	Ductile Iron Pipes	Electrosteel or equivalent
26	CPVC Pipes & fittings	Astral, Fowguard, George Fischer or equivalent

** equivalent makes to be approved by Client/Engineer-in-charge prior to installation*

SL. NO.	ITEM	MAKE
15	FLOAT GLASS	MODI GUARD, SAINT GOBAIN, ASAHI, ATUL
16	CERAMIC TILES	NITCO, KAJARIA, SOMANY, JOHNSON, SUNHEART, VARMORA
17	VITRIFIED PORCELINE TILES	NAVEEN DIAMOND TILES, NITCO, JOHNSON, MARBITO BRAND, RAK, KAJARIA, VARMORA, CT TILES
18	INTERLOCK TILES/GRASS PAVER BLOCKS/ KERB STONE	DALAL TILES, UNISTONE, MODERN OR EQUIVALENT
19	TERRAZZO TILES	NITCO, MODERN, A-1, NTC, DALAL TILES OR EQUIVALENT AS PER ISI SPECIFICATION
20 a)	CEMENT CONCRETE TILES	UNISTONE, ULTRA, DALAL TILES OR EQUIVALENT
b)	HANDMADE CERAMIC TILES	RAJA, ARIHANT, JAIN
21	ROOF WATER PROOFING	NINA CONCRETE SYSTEM PVT. LTD, C R S ASSOCIATES AND ENGINEERS PVT.LTD, CREATIONS,PIDILITE
22	PAINT	NEROLAC, JOHNSON & NICHOLSON, BERGER, ASIAN PAINTS, SHALIMAR
23	TEXTURED COATING	UNITILE, SPECTRUM, HERITAGE OR EQUIVALENT
24	DOOR FITTINGS	GODREJ, DOORSET, OZONE, INDOBRASS
25	LOCKS AND HANDLES	EVERITE, GODREJ, HARRISON, INDOBRASS
26	NON METALLIC HARDENER COMPOUND	FOSROC, S TP, PIDILITE, CICO
27	ROLLING SHUTTER	RAMA, PRAKASH, SANJEEV OR EQUIVALENT AS PER CPWD SPECIFICATIONS.
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36	WORK STATION AND MODULAR FURNITURE	GODREJ, BP ERGO, FEATHERLIGHT, WIPRO
37	BLINDS	VISTA, MAX, ARMSTRONG
38	ADHESIVE	FEVICOL, VEMICOL OR EQUIVALENT
39	FURNITURE HARDWARE	UNIQUE, HATTICH INDIA, EBCO, EARL BEHARI.
40	LACQUERED GLASS	SAINT GOBIN, ASAHI, ATUL
41	MELAMINE POLISH	ASIAN PAINT, BERGER, SHALIMAR

	ELECTRICAL WORKS LIST OF APPROVED MAKES	
1	Switch Fuse Unit (HRC Type)	Schnider/GE/L&T/Siemens/C&S/Havells/MDS
2	MCB's, MCCBs, RCCBs, ELCB's & MCB DBs	Legrand / ABB / L&T /Siemens / Havells / C&S / Schneider / GE / Hagger / Anchor / Standard / Action
3	LT XLPE Aluminium Armoured cables upto 1100v	Plaza/Skytone/ National/Ralison/PYTEX/Paragon/ KEI
4	HT XLPE Aluminium Armoured cables upto 11000V	Skytone/ National/INCAB/ Nicco
5	Air Circuit Breakers	Schneider/ GE /L & T/Siemens
6	Terminals	Elmex /Technoplast
7	Lugs	Dowells/ Ismal
8	Glands	Gripwell/ Comet
9	Indicating lamps	L &T/ Siemens/Technique
10	Power factor correction relay	Syntron/ Avomec/Sigma
11	Indicating Instruments	Automatic Electric/ Rishab
12	KWH Meters	L&T/HPL SOCOMEC
13	Current Transformers	Automatic Electric/ Kappa
14	Selector Switches	Salzer-L&T/ Kaycee
15	Change over switches	HH Elecon/HPL
16	11 KV VCB/RMU Panel	Crompton/ABB/Siemens/Areva
17	Power Transformers	Crompton/ Kirloskar/ABB/Siemens
18	HT Jointing Kits	Raychem/ Mahindra/Denson/Cabseal
19	DG Sets- Engine.	Kirloskar/Cummins/Caterpillar/Mitsubishi
20	Alternator	Kirloskar /Stamford./Crompton/Mitsubishi
21	LT Panels, Fidder Pillars etc.	Ambit, Trikolite/KEPL/Madhu elect./SPC/ Amptech/ USHA Power/Precision System Control
22	Power Capacitors	Crompton/Siemens Apcos/Khatou
23	HRC Fuse Base & HRC Fuses	L&T/GE/Schneider/HPL
24	Sound Proof Acoustic Enclosures	DG suppliers
25	Lighting Fittings & Luminaries	Crompton/Philips/Wipro/BAJAJ/Havell's
26	PVC insulated 1.1KV grade copper wires	Plaza/Pytex/National/Ralison/RKG/Finolex/Polycb / Batra-Henlay/Havells
27	Piano/Modular Type Sockets & Switches	Roma(Anchor)/Legrand/MK/Crabtree/ Philips/ Clipsal/North West
28	Steel/PVC Conduit	BEC/AKG/ATUL/STEEL KRAFT/RKG
29	Ceiling/Wall/Exhaust fans	Crompton /Almonard /Bajaj/Usha/Orient
30	External lights	Bajaj/ Philips/ Decon/K-Lite/Metal Coat

QAP for Civil Works, Check Lists & Formats

Pre- Concrete Check List

Structure No. Date & Time of Concrete
Location Grade of Concrete
Source of Concrete Brand of Cement

Sr. No	Description	Approved		Observations & Remarks
		Yes	No	
1	**ALIGNMENT / LEVEL CHECK**			
2	**GENERAL CLEANLINESS**			
3	**FORM WORK**			
	a) Shutters- Smooth & Cleaned Surface			
	b) Application of Mould Oil			
	c) The roads, Supports / Props provided			
4	**REINFORCEMENT CHECKING**			
	a) Size (as per drawing)			
	b) Spacing (As per drawing)			
	c) Starter Bar			
	d) Lapping of bars			
5	**CEMENT**			
	a) Weight of cement per cum			
	b) Theoretical cement consumption			
	c) Actual cement consumption			
6	**REINFORCEMENT COVER**			
7	**WEEP HOLES PROVIDED**			
	a) Not Required			
	b) Not Provided			
8	**CONSTRUCTION JOINT REQUIRED**			
9	**EQUIPMENT VERIFICATION**			
	a) No of needle vibrators deployed			
10	**CONCRETE PLACEMENT ARRANGEMENT**			
	A) Using Pump			
	a) Joint / Fixing Checked			
	B) Direct			
	a) Platform placed			
	b) clean chute provided			
	c) proper gradient provided			
11	**CONCRETE VOLUME REQUIRED**			
12	**NO. OF CUBES CASTED**			
13	**RFI SUBMITTED TO QA/ QC**			
14	**PROPER ACCESS ROAD PROVIDED**			
15	**LIGHTING ARRANGEMENT FOR NIGHT WORKING**			
	a) No of spot lights provided			
16	**CURING ARRANGEMENT**			
17	**SAFETY REQUIREMENTS**			

	a) Proper Barricading done			
	b) Cautionary sign boards provided			
	c) Lights & Genset Arrangement for night works			
	d) First Aid Box			
18	**MISC**			
	a) Supervisors			
	b) Labours			

Contractor Representative

Consultant Representative

NAME OF PROJECT _____

CONTRACTOR CONTRACT NO.		**CHECK LIST FOR CONCRETING** REF DRAWING NO _____ LOCATION BLOCK _____ FLOOR _____ AREA_____			
LAYOUT	☐ Alignment Checked	☐ Level of base Checked	☐ Dimensional Check (edges & diagonals)	☐ Starters	☐ Location of cu-outs & services
STAGING/ SCAFFOLDING	☐ Adequacy & rigidity of Props, stays,bracings, Conformity to scheme drawings	☐	☐		
FORMWORK	☐ Qty of forms and support ☐ Props adequate	☐ Vertical form surface in alignment & plumb	☐ Even surface ☐ Oil sprayed	☐ Gaps between shuttering are Properly closed.	☐ No space for sagging of Form work
REINFORCEMENT	☐ Cutting & bending as per Bar bending schedule (schedules attached)	☐ Adequate laps Welds	☐ Chair/cover blocks Placed as per scheme	☐ Binding wire not Touching shuttering	☐ Fixtures, inserts Conduits in position
	☐ Dowels & positioning Provided as per drg.	☐ Walkway for Labour provided			
PRE-CONCRETING	☐ Concreting Arrangements	☐ Approval of Construction joint	☐ Mixer/vibrator Condition & mixing	☐ Top level of Concerete marked	☐ Transporting & Placeing arrangement
POST-CONCRETING	☐ Compaction Checked	☐ Removal of laitance	☐ Post concreting Level/dimensions.	☐ Nos of cubes cast	
DESHUTTERING & CLEARING	☐ Curing days------- Water/compound	☐ Surface finish OK	☐ Concrete Test Results OK		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	**CHECK LIST FOR MASONRY WORK** REF DRAWING _____ LOCATIONBLOCK_____FLOOR_____AREA_____	

LAYOUT	☐ Alignment & wall Thickness checked `	☐ Brick on edge (top course)		
SCAFFOLDING	☐ Adequacy of props, Stays, platform	☐ Rigidity of base	☐ Movement space	☐ Approach to height
PRE-LAYING	☐ Working arrangements & service provisions checked	☐ Bricks as per specification	☐ Mortar grade & mix As specified	☐ Bricks moistened
LAYING	☐ Joint thickness & course Ht. As specified	☐ Joint alignment Checked	☐ Vertical joints Properly mortar filled from top	
	☐ Raking of joints Done (if applicable)	☐ Bearing plaster for Concrete		
CURING AND CLEARING	☐ Proper curing of const. Joint.	☐ Scaffolding removed (if required)		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	**CHECK LIST FOR PLASTERING WORK** LOCATION BLOCK _____ FLOOR _____AREA _____	

SCAFFOLDING	☐ Platform	☐ Stability	☐ Movement space	☐ Approach to Height	
SERVICE	☐ All chasing work Complete	☐ Fixing in position Using clamps etc.	☐ Patching Work complete	☐ All door/window frames Fixed in position	☐ Skirting to floors marked
SURFACE PREPARATION	☐ Clearing & raking of Surface	☐ Roughening Hacking done	☐ Fixing metal/lathe Chicken mesh	☐ Mortar level Guides made	☐ Surface moistened/ Cement slurry
PLASTERING	☐ Mix & w/p compound Checked as per specification	☐ Coating/thickness As specified	☐ Groove at joints Provided	☐ Corners & edges sharp & at right Angles lines & levels maintained	☐ Surface leveled with At straight edge
FINISHING	☐ Texture	☐ Curing Days----------	☐ Site cleared	☐	☐

CLEARANCE FROM AE (E)

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR LAYING OF EXTERNA SEWER REF DRAWING NO _____ LOCATION	

Excavation	☐ Layout	☐ Slope/cutting as per Specifications	☐ Level
Laying /RCC pipes	☐ Bed concrete as per Specifications	☐ RCC pipes as per Requirement	☐ Jointing of pipes
	☐ Boxing	☐ Strata bore Dewatering (wherever required)	
Manholes	☐ Bricks as per specifications	☐ Mortarasper specifications	☐ Plastering
	☐ End of pipes plugged		
Back fillings	☐ In layers		

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

NAME OF PROJECT_____

CONTRACTOR CONTRACT NO.	CHECK LIST FOR SUB GRADE LOCATION FLOOR NO._____	

LAYOUT	☐ Alignment of center line as drawings	☐ Marking of carriage way edges as per drawing		
SUB GRADE PREPARATION	☐ Initial cross sectional levels recorded	☐ Cleaning & grubbing of vegetation and top soil as specified	☐ Watering & rolling as specified	☐ Cross section levels recorded after rolling
FORMATION LEVEL (FILLING)	☐ Depth of filling upto formation Level ----------mtr.	☐ Nosof layers upto formation level ----------	☐ Fill material	☐ Spreading, watering & rolling of layers on layer no.
	☐ % compajction of soil (Proctor test)	☐ Camber/slope Provided as drawing	☐ Formationcrosssectional levels recorded	

W.O. Item	UNIT	QTY.

SIGNATURE:							
CONTRACTOR	DATE	SITE ENGR	DATE	SITE INCHARGE	DATE	CONSULTANT	DATE

LIST OF MANDATORY TESTS					
S. No.	**Description of Material**	**Test**	**Reference of IS Code / Specification for testing**	**Field / Laboratory test**	**Frequency of testing**
1	**Cement**	Physical & chemical properties	IS : 4031	Lab	Initial Test-01 test for each brand of cement. Subsequently, 01 test for 200 MT or part thereof for each brand. Cement should be of approved brand and each lot should be accompanied by manufacturer's test certificates
2	**Reinforcement steel**	Physical & chemical properties	IS :1786	Lab	Initial Test-01 test for each brand and each dia of reinforcement steel , Subsequently - One test for every 35 MT or part thereof. Reinforcement Steel should be of approved brand and each lot should be accompanied by manufacturer's test certificates
3	**Water**	PH value, chlorides, sulphates, alkalinity test, acidity test, suspended matter, organic matter and inorganic matter	IS:3025	Lab	Initial Test- Source approval at commencement of work and Subsequently- every six months or change of source.
4	**Coarse Aggregate - Building works**	Gradation	IS 2386 – I	Field / Lab	Minimum one test for every 50 cum or part thereof.
		Deleterious material	IS 2386 - II	Field / Lab	
		Specific Gravity	IS 2386 - III	Field / Lab	
		Crushing value	IS 2386 - IV	Field / Lab	
		impact value	IS 2386 - IV	Field / Lab	
		10% fine value	IS 2386 - IV	Field / Lab	
5	**Fine Aggregate- Building works**	Organic impurities	Appendix 'A 'of chapter 3 ,CPWD Specifications	Field	Minimum one test for every 50 cum or part thereof.
		Silt content	Appendix ' C 'of chapter 3 ,CPWD Specifications	Field	
		Bulking of Sand	Appendix 'D 'of chapter 3 ,CPWD Specifications	Field	
		Gradation	Appendix 'B 'of chapter 3 ,CPWD Specifications	Field / Lab	

6	**Coarse Aggregate - Road , Pavement works**	Gradation	IS 2386 – I	Field / Lab	One test for everyday's work.
		Flakiness and Elongation Index	IS 2386 – I	Field / Lab	Once for each source of supply and subsequently on monthly basis.
		Deleterious material	IS 2386 - II	Lab	One test for everyday's work.
		Water Absorption	IS 2386 - III	Lab	Regularly as required subject to a minimum one test a day. This data shall be used for correcting the water demand of mix on a daily basis
		Los Angeles Abrasion Value/Aggregate Impact value	IS 2386 - IV	Lab	Once for each source of supply and subsequently on monthly basis
		Soundness	IS 2386 - V	Lab	Before approving the aggregates and every month subsequently.
		Alkali aggregate reactivity	IS 2386 - VII, IS:456	Lab	Before approving the aggregates and every month subsequently.
7	**Fine Aggregate - Road ,Pavement works**	Gradation	IS 2386 – I	Field / Lab	One test for everyday's work.
		Deleterious material	IS 2386 - II	Lab	One test for everyday's work.
		Water Absorption	IS 2386 - III	Lab	Regularly as required subject to minimum two test per day. This data shall be used for correcting the water demand of mix on a daily basis.
		Silt Content	Appendix 'C' of chapter 3 ,CPWD Specifications	Field	Minimum one test for everyday's work.
8	**Slump Test - Building Works**		Appendix 'D' of Chapter 4, CPWD Specifications	Field	Minimum one test for every 20 cum of concrete or part thereof
9	**Slump Test - Pavement Works**		IS 1199	Field	One test per each dumper load at both Batching plant site and paving site initially when work starts. Subsequently, sampling may be done from alternate dumper.
10	**Cube Test**				
(i)	**Reinforced Cement Concrete - Building works**	7 days and 28 days Compressive strength	IS 516	Lab	One sample of six cubes for every 50 cum or part thereof
(ii)	**Dry Lean Concrete (DLC) - Pavement Work**	7 days compressive strength	IS 516	Lab	One sample of five cubes for every 150 cum or part thereof
(iii)	**Pavement Quality Concrete (PQC) - Pavement Work**	Compressive strength, flexure strength	IS 516	Lab	2 cube set samples and 2 beam set samples per 150 cum or part thereof for each day production.
11	**Earthwork**				
		Gradation/clay & sand content	IS 2720 -IV	Lab	2 tests per 3000 cum or part thereof for each source.
		Atterberg's limit	IS: 2720-V	Lab	
		California Bearing Ratio	IS 2720-XVI	Lab	

		Maximum dry density / OMC	IS 2720-VIII	Lab	
		Deleterious content	IS: 2720-XXVII	Lab	
		Free swelling Index	IS: 2720-XXXX	Lab	As and when required by Engineer
		Field density	IS: 2720-XXVIII	Field	(a) One set of 10 measurements for each layer per 3000 sqm of compacted area for embankment (b) One set of 10 measurements for each layer per 2000 sqm of compacted area of shoulder and sub-grade.
		Moisture content	IS: 2720-II	Field	2 tests per 1000 cum
12	**Granular Sub base**				
		Gradation	IS 2386- I	Field / Lab	Minimum 01 test per source and additional test after every 1000 cum
		Water absorption	IS 2386- III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Wet Aggregate Impact Value test (if WA >2.0%)	IS 5640	Lab	As required by Engineer
		Aggregate Impact Value	IS 2386- IV	Lab	Minimum 01 test per source and additional test after every 2000 cum
		Atterberg's limit	IS 2720-V	Lab	Minimum 01 test per source and additional test after every 1000 cum
		Maximum dry density /OMC	IS 2720-VIII	Lab	Minimum 01 test per source and additional test as required by Engineer
		Moisture content prior to compaction	IS 2720-II	Field	Minimum 01 test every 400 cum
		Field Density	IS 2720-XXVIII	Field	one test per 2000 Sqm or part thereof
		Deleterious material	IS: 2720-XXVII	Lab	Minimum 01 test per source and additional test as required by Engineer
		CBR	IS 2720-XVI	Lab	Minimum 01 test per source and additional test as required by Engineer
13	**Water Bound Macadam**				
		Gradation	IS 2386- I	Field / Lab	Minimum 01 test per source and additional test after every 500 cum
		Aggregate Impact Value	IS 2386- IV or IS5640	Lab	Minimum 01 test per source and additional test after every 500 cum
		Combined Flakiness and Elongation Indices	IS 2386- I	Lab	Minimum 01 test per source and additional test after every 500 cum
		Atterberg's Limit (Screening, Binding Material)	IS 2720-V	Lab	Minimum 01 test per source and additional test after every 500 cum or part thereof
		Water absorption	IS 2386-III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Sulphur Content, Water Absorption, Chemical Stability, Density for Crushed Slag (if used)	To comply with requirements of Appendix of BS : 1047	Lab	As required by Engineer
		Soundness test (if WA >2.0%)	IS 2386-V	Lab	As required by Engineer
14	**Wet Mix**	Gradation	IS 2386 – I	Field / Lab	Minimum 01 test per source and

	Macadam				additional test after every 500 cum
		Water Absorption	IS 2386-III	Lab	Minimum 01 test per source and additional test as required by Engineer
		Soundness (if WA > 2.0%)	IS 2386-V	Lab	As required by Engineer
		Atterberg's limit of portion of aggregate passing 425 micron sieve	IS 2720 - V	Lab	Minimum 01 test per source and additional test after every 500 cum or part thereof
		Aggregate Impact value	IS 2386- IV or IS 5640	Lab	Minimum 01 test per source and additional test after every 500 cum
		Maximum Dry Density / OMC	IS 2720 - VIII	Lab	Minimum 01 test per source and additional test as required by Engineer
		Combined Flakiness and Elongation Indices	IS 2386 – I	Lab	Minimum 01 test per source and additional test after every 500 cum
		Moisture content	IS 2720-II	Field	Minimum 03 tests per day
		Field Density	IS 2720 – XXVIII	Field	One set of three test per 2000 sqm or part thereof
15	**Prime /Tack Coat**				
		Quality of Binder	IS 73, IS 217, IS 8887	Lab	No. of samples per lot and tests as per IS 73, IS 217, IS 8887as applicable
		Binder Temperature for Application	As per MORTH specifications	Field	At regular close interval
		Rate of Spread of Binder	As per MORTH specifications	Field	Minimum 03 tests per day
16	**Dense Bituminous Macadam / Bituminous Concrete**				
		Mix grading	IS 2386- I	Lab	One set for individual constituent and mixed aggregates from dryer for each 400 tonnes of mix subject to a minimum of two tests per day per plant
		Plasticity Index	IS 2720-V	Lab	One test for each source and whenever there is change in the quality of aggregate.
		water absorption	IS 2386-III	Lab	One test for each source and whenever there is change in the quality of aggregate.
		Soundness (if WA>2%)	IS 2386-V	Lab	One test for each source and whenever there is change in the quality of aggregate
		Impact value / Abrasion value	IS 2386-IV	Lab	One test per 350 cum of aggregates for each source and whenever there is change in the quality of aggregates
		Combined flakiness and elongation Indices	IS 2386- I	Lab	One test per 350 cum of aggregates for each source and whenever there is change in the quality of aggregates
		Stripping value	IS 6241	Lab	Initially one set of 3 aggregate representative specimen and then for each change in quality of aggregate
		Stability and Void Analysis of Mix	ASTM: D-1559	Lab	Three tests for stability, flow value, density and void contents for each 400 tonnes of mix subject to minimum of two tests per day per plant

		Retained Tensile test (if retained Coating <95%) / Moisture Susceptibility Mix	AASHTO T283	Lab	one test for each mix type whenever there is change in quality or source of coarse or fine aggregate
		Binder Content	IRC: SP 11 Appendix 5	Field	Minimum 2 tests per day
		Field Density	IRC: SP 11 Appendix 5	Field	One test per 700 sqm
		Quality of Binder	IS 1201 to IS 1220	Lab	number of samples per lot (as in IS 73) and tests as per IS 73
		Temp Control at the time of laying and compaction		Field	At regular interval
17	**Brick work / brick tiles / sewer brick/Burnt clay perforated building Bricks**				
		Dimension	Appendix A, B, C & D of Chapter 6 of CPWD Specifications	Lab	Minimum one test for every 50000 bricks or part thereof
		Compressive strength		Lab	
		Water Absorption		Lab	
		Efflorescence		Lab	
18	**Stone work**				
		Water absorption	IS 1124	Lab	Minimum one test for every 200 sqm / 100 cum or part thereof
		Transverse Strength	IS 1121 - II		
		Resistance to wear	IS 1706		
		Durability	IS 1126		
19	**Marble**				
		Moisture absorption	IS 1124	Lab	Minimum one test for every 100 sqm or part thereof
		Hardness test	Mho's Scale		
		Specific Gravity	IS 1122		
20	**Granite**				
		Moisture	IS 1124	Lab	Minimum one test for every 100 sqm or part thereof
		Specific Gravity	IS 1122		
21	**Structural Steel (other than PEB)**				
		Tensile strength	IS 1599	Lab	Minimum one test for every 20 tonnes or part thereof per source and also manufacturer's test certificates for each consignment should be accompanied.
		Bend Test			
22	**Steel Tubular pipes**				
		Tensile test	IS 1608	Lab	Minimum one test for every 8 tonne or

		Bend Test	IS 2329		part thereof per source and also manufacturer's test certificates for each consignment should be accompanied.
		Flattening Test	IS 2328		
23	**M 50 Grade Cement Concrete Paver Blocks**				
(i)	**M-50 Grade Pre-Cast Concrete Paving Blocks**	Compressive Strength	As per Technical Specifications	Field / Lab	a) 16 paving blocks for everyday production. If, however, the average strength of the first 04 blocks tested is not less than 54 N/sqm, the sample shall be deemed to comply and the remaining 12 blocks from the sample need not be tested.
					b) If blocks are procured from outside and not manufactured at project site 01(one) test of 16 blocks per 10,000 nos. paving blocks or part thereof
		Dimensions	As per Technical Specifications	Field / Lab	a)16 paving blocks for everyday production b) If blocks are procured from outside and not manufactured at project site 01(one) test of 16 paving blocks per 10,000 nos. paving blocks or part thereof
(ii)	**Sand for Bedding Layer**				
		Percentage of Deleterious material	IS 2386	Lab	Minimum one test for every 50 cum or part thereof
		Particle Size Distribution	As per Technical specification	Field / Lab	
		Silt Content	As per Appendix 'C' of Chapter 3 of CPWD Specifications	Field	
		Moisture Content	IS 2720	Field	
(iii)	**Sand for Joint Filling**	Particle Size Distribution	As per Technical specification	Field / Lab	Minimum one test for every 50 cum or part thereof
Note:-	**For items not covered above may be dealt with as per the technical specifications in the contract.**				

1. Site Order Book				
Date	**Instructions issued on the Inspection of work with Signature and designation**	**Contractor / contractor's representative acknowledgement with Signature, Name & Date**	**Compliance report by contractor / contractor's representative with Signature, Name & date**	**Final remark Engineer with S designation**
2	**3**	**4**	**5**	**6**

2. Hindrance Register

Sl. No.	Nature of Hindrance	Date of Occurrence	Date of clearance	Period	Over lapping period if any	Weight age of hindrance	Net effective days of hindrance	Remarks and references	Sign. of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
1	2	3	4	5	6	7	8	9	10	11

3. Drawing Register

Sl. No	Drg. No. and revision no. if any	Date of receipt	Details of DRG	Date of Issue to Contractor	Acknowledgement of contractor	Signature of Site Engineer with date
1	2	3	4	5	6	7

4 Cement Register

Sl. No.	Date of Receipt	Source of Receipt	Bill/ Challan no.	Manufacture Test Certificate reference	Quantity Received (bags)	Progressive Total of Receipts (Bags)	Date of Issue	Qty. Issued (Bags)	Qty. Returned at the end of the Day (Bags)	Net Qty issued (Bags	Progressive Total of issue (Bags)	Balance at the end of the day (Bags)	Items of work for which Issued	Sign. of Site Engineer with date	Sign of Contractor with date	Remarks

5 Steel Register

Sl. No	Date of Receipt	Source of Receipt & Ch. No. /Bill No.	Qty Received (MT)	Cum Qty Received (MT)	Date of Issue	Qty issued (MT)	Cumulative qty issued (MT)	Balance at the end of the Day (MT)	Item of work in which consumed	Sign. Of Site Engineer with date	Sign. Of contractor with date	Manufacture Test certificate details	Remarks

6. Sieve Analysis of Stone Aggregate Nominal Size

Sl. No.	Date	Weight of sample in gms	Size of Sieves	Weight retained on each Sieve	%age of weight retained	Cumulative %age of weight Retained	%Age of weight passing	Specified %age of weight Passing	Sign. Of contractor with date	Sign. Of Site Engineer with date	Remarks/action taken
1	2	3	4	5	6	7	8	9	10	11	12

Note: Size of Sieve should be as per CPWD manual/BIS specification

7. Silt Contents of Fine Sand/Coarse Sand

Sl. No.	Date	Source of material	Height of Silt after Setting (V-1)	Height of sand after setting (V-2)	%age Silt Content V1/V2x100	Acceptability as per specification	Sign. Of Site Engineer with date	Sign. Of contractor with date	Location where sand used	Remarks/action taken
1	2	3	4	5	6	7	8	9	10	11

8. Slump Test

Sl. No.	Date of Testing	Item of work and location	Vibrators used Yes / No	Quantity of water added per bag of cement (Liters)	Height of specimen after removal of mould in (mm)	Slump (mm)	Acceptability of result or action taken	Sign. Of Site Engineer with date	Sign. of contractor with date	Remarks
1	2	3	4	5	6	7	8	9	10	11

9. Cube Test

Sl. No.	Date of Collection	Grade of Mix	Mark of Specimen	7 days Test Result				28 days Test Result				Required specified strength	Approx. qty represented by	Item of work from where the	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
				Date of Testing	Load in KN	Compressive strength (KN / mm2)	Average compressive strength (KN / mm2)	Date of Testing	Load in KN	Compressive strength(KN / mm2)	Average compressive strength (KN / mm2)					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

10. Density Test by Core Cutter Method

MDD as per lab test W5……..

Sl. No	Location (C.H.) / Area Represented by the Test	Core Cutter Nos.	Weight of Core Cutter + Weight of Soil (in gram) (W1)	Weight of Empty Core cutter (in gram) (W2)	Weight of Wet Soil (in gram) W= W1-W2	Volume of Core Cutter (in CC) V	Bulk Density (gram/cc) W3= W/V	Moisture Content of compaction layers (M)	Dry Density gram/cc W4 = W3/ (1+M)	Degree of compaction W4/W5	Acceptability limit	Sign. of Site Engineer with date	Contractor / contractor's representative Signature with Name & date
1	2	3	4	5	6	7	8	9	10	11	12	13	14

11. Test for Thickness and Density of the Compacted Layer (By Sand Replacement Method) for Asphalt Concrete / Bitumen Macadam / CC Pavement

Lab Test Density in gms/CC ……..

Sl. No	Date of Test	Qty. represented by the test	Location of holes	Thickness of Layer		Weight of materials removed from the carpet Hole	Initial weight of sand taken in Cylinder	Weight of sand filling in cone of cylinder	Weight of sand remaining in cylinder	Predetermined bulk density of sand	Density = $\frac{A.d.}{W-(W1+W2)}$	Remarks / Acceptability	Sign. Of Site Engineer	Contractor / contractor's representative Signature with Name & date	Action Taken
				Individual (mm)	Average (mm)	A gm	W gm	WI gm	W2 gm	d gm/CC	gm/CC				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

12. Density Test Register for Soil ---- By Sand Replacement Method

Unit Wt. of Standard Sand in grams/CC (W6) = …….

Lab Test MDD in gms/CC (W10) = …….

Sl. No	Date of Test	Qty. represented by the test	Location of holes	Thickness of Layer (mm)		Wt. of Material from the hole	Moisture Content %age	Initial weight of sand taken in the Cylinder before filling in hole in gms	Wt. of sand after filling in hole in gms	Wt. of sand in hole & cone in gms	Wt. of sand in cone in gms	Wt. of sand in hole in gms	Volume of hole in CC	Bulk Density in gms/CC	Dry Density in gms/CC	Degree of compaction	Remarks / Acceptability	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date	Action Taken
				Individual	Average	(W) gms	(Y)	(W1)	(W2)	(W3)= W1-W2	(W4)	W5 = (W3-W4)	(W7)= W5/W6	(W8)=W/W7	(W9)= W8/Y	W9/W10 x100	W9/W10 x100			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

13. Test of the Brick / Brick Tiles for Compressive Strength

Sl. No	Date of collection of sample	Date of testing	Wt. (in Kg)	No. of Specimen	Size in cm/Area in cm2	Compressive Strength obtained for individual bricks in Kg. per Cm2	Average Strength in Kg/Cm2	Specified Compressive Strength in Kg/Cm2	Acceptability	Sign. Of Site Engineer with date	Contractor / contractor's representative Signature with Name & date	Action Taken / Remark
1	2	3	4	5	6	7	8	9	10	11	12	13

14 Inspection Register

Sl. No	Date and time	Officer's Name and designation	Items inspected and specific defects noticed & action to be taken	Signature	Defects taken to Site Order Book/letter written			Final action / result
					Site Order Book Page no. / letter no.	Date	Sign. of Site Engineer / PMC	

Bill Performa

Name of work :

LOI No.

Name of Contractor :

Date of Start :

Date of Preparation of Bill :

S N	Item No.	Description of Items	Unit	Qty as per Agt.	Rate as per Agt.	Qty as per Pre. Bill	Qty as per this Bill	Cumulative Qty.	Amt. as per Previous Bill	Amt. as per this Bill	Cumulative Amount
1											
2											
3											
4											
5											
						Total of Schedule A					
						Add Enhancement or Rebate @					
						Grand Total of Schedule A					

Quality Assurance Plan				
S.N.	**Material**	**Test to be carried out**	**Contractor Role**	**SMFPIL Role**
1	100 mm thick Poly urethane foam(PUF) or as per any thickness designed by bidder conforming to industrial standards	Physical & Lab Test	• To be procured from approved make • Submission of OEM's Test Certificate for each Lot • One Lab Test for every 2000 Sq. Mtr • The tests to be conducted are enlisted in Annexure A	• Review of OEM's Test Certificate • Review of Lab Test Report
2	100mm Bare PUF Slabs or as per any thickness designed by bidder conforming to industrial standards	Physical & Lab Test	• To be procured from approved make • Submission of OEM's Test Certificate for each Lot • One Lab Test for every 2000 Sq. Mtr • The tests to be conducted are enlisted in Annexure A	• Review of OEM's Test Certificate • Review of Lab Test Report
3	All other PUF panels of varied thickness as applicable and design considerations conforming to industrial standards	Physical & Lab Test	• To be procured from approved make • Submission of OEM's Test Certificate for each Lot • One Lab Test for every 2000 Sq. Mtr • The tests to be conducted are enlisted in Annexure A	• Review of OEM's Test Certificate • Review of Lab Test Report
4	PUF doors	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate and technical compliance sheet to the tender technical specifications	• Review of OEM's Test Certificate
5	Overhead sectional door	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate and technical compliance sheet to the tender technical specifications	• Review of OEM's Test Certificate

6	Dock leveler	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate and technical compliance sheet to the tender technical specifications • Load testing at site during commissioning confirming to loads as per tender technical specifications.	• Review of OEM's Test Certificate • Review of site test report
7	Dock seals retractable type	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate and technical compliance sheet to the tender technical specifications	• Review of OEM's Test Certificate
8	Racking and material handling equipment and pallets and storage bins/crates etc.	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate • The Reach truck/stackers and racking storage system should be tested for load carrying capacity at the highest level of loading confirming to the loading parameters as per tender specifications during commissioning. • The battery accessories (as applicable) for all material handling equipments and all standbys should be tested as on then in the commissioning.	• Review of OEM's Test Certificate • Review of site test report
9	Sorting Grading Machinery and All Refrigeration equipment's, Accessories & Controls	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate • Commissioning certificate to be submitted as given in Annexure-B	• Review of OEM's Test Certificate • Review of Commissioning Certificate

10	Electrical Panel & Accessories	Physical Inspection at site OEM's Test Report	• To be procured from approved make • Submission of OEM's Test Certificate	• Review of OEM's Test Certificate

Annexure A-

As per tender documents all mentioned below parameters for OEM Test certificate and Lab test are required to confirm all parameters in line for PUF panels:

1-Density Test

2-Thickness of GI Sheet

3-Thickness of PUF

4-Epoxy Primer on both sides (thickness)

5- Polyester Top Coat (thickness)

6- Zinc Coating

7- Thermal Conductivity

8- Yield Strength of GI sheet

9- Tensile Strength of GI sheet

Annexure B-

All refrigeration machinery and equipments shall be tested for COP (Coefficient of performance) at the time of commissioning for 3 times as per the pull down time of chambers or on a shift basis as applicable. These tests shall cover for all compressors, evaporator (all indoor units), condenser, Water chillers etc including all accessories.

FORMATS

SCHEDULE – 1

ELIGIBILITY CRITERIA DOCUMENT

1.	Name of Company/Firm	
	Registered Address	
	Website & Email Address	
	Telephone Number	
	Fax Number	
2.	Description of the company giving detail of activities	
3.	Number of years of experience as a General Contractor	
4.	Number of years of experience as a Sub-Contractor	
5.	Names of members of Board of Directors	
6.	Names of principals who sign documents on behalf of the company	
7.	Attach a Company organization chart	
8.	Previous names of the company with the dates of changes (if any)	
9.	Previous partners with dates of changes(if any)	
10.	State if a member of any contractor's association/organization.	
11.	In which field of SITC/Engineering do you claim specialization & Interest.	

Encl.:

1) Attach attested copies of original documents:
a) Applicant's legal status.
b) Principal place of business.
c) The place of Incorporation (for applicants who are Corporation), the place of registration and nationality of the owners (for applicants who a rein partnerships or individually owned firms).
2) Power of attorney or authority to sign duly attested by Magistrate 1st Class.
3) Latest brochures and technical literatures.

Authorized Signatory with official seal

SCHEDULE – 2
ELIGIBILITY CRITERIA DOCUMENT

FINACIAL CAPABILITY

a) Summary of assets and liabilities on basis of the audited financial statements of the last three financial years.

ITEM	DESCRIPTION	2016-2017	2017-2018	2018-2020
1.	Total Assets			
2.	Current Assets			
3.	Total Liabilities			
4.	Current liabilities			
5.	Net worth (1-3)			
6.	Working Capital (2-4)			
7.	Annual Turn over			
8.	Services related turn over			
9.	Profit before taxes			
10.	Profit after Taxes			

Note:

a) Attach attested copies of the audited financial statements of the last three financial years.
b) Details of services related turnover

Name and Address of the Bank providing Credit line

c) Specify proposed sources of financing to meet the cash flow demands of the project, net of current commitments:

SOURCE OF FINANCING	AMOUNT
1.	
2.	
3.	

4.	

Firms owned by individuals, partnerships, may submit their balance sheets certified by the registered Chartered Accountant, and supported by copies of tax returns, if audits are not required by the laws of their countries of origin.

NOTE: (The following information is mandatory)

i) The average annual financial turnover during the last 3 years ending 31st March of previous financial year should clearly be indicated.

ii) The applicant should have positive net worth. This will be judged from audited balance sheet of the last financial year ending on a date not prior to 24 months from the due date of submission of this document.

Authorized Signatory with official seal

SCHEDULE - 3
ELIGIBILITY CRITERIA DOCUMENT

Assessed Available Bid capacity

The applicant must fulfil the criteria of...

Working Bid Capacity> Total estimated **cost of work(s) at the time of bidding**. Contractors should calculate the bid capacity as per given formula.

WBC = 2AN – B

A=	Average Annual Turnover of the bidder for last three financial years from similar nature of projects
B=	Value of the existing commitments and ongoing works of the bidder (lead member of the Consortium) to be completed during next 6 months (period of completion of works as per bid)
N=	No. of years prescribed for completion of works for which bids are invited i.e. 0.5 in this case.

Authorized Signatory with official seal

SECHUDLE – 4
ELIGIBILITY CRITERIA DOCUMENT

WORK EXPERIENCE

LIST OF RELEVANT PROJECTS OF VALUE OF PACKAGE (FOR WHICH PREQUALIFICATION IS SOUGHT), COMPLETED/STILL CONTINUING, DURING THE LAST TEN YEARS

Name of Employer / Client	Name, Location, Nature & Description of Work	Contract Price in Indian Rs.	% of Participation of the Company	Contractual Date of Commencement	Contractual Date of completion of Work	Actual Date of Start of Work	Actual Date of Completion of work	Reasons for Delay in Completion, if any	Value of work completed till the last date of submission of bid supported with certificate from employer/ client

Note :-
1. Certificates from the employers are to be attached in respect of the information furnished.
2. Attach photographs of completed Projects.
3. Attach additional photo copied pages, if required.
4. Works to be listed separately as per the similarity.
5. Attach performance certificates as per the value of work as defined in this document. There should not be an unsatisfactory performance of the applicant.

Authorized Signatory with official seal

SCHEDULE – 5
ELIGIBILITY CRITERIA DOCUMENT

LIST OF CURRENT PROJECTS

PROJECT TITLE	WORKS INVOLVED	HAFED	CONTRACT VALUE	DATE OF COMMENCEMENT OF WORKS	DUE DATE OF COMPLETION	%AGEWISE COMPLETION	EXPECTEDDATE OF COMPLETION

Note :- Works to be listed separately as per the similarity.

Authorized Signatory with official seal

SCHEDULE – 6

ELIGIBILITY CRITERIA DOCUMENT

INFORMATION REGARDING CURRENT LITIGATION OR ABANDONMENT OF WORK BY APPLICANT

i)	a) Is the applicant currently involved in any arbitration/litigation to the contract works.	**Yes / No**
	b) If yes, give details	
ii)	a) Has the applicant or any of its constituent partners been debarred/expelled by any agency in India during the last 5 years due to any reason	**Yes / No**
	b) If yes, give details	
iii)	a) Has the applicant or any of its constituent partners failed to complete any contract work in India during the last 5 years due to any reason.	**Yes / No**
	b) If yes, give details	
iv)	Applicant shall submit an affidavit with an undertaking that the applicant / associates have not been blacklisted by any Govt. Agency / State Government/ Central Government offices if any of the State in India.	

Note:- If any information in this schedule is found to be incorrect or concealed, participation of applicant will be summarily rejected at any time. The applicant is supposed to fill-up the correct details of arbitration/litigation during last five years with their outcome.

Details of dispute	Year	Award for or against applicant	Name of HAFED, cause of litigation and matter of dispute	Current value of disputed amount	Actual awarded amount

Signature with Seal of the Company
(Name of the Authorized Signatory)
Title / Designation

SCHEDULE – 7
ELIGIBILITY CRITERIA DOCUMENT
AFFIDAVIT

1. I, the undersigned duly authorized on behalf of company/firm/do hereby certify that all the statements made in the required attachments are true and correct to the best of my knowledge.

2. The undersigned hereby authorize(s) and request(s) any bank, person, firm or Corporation to furnish pertinent information deemed necessary and requested by the HAFED to verify this statement or regarding my(our)competence and general reputation.

3. The undersigned understands and agrees that further qualifying information may be requested and agrees to furnish any such information at the request of the HAFED.

(Signed by an Authorized Officer of the Firm)

Name and Title of Officer

Name of the Firm

Date
Encl.: Requisite Power of Attorney duly attested by Magistrate – 1st Class.

SCHEDULE – 8
ELIGIBILITY CRITERIA DOCUMENT

ADDITIONAL INFORMATION

Following additional information supported with attested copies, may be supplied along with your application:

1. Registration of company, partnership deed, Article of Association, Registration under Labour Law, Registration under GST etc

2. EPF No., PAN No. etc.

3. Details of available site testing equipments.

4. Details of possession of Electrical License from Chief Electrical Inspector of the State for execution of High Tension line network.

Please add any further information, which you consider to be relevant to the evaluation of your application. If you wish to attach other documents please list below, otherwise state “not applicable”.

Authorized Signatory with official seal

Format of Bank Guarantee for Bid Security
(BANK GUARANTEE ON NON-JUDICIAL STAMP PAPER OF Rs.100)

BID SECURITY (BANK GUARANTEE)

WHEREAS, _____ *[name of Bidder]* (hereinafter called "the Bidder") has submitted his Bid dated _____ *[date]* for the (**insert the name of the works)** (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that We _____ *[name of bank]* of having our registered office at _____ (hereinafter called "the Bank") are bound unto _____(hereinafter called "the Employer") in the sum of Rs._____[1](Rupees _____ _____ ____ _____) for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____ 2018.
THE CONDITIONS of this obligation are:

(1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified in the Form of Bid;
or
(2) If the Bidder having been notified of the acceptance of his bid by the Employer during the period of Bid validity:

(a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or

(b) fails or refuses to furnish the Performance Security, in accordance with the Instruction to Bidders; or

(c) does not accept the correction of the Bid Price pursuant;

we undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without any protest or demur or any objection, whatsoever on our part and without any first claim or reference to the Contractor, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the three conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date _____ days after the deadline for submission of Bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than the above date.

DATE _____ SIGNATURE OF THE BANK _____

WITNESS _____ SEAL _____

_____
[signature, name, and address]

The Bidder should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Section 1 (II).

Instruction for furnishing Bank Guarantee

- The Bank Guarantee by Bidders will be given on non-judicial stamp paper as per stamp duty applicable at the place where the tender has emanated. The non-judicial stamp paper should be in name of the issuing bank.
- This bank guarantee/ all further communication relating to the bank guarantee should be forwarded to HAFED Office, Panchkula only.
- The full address along with the Telex/Fax No. and email address of the issuing bank to be mentioned.

PERFORMANCE BANK GUARANTEE

To

_____ [name of Employer]
_____ [address of Employer]

WHEREAS _____ [name and address of Contractor] (hereafter called "the contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ [name of Contract and brief description of Works] (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligation in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee:

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you on behalf of the Contractor, up to a total of _____ [amount of guarantee]* _____ (in words), such sum being payable in the types and proportions of currencies in which the Contract Price is Payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____[amount of guarantee] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we waive notice of any such change, addition or modification.
The Bank guarantee for performance security shall remain in force as given in the Bid Document shall be valid up to 3 months beyond the expiry of the Defects Liability Period.

Signature and Seal of the guarantor_____
Name of Bank_____
Address _____
Date_____

* An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract including additional security for unbalanced Bids, if any and denominated in Indian Rupees.

BANK GUARANTEE FOR ADVANCE PAYMENT

To

_____ [name of Employer]
_____ [address of Employer]
_____ [name of Contractor]
_____ [name of Contract]

Gentlemen:

In accordance with the provisions of the Conditions of Contract, sub-clause 51.1 ("Advance Payment") of the above mentioned Contract,_____

[Name and address of Contractor] (Hereinafter called" the Contractor") shall deposit with _____ [name of Employer]a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of _____[amount of Guarantee]*_____[in words].

We, the _____[bank of financial institution], as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____[name of Employer] on his first demand without whatsoever right of obligation on our part and without his first claim to the Contractor, in the amount not exceeding_____[amount of guarantee]*_____[in words].

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between_____ [name of Employer]and the contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

The guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until_____ [name of Employer] receives full repayment of the same amount from the Contractor.

Yours truly,

Signature and Seal: _____
Name of Bank/Financial Institution:_____
Address: _____
Date: _____

---

* An amount shall be inserted by the Bank of Financial Institution the amount of the Advance Payment, and denominated in Indian Rupees.

INDENTURE FOR SECURED ADVANCES
FORM 31

(for use in cases in which the contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time)

This indenture made the _____ day of _____, 20____ BETWEEN _____ (hereinafter called the contractor which expression shall where the context so admits or implies be deemed to include his executors, administrators and assigns) or the one part and the Employer of the other part.

Whereas by an agreement dated _____ (hereinafter called the said agreement) the contractor has agreed.

AND WHEREAS the contractor has applied to the Employer that he may be allowed advanced on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to executive at rates fixed for the finished work (inclusive of the cost of materials and labour and other charges.)

AND WHEREAS the Employer has agreed to advance to the Contractor the sum of Rupees _____ on the security of materials the quantities and other particulars of which are detailed in Accounts of Secured Advances attached to the Running Account bill for the said works signed by the Contractor on _____ and the Employer has reserved to himself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works.

Now THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees _____ on or before the execution of these presents paid to the Contractor by the Employer (the receipt where of the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as a for said the Contractor doth hereby covenant and agree with the President and declare as follows:

(1) That the said sum of Rupees _____ - so advanced by the Employer to the Contractor as aforesaid and all or any further sum of sums advanced as aforesaid shall be employed by the Contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials details in the said Account of Secured Advances which have been offered to and accepted by the Employer as security are absolutely the Contractor's own propriety and free from encumbrances of any kind and the contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnified the Employer against all claims to any materials in respect of which an advance has be made to him as aforesaid.

(3) That the materials detailed in the said account of Secured Advances and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (Hereafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Engineer.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and on his own officer authorized by him. In the event of the said materials or any part thereof being stolen, being stolen, destroyed of damaged of becoming deteriorated in a greater degree than is due to reasonable use and wear thereof the Contractor will forthwith replace the same with other materials of like quality of repair and make good the same required by the Engineer.

(5) That the said materials shall not be any account be removed from the site of the said works except with the written permission of the Engineer of an officer authorized by him on that behalf.

(6) That the advances shall be repayable in full when of before the Contractor receives payment from the Employer of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the Employer will be at liberty to make a recovery from the contractor's bill for such payment by deducting there form the value of the said materials than actually used in the construction and in respect of which recovery has not been made previously, the value of this purpose being determined in respect of each description of materials at the rates at which the amounts if the advances made under these presents were calculated.

(7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing of the Employer shall immediately on the happening of such default be repayable by the Contractor to be the Employer together with interest thereon at twelve percent per annum from the date or repayment and with all costs, charges, damages and expenses incurred by the **Employer** in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the **Employer** to reply and pay the same respectively to him accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the Employer of the said sum of Rupees _____ and any further sum of sums advanced as aforesaid and all costs, charges, damages and payable under these presents

PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the power contained therein if and whenever the covenant and the money owing shall not be paid in accordance there with the **Employer** may at any time thereafter adopt all of any of the following courses as he may deem best:

(a) Seize and utilize the said materials or any thereof in the completion of the said works on behalf of the contractor in accordance with the provisions in that behalf contained in the said agreement and the amount due to the contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the contractor, he is to pay same to the **Employer** on demand.

(b) Remove and sell by public auction the sized materials or any part thereof and our of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the **Employer** under these presents and pay over the surplus (if any) to the Contractor.

(9) That except in the event of such default on the part of the contractor as aforesaid interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute of difference arising over the construction of effect of these presents the settlement of which has not been here-in-before expressly provided for the same shall be referred to the Employer whose decision shall be final and the provision of the Indian Arbitration Act for the time being in force shall apply to any such reference.

FORMAT FOR POWER OF ATTORNEY FOR LEAD MEMBER OF CONSORTIUM POWER OF ATTORNEY

(Only applicable for JV/ Consortium)

Whereas the Awarder of India (AWARDER) has invited applications from interested parties for Whereas, the member of the Consortium are interested in bidding for the Project and implementing the Project in accordance with the terms and conditions of the tender document (DNIT) and other connected documents in respect of the Project.

Whereas, it is necessary under the DNIT Document for the members of the Consortium to designate one of them as the Lead Member with all necessary power and authority to do for and on behalf of the Consortium, all acts, deeds and things as may be necessary in connection with the Consortium's bid for the Project.

NOW THIS POWER OF ATTORNEY WITNESSE THAT:

We, M/s. , M/s. and M/s. (the respective names and addresses of the registered office) do hereby designate M/s.(name and address of the registered office) being one of the members of the Consortium, as the Lead Member of the Consortium (name and address of the registered office) being one of the members of the Consortium, to do on behalf of the Consortium, all or any of the acts, deed or things necessary or incidental to the Consortium's bid for the Project, including submission of application / Proposal, participating in conference, responding to queries, submission of information / documents and generally to represent the Consortium in all its dealings with AWARDER, any other Government Agency or any person, in connection with Project until culmination of the process of bidding and thereafter till the Concession Agreement is entered into with AWARDER.

We hereby agree to ratify all acts, deeds and things lawfully done by Lead Member our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the day of[year] (Executants)

(To be executed by all the members of the Consortium) Notes:

• The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executants (s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

• Also, wherever required, the executants (s) should submit for verification the extract of the charter documents and documents such as a resolution / power of attorney in favor of the Person executing this Power of Attorney for the delegation of power hereunder on behalf of the executants (s)

FORMAT FOR POWER OF ATTORNEY FOR SIGNING OF APPLICATION
(Applicable for all bidders including JV)

(On Stamp paper of relevant value)

POWER OF ATTORNEY Know all men by these presents, we(name and address of the registered office) do hereby constitute, appoint and authorize Mr. / Ms. (name and address of residence) who is presently employed with us and holding the position of as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our bid for the project envisaging Bid for _____.at HAFED Mega Food Park, Rohtak including signing and submission of all documents and providing information / responses to HAFED, representing us in all matters before HAFED, and generally dealing with HAFED in all matters in connection with our bid for the said Project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

Dated this the Day of ....., …… For _____

(Signature)
(Name, Title and Address)
Signing on behalf of the Bidder/ Lead Member in case of Consortium

Accepted …… (Signature)
(Name, Title and Address of the Attorney)

Agreement Form

Agreement

This agreement, made the _____ day of _____ between _____ (name and address of Employer) [hereinafter called "the Employer"] and _____ (name and address of Contractor) hereinafter called "the Contractor" of the other part.

Whereas the Employer is desirous that the Contractor execute

_____

(name and identification number of Contract) (Hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein, at a cost of Rs.

_____

NOW THIS AGREEMENT WITNESSTH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to tem in the conditions of contract hereinafter referred to and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein conformity in all aspects with the provisions of the contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be ready and construed as part of this Agreement viz.
   - i) Letter of Acceptance
   - ii) Notice to proceed with the works;
   - iii) Contractor's Bid
   - iv) Condition of Contract : General and Special
   - v) Contract Data
   - vi) Additional condition
   - vii) Drawings
   - viii) Bill of Quantities and
   - ix) Any other documents listed in the Contract Data as forming part of the Contract.

In witnessed whereof the parties there to have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____ was hereunto affixed in the presence of:

Signed, Sealed and Delivered by the said _____
_____

in the presence of :

Binding Signature of Employer _____

Binding Signature of Contractor _____

Witnesses of Employer	Witnesses of Contractor
1	1
2	2

Section-7

BILL OF QUANTITIES/DNIT

Sr. No.	Description	Unit	Estimated Lump-sum Cost (Rs. in Crores)
1	Planning, Design, Fabrication, Supply, Erection, Testing, Commissioning and Trial Run (3 Months) including Civil, PEB, MEP, Firefighting Works for COLD STORAGE (500 MT), SORTING GRADING (1.5 TPH), WAREHOUSE (500 MT), Complete In all Respect On Turnkey Basis, with annual maintenance and technical operations of three years , with annual maintenance and technical operations of three years At HAFED Mega Food Park, Primary Processing Center JIND, Haryana	**JOB**	**Rs. 6.68 Crores**

Note:

1. The item wise price of goods to be supplied shall be on F.O.R. site basis inclusive of GST, applicable taxes, duties, freight etc. The item wise price shall also include the charges for packing and forwarding, transportation, transit insurance and all other local costs incidental to delivery of the goods to their final destination, storage insurance and safe custody at site.

2. The bidder should submit the bill of quantities/ individual price break-up of each item, clearly mentioning the item description, makes, model nos., quantities, rate, amount, GST and all applicable Tax if any and total price in numbers as well as in words. Failing to submit the individual price break-up in the asked format shall not be taken into account for evaluation and shall not be considered for award.

3. Bidders must quote their prices for all the three parts. In case the bidder omits any part(s), their bid will be considered as incomplete and treated as non-responsive.

4. Individual price break-up of each item shall be finalized by Competent Authority of HAFED for billing purpose.

5. The item wise price of goods to be supplied shall be on FOR site basis inclusive of applicable taxes & duties. The item wise price shall also include the charges for packing and forwarding, transportation, transit insurance and all other local costs incidental to delivery of the goods to their final destination, storage insurance and safe custody at site.
6. In case of discrepancy between unit price and total price, unit price shall prevail.

7. The item wise quoted price should inclusive of service cover/incidental services during defect liability period of 2 years.

FORM FOR PRICE BID

I/We hereby tender for the execution of the works for the Haryana State Cooperative Supply and Marketing Federation Limited (here in after referred to as HAFED) specified in the underwritten memorandum within the time specified in such memorandum.

Single percentage rates are to be quoted in the box specified below in figures as well as in words above/below applicable on Lump cost mentioned as Estimated cost in Tender documents.

We quote our rates _____ (in figures) above/below which will be applicable on the LS Amount provided in DNIT	We quote our rates _____ (in words) above/below which will be applicable on the LS Amount provided in DNIT

And in accordance, in all respects, with the specifications drawings and instructions in writing referred to in Section 1 to 9 of this document and with such materials as are provided by the Implementing Agency in all other respect in accordance with such conditions so far as applicable. The contract shall be divided in four part (i. SITC Supply Installation Testing and Commissioning, ii. AMC, iii. Operations separately, iv. Civil & PEB).

Enter both the rates in figures as well as in words, only in the space provided above. In the event of variation of rate in figures and words, the lower value only shall be considered. Only single percentage on all items of DNIT/BOQ is to be entered. In case more than one percentage is entered, the tender will liable to be rejected.

MEMORANDUM

(a)	General Description	Planning, Design, Fabrication, Supply, Erection, Testing, Commissioning and Trial Run (3 Months) including Civil, PEB, MEP, Firefighting Works for COLD STORAGE (500 MT), SORTING GRADING (1.5 TPH), WAREHOUSE (500 MT), Complete In all Respect On Turnkey Basis, with annual maintenance and technical operations of three years , with annual maintenance and technical operations of three years At HAFED Mega Food Park, Primary Processing Center JIND, Haryana
(b)	Estimated Cost	Rs. 668.00 Lakhs
(c)	Earnest Money	Rs. 6.68 Lakhs
(d)	Security to be deducted	5% of all bills (including earnest money)
(e)	Time allowed for completion of capital work	06 (Six) Months

Signature of Contractor

If, this tender is accepted, I/We hereby agree to abide by and fulfill all the terms and provisions of the said conditions of contract annexed hereto so far as applicable or in default thereof forfeit to and pay to the Federation or its successors in office the sums of money mentioned in the said conditions.

The Bank Guarantee of Rs. _____ lakhs is being submitted as EMD for this Bid, the full value of which is to be absolutely forfeited by the Federation or its successors in office without prejudice to any other rights or remedies of the said Federation or its successors in office, if I/We fail to commence the works specified in the above memorandum or otherwise the Bank Guarantee of Rs. _____ Lakhs shall be retained by the Federation on account of the security deposit. Should I/We withdraw or modify the tender within the period of bid validity, my/our earnest money will stand forfeited to the said Federation.

(Signature of the Contractor)

Price Schedule

(To be filled by the technical qualified bidders and submitted in hard copy in sealed envelope to HAFED on the date of financial bid opening)

Planning, Design, Fabrication, Supply, Erection, Testing, Commissioning and Trial Run (3 Months) including Civil, PEB, MEP, Firefighting Works for COLD STORAGE (500 MT), SORTING GRADING (1.5 TPH), WAREHOUSE (500 MT), Complete In all Respect On Turnkey Basis, with annual maintenance and technical operations of three years , with annual maintenance and technical operations of three years At HAFED Mega Food Park, Primary Processing Center JIND, Haryana

Part –I: SITC (Supply Installation, Testing & Commissioning) of for COLD STORAGE (500 MT), SORTING GRADING (1.5 TPH), WAREHOUSE (500 MT), Trial Run and Civil, MEP, Freighting works

S. NO.	ITEM DESCRIPTION	MAKE	MODEL NO.	QUANTITY	RATE	AMOUNT	PACKING FORWARDING	INSURANCE	GST	FREIGHT	TOTAL

Part II: Annual Maintenance of three years after completion of Defect Liability Period

S. NO.	Per Month Cost for 36 months	

Part III: Technical Operations of three years

S. NO.	Per Month Cost for 36 months	

Part IV: Civil & PEB Works:

S. NO.	Cost above/ below the estimated cost in the BoQ	

Authorized Signatory with official seal

SECTION – 8

Deviation Statement Forms Technical Deviation Statement

(TO BE SUBMITTED AND ATTACHED IN TECHNICAL BID)

Format A: Technical Deviation Statement

(1) The following are the particulars of deviations from the requirements of the tender specifications:

CLAUSE REFERENCE	DEVIATION	JUSTIFICATION	REMARKS

The technical specifications furnished in the bidding document shall prevail over those of any other document forming a part of our bid, except only to the extent of deviations furnished in this statement.

Dated:

Signature and seal of the Manufacturer / Bidder

NOTE:

- Where there is no deviation, the statement should be returned duly signed with an endorsement indication **"NO DEVIATIONS"**

FORMAT-B: Bidding Terms Deviation Statement Form

(2) The following are the particulars of deviations from the requirements of the bidding conditions / terms:

CLAUSE REFERENCE	DEVIATION	JUSTIFICATION	REMARKS

Dated:

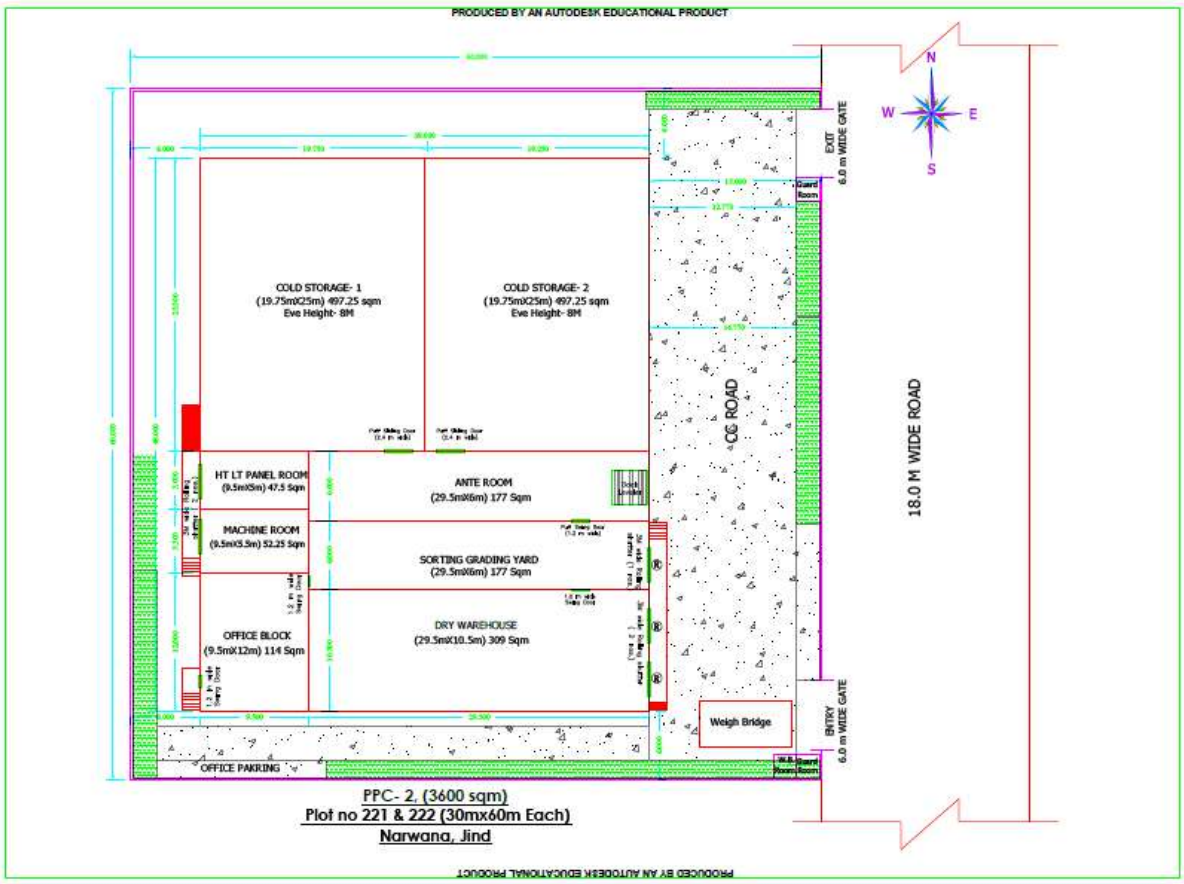
Signature and seal of the

Manufacturer / Bidder

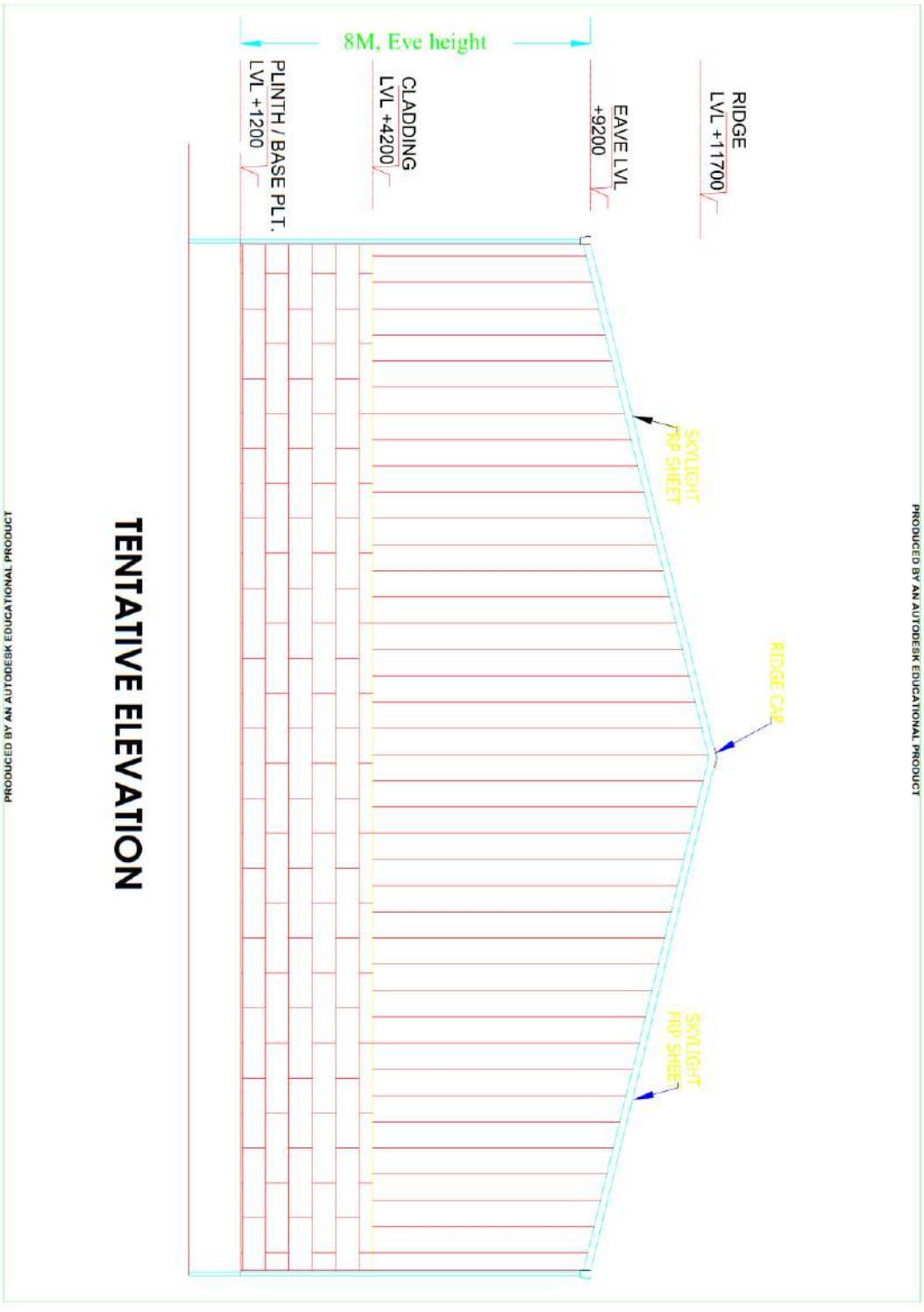
NOTE:

(1) Where there is no deviation, the statement should be returned duly signed with an endorsement indication **"NO DEVIATIONS"**

SECTION- 9 (Layout of Plot and BoQ of Construction Works)



The layout is for indicative purpose. The bidders are advised to propose their own design fulfilling the capacity and government norms.



TENTATIVE ELEVATION

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

Indicative Cost Summary of Construction Works- Refer Annexure A

Tentative BoQ of Civil, MEP, PEB works of PPC at HAFED MFP, Narwana Jind.		
Summary of Estimated Cost		
Sr. No.	**Description**	**Amount (Rs.)**
Bill No. 01	Civil Works	2,67,98,755.08
Bill No. 02	Electrical Works	22,52,426.00
Bill No. 03	Plumbing Works	15,22,307.25
Bill No. 04	PEB Works	65,65,815.00
Bill No. 05	FIRE FIGHTING WORK	37,39,535.00
	Total	**4,08,78,838.33**

Estimate for the Civil work of Construction of PPC Building in HAFED MFP, Narwana, Jind							
Civil Works							
S. No	**Item Source**	**Item Ref.**	**Description**	**Unit**	**Quantity**	**HSR & DSR-2018 Rate (Rs.)**	**Amount (Rs.) I/C CP**
			CIVIL WORKS				
			EXCAVATION				
1	HSR	4.12.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge. All kinds of soil	Cum	938.0	94.00	88,172.00
a	HSR	4.32	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.	Cum	510.0	67.00	34,170.00
2	HSR	4.33	Excavating, supplying and filling of local earth (including royalty) by mechanical transport upto a lead of 1 km also including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundation etc. complete.	Cum	5913.0	158.00	9,34,254.00
3	NS	NS	Supplying and filling in plinth with Jamuna sand under floors, including watering, ramming, consolidating and dressing complete.	Cum	188.00	852.82	1,60,330.16
4	HSR	4.38.1	Supplying chemical emulsion in sealed containers including delivery as specified. Chlorpyriphos/ Lindane emulsifiable concentrate of 20%	Per ltr	1030.0	194.00	1,99,820.00

5.00		4.39	Providing and injection chemical emulsion for PRE-CONSTRUCTIONAL antitermite treatment (excluding the cost of chemical emulsion) and creating a chemical barrier under and around the column pits, wall trenches, basement excavation, top surface of plinth filing junction of wall and floor, alongwith the external perimetre of building, expansion joints surrounding of pipes and conduite etc, complete (plinth area of the building at ground floor only shall be measured) using Chlorpyriphos/ Lindane emulsifiable concentrate of 20%	Sq Mt	2060.0	281.00	5,78,860.00
							-
6	HSR	6.1.4	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level :1:3:6 (1 Cement : 3 coarse sand (zone-III) : 6 graded stone aggregate 20 mm nominal size)	Cum	361.0	3,881.00	14,01,041.00
							-
7	HSR	6.1.2	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1: 2 :4 (1 Cement :2 Coarse sand (zone-III) : 4 graded stone aggregate 20mm nominal size)	Cum	12.0	4,376.00	52,512.00
							-

8	HSR	6.25.1	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works upto plinth lvl. (Note :- Cement content considered in this item is @ 330 kg/cum. Less cement used as per design mix is recoverable. However no extra payment shall be made if excess cement is used as per design mix).	Cum	491.0	5,277.00	25,91,007.00
8	HSR	6.25.2	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works above plinth level upto floor IV level. (Note :- Cement content considered in this item is @ 330 kg/cum. Less cement used as per design mix is recoverable. However no extra payment shall be made if excess cement is used as per design mix).	Cum	80.0	5,318.00	4,25,440.00
9		6.26.1	Providing M-30 grade concrete instead of M-25 grade BMC/ RMC. (Note:- Cement content considered in M-30 is @	Cum	571.0	60.00	34,260.00
10	HSR	10.115	Two coats of bitumen painting 20/30 penetration @ 1.65 Kg./Sqm.	Sqm	58.0	8.45	490.10

11	HSR	6.29.1	Centering and shuttering including strutting, propping etc. and removal of form work for : **Foundations, footings, bases for columns**	Sqm	990.0	158.00	1,56,420.00
12	HSR	6.29.3	Centering and shuttering including strutting, propping etc. and removal of form work for : **Columns, piers, abutments, pillars, posts and struts**	Sqm	656.0	384.00	2,51,904.00
13	HSR	6.30.5	Centering and shuttering including strutting, propping etc. and removal of form for : **Lintels, beams, plinth beams, girders, bressumers and cantilevers**	Sqm	3091.0	297.00	9,18,027.00
14	HSR	6.29.2	Centering and shuttering including strutting, propping etc. and removal of form work for : **Retaining walls, return walls, walls (any thickness) including attached pilasters, buttresses, plinth and string courses fillets, kerbs and steps etc.**	Sqm	720.00	319.00	2,29,680.00
15	HSR	6.30.3	Centering and shuttering including strutting, propping etc. and removal of form for : **Suspended floors, roofs, landings, balconies and access platform**	Sqm	82.0	364.00	29,848.00
16	HSR	6.33.6	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. : **Thermo-Mechanically Treated bars of grade Fe-500D or more.**	Kg	81340.0	69.00	56,12,460.00
17	HSR		Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level.: **Thermo-Mechanically Treated bars of grade Fe-500D or more.**	Kg	10305.0	69.00	7,11,045.00
			BRICK WORK IN CEMENT MORTAR				-
18	HSR	7.21.1	Brick work with common burnt clay non-modular bricks of class designation 7.5 in foundation and plinth in: **Cement mortar 1:4 (1 cement : 4 coarse sand)**	Cum	346.0	5,549.00	19,19,954.00
							-

19	HSR	7.23.1	Brick work with common burnt clay machine moulded perforated bricks of class designation 12.5 conforming to IS: 2222 in superstructure above plinth level up to floor four level in cement mortar 1:6 (1 cement : 6 coarse sand) : **With non-modular bricks**	Cum	235.0	5,579.00	13,11,065.00
							-
20	HSR	7.28.1	Half brick masonry with common burnt clay non-modular bricks of class designation 7.5 in superstructure above plinth level up to floor IV level. : **Cement mortar 1:3 (1 cement :3 coarse sand)**	Sqm	35.0	728.00	25,480.00
			FLOORING				-
21	HSR	10.63.2	Providing and laying vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08% and conforming to IS: 15622, of approved make, in all colours and shades, laid on 20mm thick cement mortar 1:4 (1 cement : 4 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joints with white cement and matching pigments etc., complete : **Size of Tile 600x600 mm**	Sqm	128.0	985.00	1,26,080.00
							-
22	HSR	10.67.2	Providing and laying Vitrified tiles in different sizes (thickness to be specified by manufacturer), with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shade, in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), jointing with grey cement slurry @ 3.3 kg/ sqm including grouting the joint with white cement & matching pigments etc. complete : **Size of Tile 600x600 mm**	sqm	8.0	994.00	7,952.00
							-

23	HSR	10.37.1	Providing and fixing of Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) **: 25mm thick**	Sqm	27.0	988.00	26,676.00
24	HSR	10.38	Providing and fixing of Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	Sqm	6.0	1,036.00	6,216.00
25	HSR	10.43	Extra for Kota stone/ sand stone in treads of steps and risers using single length up to 1.05 metre. (labour rate only)	Sqm	6.0	14.00	84.00
26	HSR	10.42	Extra for pre finished nosing in treads of steps of Kota stone/ sand stone slab. (labour rate only)	Meter	20.0	78.00	1,560.00
27	HSR	10.57	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS : 15622 of approved make in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand), Jointing with grey cement slurry @ 3.3 kg/sqm including pointing the joints with white cement and matching pigment etc., complete.	Sqm	18.0	541.00	9,738.00
							-

28	HSR	11.58	Providing and fixing 1st quality ceramic glazed wall tiles conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge in skirting, risers of steps and dados over 12 mm thick bed of cement Mortar 1:3 (1 cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.	Sqm	141.0	537.00	75,717.00
29	HSR	11.39	Washed stone grit plaster on exterior walls height upto 10 metre above ground level, in two layers, under layer 12 mm cement plaster 1:4 (1 cement : 4 coarse sand), furrowing the under layer with scratching tool, applying cement slurry on the under layer @ 2 kg of cement per square metre, top layer 15 mm cement plaster 1:1/ 2:2 (1 cement: 1/2 coarse sand : 2 stone chipping 10 mm nominal size), in panels with groove all around as per approved pattern, including scrubbing and washing the top layer with brushes and water to expose the stone chippings ,complete as per specification and direction of Engineer-in-charge (payment for providing grooves shall be made separately).	sqm	783.0	443.00	3,46,869.00
30	HSR	11.40.0	Forming groove of uniform size in the top layer of washed stone grit plaster as per approved pattern using wooden battens, nailed to the under layer, including removal of wooden battens, repair to the edges of panels and finishing the groove complete as per specifications and direction of the Engineer-in-charge :				-
	HSR	11.40.1	15 mm wide and 15 mm deep groove	meter	522.0	23.00	12,006.00
a	HSR	11.44	Extra for using white cement in place of ordinary cement in the top layar of the item of washed stone girt plaster	Sqm	783.00	71.00	55,593.00

b	NS	NS	Extra for using marble stone chips & Marble power instead of stone chips & Coarse sand in top layar 15mm thick washed stone grid plaster 1: 1/4:1/ 4 (1 Cement, 1/4 Marble power :1/4 Coarse snad, 2 marble chips & 2 Stone chipping 10 mm nominal size) complete as per specification and direction of Engineer-in- charge.	Sqm	783.00	54.10	42,360.30
31	HSR	11.1.1	6 mm cement plaster of mix : 1:3 (1 cement : 3 fine sand)	Sqm	36.0	112.00	4,032.00
32	HSR	11.5.2	12 mm thick cement plaster : 1:3 (1 cement: 3 fine sand) on walls.	Sqm	2345.4	151.00	3,54,155.62
33	HSR	11.6.1	15 mm cement plaster on the rough side of single or half brick wall of mix : **1:4 (1 cement: 4 fine sand)**	Sqm	118.0	162.00	19,116.00
34	HSR	9.12.1	10cm thick (average) mud phaska of damped brick earth on roofs laid to slope consolidated and plastered with 25 mm thick mud mortar with bhusha @ 35 kg per cum of earth and gobri leaping with mix 1:1 (1 clay : 1 cow-dung) and covered with machine moulded tile bricks, grouted with cement mortar 1:3 (1 cement : 3 fine sand) mixed with 2% of integral water proofing compound by weight of cement and finished neat : **With machine moulded common burnt clay non-modular brick tiles of class designation 12.5, conforming to IS 2690**	Sqm	34.0	551.00	18,734.00
35	HSR	9.18	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.	nos	6.0	151.00	906.00

36	HSR	9.17.1	Providing gola 75x75 mm in cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge), including finishing with cement mortar 1:3 (1 cement : 3 fine sand) as per standard design : **In 75x75 mm deep chase**	Rmt	24.0	115	2,760.00
37	HSR	9.55.5	Supplying and fixing in position 60 cm long G.I. pipe class 'B' spouts in chajjas and cantilevers : **50 mm internal dia** (Provision only)	Each	2.0	303	606.00
38	HSR	9.57.3	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes.				-
a			150mm dia pvc pipe	Mtr	150.0	264.00	39,600.00
39	HSR	9.58.5.3	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion.				-
a		(b)	150mm dia pvc bend	Each	20.0	128.00	2,560.00
40		11.60.1	Providing and applying white cement based putty of average thickness 1 mm, of approved brand and manufacturer, over the plastered wall surface to prepare the surface even and smooth complete.	Sqm	2560.2	58.00	1,48,489.07
41		11.69.2	Applying priming coats with primer of approved brand and manufacture, having low VOC (Volatile Organic Compound) content. : **With water thinnable cement primer on wall surface having VOC content less than 50 grams/litre**	Sqm	2560.2	26.00	66,564.07
							-

42	HSR	11.71.1	Wall painting on a cement plaster surface with acrylic emulsion paint of approved brand and manufacture to give an even shade : two or more coats on new work	Sqm	2560.2	64.00	1,63,850.01
43	HSR	11.78	Painting two coats excluding priming coat with synthetic enamel paint in all shades on new wood work or metallic or plastered or concrete surfaces to give an even shade.	Sqm	100.0	36.00	3,600.00
44	HSR	32.47.1	Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance ≥ 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge. : **With 16 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.55 to 0.6**	Sqm	114.0	1,488.00	1,69,632.00
							-
			JOINERY				-

45	HSR	12.157.1.3	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) : **Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron)**	Kg	822.0	352.00	2,89,344.00
46		12.157	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :				-
a		12.157.2.3	For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required (Fittings shall be paid for separately) : **Polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron)**	Kg	822.0	403.00	3,31,266.00

47		12.158.2	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade l Type ll, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer-in-charge. Pre-laminated particle board with decorative lamination on both sides	Sqm	20.0	776.00	15,520.00
48		12.160.1	Providing and fixing double action hydraulic floor spring of approved brand and manufacture conforming to IS : 6315, having brand logo embossed on the body / plate with double spring mechanism and door weight upto 125 kg, for doors, including cost of cutting floors, embedding in floors as required and making good the same matching to the existing floor finishing and cover plates with brass pivot and single piece M.S. sheet outer box with slide plate etc. complete as per the direction of Engineer-incharge. With stainless steel cover plate minimum 1.25 mm thickness	Each	4.0	1,871.00	7,484.00
							-
49	HSR	12.159.2	Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item):				-
a		(b)	With float glass panes of 5 mm thickness (weight not less than 12.50 kg/sqm)	Sqm	65.4	907.00	59,317.80
50		12.162.3	Providing and fixing stainless steel (SS 304 grade) adjustable friction windows stays of approved quality with necessary stainless steel screws etc. to the side hung windows as per direction of Engineer-in-charge complete : (355 X 19 mm)	Each	24.0	233.00	5,592.00
							-

51		12.164	Providing and fixing Brass 100mm mortice latch and lock with 6 levers without pair of handles (best make of approved quality) for aluminium doors including necessary cutting and making good etc. complete.	Each	10.0	316.00	3,160.00
52		12.166.2	Providing and fixing aluminium casement windows fastener of required length for aluminium windows with necessary screws etc. complete : **Powder coated minimum thickness 50 micron aluminium**	Each	50.0	58.00	2,900.00
53		12.167.2	Providing and fixing aluminium round shape handle of outer dia 100 mm with SS screws etc. complete as per direction of Engineer-in-charge : **Powder coated minimum thickness 50 micron aluminium**	Each	20.0	68.00	1,360.00
54		12.169.1	Filling the gap in between aluminium frame & adjacent RCC/ Brick/ Stone work by providing weather silicon sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete. : **Upto 5mm depth and 5 mm width**	meter	200.0	39.00	7,800.00
55		12.173	Providing and fixing bright finished 100 mm mortice lock with 6 levers without pair of handles of approved quality for aluminium door, with necessary screws etc complete as per direction of Engineer- in-charge.	Each	20.0	486.00	9,720.00
56	HSR	12.143	Providing and fixing Fiber Glass Reinforced plastic (FRP) Door Frames of cross-section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness. The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat. Door frame laminate shall be 2mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.	Mtr	14.9	553	8,212.05
							-

57	HSR	12.144.2	Providing and fixing to existing door frames- 30 mm thick Fiberglass Reinforced Plastic (F.R.P.) flush door shutter in different plain and wood finish made with fire retardant grade unsaturated polyester resin, moulded to 3 mm thick FRP laminate all around, with suitable wooden blocks inside at required places for fixing of fittings and polyurethane foam (PUF)/Polystyrene foam to be used as filler material throughout the hollow panel, casted monolithically with testing parameters of F.R.P. laminate conforming to table - 3 of IS: 14856, complete as per direction of Engineer-in-charge.	Sqm	6.0	3,202.0	19,212.00
							-
58	HSR	13.37.1	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters.-				-
a			80x1.25 mm M.S. laths with 1.25 mm thick top cover	Sqm	105.0	1,962.00	2,06,010.00
							-
59	HSR	13.38	Providing and fixing ball bearing for rolling shutters.	each	5.0	317.00	1,585.00
							-
60	HSR	13.39.1	Extra for providing mechanical device chain and crank operation for operating rolling shutters- Exceeding 10.00 sqm and upto 16.80 sqm in the area	Sqm	105.0	924.00	97,020.00
61		13.40	Extra for providing grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in-charge, (area of grill to be measured).	Sqm	20.0	571.00	11,420.00
							-

			External work				-
62	**HSR**	6.1.4	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : **1:3:6 (1 Cement : 3 coarse sand (zone-III) : 6 graded stone aggregate 20 mm nominal size)**	Cum	243.0	3,881.00	9,43,083.00
63	**HSR**	6.24.1	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge.:**All works upto plinth level**	Cum	405.0	5,620.00	22,76,100.00
64		6.26.3	Extra for providing richer mixes up to plinth and at all floor levels.: **Providing M-40 grade concrete instead of M-25 grade BMC/ RMC.(Note : Cement content considered in M-40 is @**	Cum	405.0	179.00	72,495.00
65	HSR	6.39.1	Providing and fixing at or near ground level precast cement concrete in kerbs, edgings etc. as per approved pattern and setting in position with cement mortar 1:3 (1 Cement : 3 coarse sand), including the cost of required centering, shuttering complete.: 1:1½:3 (1 Cement: 1½ coarse sand(zone-III) : 3 graded stone aggregate 20 mm nominal size).	cum	48.0	4,958.00	2,37,984.00
							-
66	HSR	13.42.1	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approved steel primer. M.S. Tube	kg	400.0	106.00	42,400.00
							-

67	NS	NS	Providing and laying C.C. pavement of mix M-30 with ready mixed concrete from batching plant. The ready mixed concrete shall be laid and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge. (The panel shuttering work shall be paid for separately). to give an even shade :	cum	281.0	5601.38	15,73,987.10
68	NS	NS	Providing and cuttting groove 10/5mm & to be filled with FIBEAL JSP 700 of Fibrex or equivalent make in a groove. Ensure that the groove or expansion joint to be treated should be free from all contaminants, dirt, dust, debris and unsound material in order to attain proper bonding. Moisture content should be less than 4%-6%. Apply masking tape on both edges of the groove or expansion joint in a straight line fashion.	cum	1100.0	110.00	1,21,000.00
69	HSR	13.28	Structural steel work in girders or stanchions built up one joint or channel sections welded including cutting and fixing all gusset plate bolts nuts welding rods etc complete with flange plates heads sole plates angle connections etc with hoisting and erecting in posititon				
		a	With one R.S Joint	Kg	10273.0	74.00	7,60,202.00
70		6.13	Making plinth protection 50mm thick of cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) over 75mm thick bed of dry brick ballast 40 mm nominal size, well rammed and consolidated and grouted with fine sand, including necessary excavation, levelling & dressing & finishing the top smooth.	sqm	52.2	357.00	18,635.40
			AREA DEVELOPMENT				
71	HSR	24.1	Preparation of sub grade, including trenching, rough dressing of spoil final dressing of earth,to given levels and camber, watering, rolling with road roller, and compacting the bed	100 sqm	1620.0	0.92	1,490.40

72		NS	Providing and laying of compacted Granular Sub Base Grading-I, in two layers including preparation and compaction complete as per MORT&H specification Clause 401.	cum	243.0	1100.00	2,67,300.00
			TOTAL				**2,67,98,755.08**

Estimate for the Electrical work of Construction of PPC Building , Narwana Jind.							
Electrical Works							
S.No	**Item Source**	**Item Ref.**	**Description**	**Unit**	**Quantity**	**HSR & DSR E & M-2018 Rate (Rs.)**	**Amount (Rs.) I/C CP**
1			**MAIN PANEL**				
	Market Rate	MR	Supply with all standard accessories & fixtures including testing at Factory & at Site. Receiving, unloading, Storing, Shifting, installing, commissioning of incoming & outgoing cable at site location	Set	1	76,840.00	76,840.00
			INCOMER				
-			1No. 100A TPN MCCB (25KA)				
			METERING & INDICATION				
-			1 set of R,Y,B phase indicating lamps with 6Amp SP MCB (3nos)				
			CT Operated Dual resistor Multifunction meter 3 nos				
			BUS-BAR				
-			1 Set of 200A, TPN Aluminium Bus Bar with colour coded PVC Sleeves				
			OUTGOINGS				
-			8 Nos. 63A 4 pole C Curve				

			Supply of weatherproof 20/32A SPN Metal Clad Socket with DP 16/32 DP MCB				
2			**Industrial Socket Outlets**				
	DSR E & M 2018		Supply, installation, testing & commissioning of weather proof type (IP 65) industrial type plug and socket outlet with MCB's (10 KA motor duty) mounted In a factory fabricated enclosure including termination, earthing etc as required				
		DSR18(E &M) 2.18	20/32A metal clad SPN Socket outlet controlled by 16/20/32A DP MCB.	Set	4	1,232.00	4,928.00
3			**CABLES, SUB MAINS & CABLE TRAYS:**				
			LT Cables:				
			Supply, installation, testing and commissioning of following sizes of PVC sheathed PVC/ XLPE insulated Aluminium armd. conductor/ copper armd conductor power/ multi-core control armoured cable of 1.1 KV grade on surface or in existing cable tray /masonry ducts/ hume pipe/ trench with fixing hardware etc as required.				
			<u>Aluminium Conductor Armoured Cables:</u>				
a	HSR	HSR 31.25 (xxvii)	3 ½ core 50 sqmm PVC Al cable	RM	180	203.07	36,552.60
4			**Cable Termination:**				
			Supply and making end termination with brass double compression glands for the following PVC/XLPE insulated PVC sheathed 1100 V grade cable including cost of crimping lugs/ferrules, compression glands, solder, cable sockets, insulation tap etc complete as required.				
			<u>Aluminium conductor armoured cables</u>				

a	HSR	HSR 31.28(iii)	3 ½ core 50 sqmm PVC Al cable	Set	6	38.20	229.20
		20.106	Supply, erection, testing & commissioning in LT cables PVC aluminum armoured / copper cable including cost of thimbles, lugs for making connection underground covered with sand and bricks / in trench / in pipe on steel bridges (detail of cable sizes & length to be provided be clearly mentioned) for making following connection complete as per directions of Engineer-in-charge				
a	HSR	20.106.1	from transformer to LT panel 1100 V grade 3.1/2 core 10 Sq. mm XLPE or for motor side 3 core aluminum 2x6 sq.mm XLPE	RM	180	180.00	32,400.00
5			**Cable Trays:**				
	DSR E & M 2018	DSR18(E &M) 4.1.8	Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc as required.				
		a	300 mm wide x 62.5mm depth x 2.0mm thickness	RM	100	599.00	59,900.00
6			**GI Pipe**				
	DSR E & M 2018	DSR201 8 (E & M) 14.13.2	Supply and installation of following sizes of `B' class GI pipe for cable sleeves in recess/ on surface/Ground complete with all accessories pull boxes where ever required, G.I. fish wire, fixing hardware etc. including the chasing of wall/floor, and plastering the chased portion, digging the trench and back filling, making good the damages, sealing of pipe entry etc as required.				
			Providing, laying and fixing following dia GI pipe (medium class) in ground complete with GI fittings including trenching (75cm deep) and refelling etc as required - 80 mm dia	RM	75	803.00	60,225.00

7			**WIRING**				
a	DSR 2018(EM)	1.3.3	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required. (GROUP C)				
		(a)	Group C	Each	100	1213	1,21,300.00
b	DSR 2018 (EM)	1.12	Wiring for light/ power plug with 2X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed medium class PVC conduit along with 1 No. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.	Mtr	600	200.00	1,20,000.00
c	DSR 2018 (EM	1.13	Wiring for light/ power plug with 4X4 sq. mm FRLS PVC insulated copper conductor single core cable in surface/ recessed medium class PVC conduit alongwith 2 Nos. 4 sq. mm FRLS PVC insulated copper conductor single core cable for loop earthing as required.	Mtr	600	308.00	1,84,800.00
d	DSR 2018 (EM)	1.14	Wiring for circuit / submain wiring alongwith earth wire with the following sizes of FR PVC insulated copper conductor single core cables in surface/recessed PVC conduit complete as required				
		1.14.3	2 X 4 sq. mm + 1 X 4 sq. mm earth wire - Ground Floor	mtr	600	200	1,20,000.00
8			SUBMAIN WIRING				
a	DSR 2018(EM)	1.14.9	4 X 6 sq. mm + 2 X 6 sq. mm earth wire	mtr	600	394	2,36,400.00
b	DSR 2018(EM)	1.14.10	4 X 10 sq. mm + 2 X 6 sq. mm earth wire	mtr	600	543	3,25,800.00

		23.8.10	Providing and fixing GI concealed sheet metal boxes with inner and outer face plate including concealing the box in wall and fixing in position with inner plate and face plate with all labour and material required for the job complete in all respects.				
		23.8.10.1	1 & 2 Modules including combined plate for Telephone and data	Each	10	92	920.00
		23.8.10.2	3 Modules	Each	10	125	1,250.00
		23.8.10.3	4 Modules	Each	20	138	2,760.00
		23.8.10.4	6 Modules	Each	20	182	3,640.00
		23.8.10.5	8 Modules	Each	30	229	6,870.00
		23.8.10.6	12 Modules	Each	20	278	5,560.00
9	HSR	23.8.11	Providing and fixing modular type accessories of approved make in existing box including fixing and making necessary connections, complete in all respect.				
		23.8.11.1	5 amp 1 way switch	Each	50	40	2,000.00
		23.8.11.2	5 amp 2 way switch	Each	40	73	2,920.00
		23.8.11.3	15 amp 1 way switch	Each	50	81	4,050.00
		23.8.11.4	5 amp Socket	Each	50	81	4,050.00
		23.8.11.5	15 amp 6 pin Socket	Each	30	122	3,660.00
		23.8.11.6	Bell Push	Each	1	75	75.00
		23.8.11.7	step type Fan Regulator 2 modules 300 watt	Each	12	253	3,036.00
		23.8.11.10	Blanking plate	Each	50	18	900.00

10			**CONDUITS**				
	HSR	HSR 31.58	Supplying and fixing of following sizes of FRLS PVC conduit along with the all accessories in surface/recess including cutting the wall and making good the same in case of recessed conduit as required or clamping with steel truss complete with junction boxes as required				
a			PVC pipe of 32mm dia	mtr	250	45.00	11,250.00
11			**VERTICAL/MULTITIER DISTRIBUTION BOARD**				
			Supply & Installation, testing & commissioning of following surface/reccesed Distribution Board (I.P-42 Protection), fabricated out of 16SWG, CRCA sheet indoor type, dust & vermin proof, hinged complete with bus bar, Internal connection, numbering,earthing, painting complete as required.				
			Make-ABB/Schneider				
			8W SPN DB				
	DSR E & M 2018	Basic Rate DSR 2018 (E&M) 1737	2+10 way, SPN, double door, MCB DB	Set	4	936.00	3,744.00
i			Incoming :				
-	DSR E & M 2018	Basic Rate DSR 2018 (E&M) 1710	6 amps to 32 amps ratings , TPN MCB “C” curve 10KA breaking capacity	nos	40	776.00	31,040.00
ii			Outgoings :				

-	DSR E & M 2018	Basic Rate DSR 2018 (E&M) 1707	6 amps to 32 amps ratings , SPN MCB “C” curve 10KA breaking capacity	Set	40	362.40	14,496.00
12			**LIGHT FIXTURES**				
			Supply following type of light fixtures with installation arrangement & proper support etc. complete as required. (Light Fixture Hang From the ceiling Height upto 11mtr or as per site requirement)				
a	Market Rate	MR	High bay Led 100W 240 v 0.440 A PF >0.95 THD <10 CT 5700K CRI >70 10000 lm	each	15	11,760.00	1,76,400.00
b	Market Rate	MR	supply and fixing of 1'X1' 24 WAtt LED light of Rossete /philips complete	each	20	7,000.00	1,40,000.00
		MR	72 watt LED with lens S/2 litting with having min. Of 7200 lumens & lumen efficence100 LPW, fitting should be IP/66/65 irrgress protection with interval lurge protection of min 5 KV Make-BAJAJ/Philips/Crompton /Halomix/ Jaquar/Surya Roshni	each	20	9,395.11	1,87,902.20
13			**EARTHING PITS & LIGHTENING CONDUCTOR**				
		24.1	**Earthing and Lightening Arrestor**				
		24.1.1	Earthing with GL earth pipe 4.5 m long and 40 mm dia with masonry enclosures on the top etc. (but without charcoal or coke and salt) as required.	each	4	2,736.00	10,944.00
		24.1.2	Extra for using salt and char coal/coke for pipe earth electrode as required.	each	4	642.00	2,568.00

a	HSR	24.1.4	Earthing with G.I. earth plate 600 mmx 600 mm x 6 mm thick including accessories and providing masonry enclosures with cover plate having locking arrangement and watering pipe etc. (but without charcoal or coke and salt) complete as required.	Set	6	8,202.00	49,212.00
b	HSR	24.1.16	Supply and erection of 25mm dia 1.5 metre long lightning GI. tube rod tapered into a point at the top with 16cm x 16cm x 3mm thick G.I. base plate and necessary nuts and bolts with washers.	Lot	6	884.00	5,304.00
c	HSR	24.1.9	Providing and fixing 25 mm x5 mm copper strip in 40 mm dia G.I. pipe from earth electrode as required.	RM	40	719.00	28,760.00
14			**External light**				
	HSR	24.4.8	Supply of Hot Dip Galvanized octagonal pole of 3mm thickness, with base plate including cost of nut and bolts , earthing studs, Integral Cable termination arrangement 5 mm thick Bakellite base plate on suitable welded MS/GI bracket 32 A four way connector 2 no 10 A SP MCB , end cover and all accessories as supplied by the manufacture	Each			
		24.4.8.5	7 Mtr Long pole with top dia 75 0mm and bottom dia 150 mm with base plate of size 300 x 300 x 20 mm	Each	20	8,487.00	1,69,740.00
			Total Electrical Works				**22,52,426.00**

PEB WORKS

Providing and installing Pre Engineered Building (PEB) comprising of pre-fabricated steel portals with rod / angle bracings as per drawing. 26 G Colored Galvalume 0.5mm thick TCT wall sheeting. 26 G Bare Galvalume 0.5mm thick TCT (Total Coated Thickness) roof sheeting with daylight panel on 2% of Roof Area & turbo vents for ventilation. All primary and secondary members with Red Oxide primer and synthetic enamel paint. And The shed shall be supplied with all necessary fittings, fasteners, EPDM gaskets / washers & flashings & rain water pipes (0.5mm thick colour coated galvalume sheet). The pre-fab shed wok should be carried out by a specialized approved agency having in house manufacturing facility and having ISO : 9001 certification for both manufacturing and contracting. The design and engineering and supply and installation shall be in the scope of the vendor.

S.No.	Description of Item	Qty	Unit	Supply Charges		Erection Charges		
				Rate	Amount	Rate	Amount	Final Cost
1	**Structural Steel -** Primary & Secondary Steel complete with primer & 2 coats of synthetic enamel paint (applied at site)	39640	Kg.	76.00	30,12,640.00	8.50	3,36,940.00	**33,49,580.00**
2	**Roofing** - HI RIB SMP 0.50 Galvalume with screws	1928	Sq.mtr.	405.00	7,80,840.00	50.00	96,400.00	**8,77,240.00**
3	**Insulation - 50**mm thick 16 kg/m3 density Alum Foil	2059	Sq.mtr.	150.00	3,08,850.00	20.00	41,180.00	**3,50,030.00**
4	**Cladding** - HI RIB SMP 0.50 Galvalume with screws	1928	Sq.mtr.	405.00	7,80,840.00	50.00	96,400.00	**8,77,240.00**
5	**Day Light Panels** - Polycarbonate 2.00mm	56.16	Sq.mtr.	950.00	53,352.00	50.00	2,808.00	**56,160.00**
6	**Turbo Ventilators 600mm**	12	Nos.	4,000.00	48,000.00	500.00	6,000.00	**54,000.00**
	Total				**49,84,522.00**		**5,79,728.00**	**55,64,250.00**
	ADD 18% GST							**10,01,565.00**
	Total							**65,65,815.00**

Estimate for the plumbing work of Construction of PPC Building in Mega Food Park at Indl. Estate, Narwana							
PLUMBING WORKS							
S.No	**Item Source**	**Item Ref.**	**Description**	**Unit**	**Quantity**	**HSR & DSR-2018 Rate (Rs.)**	**Amount (Rs.) I/C CP**
1	HSR	22.24	Providing and fixing white vitreous chinaware pedestal type water closet (European type) with seat and lid, 10 litre low level white vitreous chinaware flushing cistern & C.P. flush bend with fittings & C.I. brackets, 40 mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required :				
		22.24.1	W.C. pan with ISI marked white solid plastic seat and lid	each	3	4,317.00	12,951.00
2	HSR	22.42	Providing and fixing toilet paper holder :				
		22.42.2	vitreous chinaware- white	each	3	248.00	744.00
3	HSR	22.10	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require:				
	b	22.1.1	White vitreous chinaware Wash basin size 630x450 mm with a pair of 15 mm C.P. brass pillar taps	each	3	1994	5,982.00
4	HSR	22.14.1.1	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete. (semi girid pipe): 32 mm dia	each	3	45	135.00
5	HSR	22.17.1	Providing and fixing 40mm i/d chromium plated trap with chromium plated pipe to wall with walflange completed for use with sinks: With Bottle Trap (Indian make)	each	6	869	5,214.00
6	HSR	22.35	Providing and fixing G.I. inlet connection for flush pipe connecting with W.C. pan.	each	3	79	237.00

7	HSR	22.26.4	Providing and fixing white vitreous chinaware flat back half stall urinal of size 580x380x350 mm with white PVC flushing cistern, with fittings, standard size C.P. brass flush pipe, spreaders with unions and clamps (all in C.P. brass) with waste fitting as per IS : 2556, C.I. trap with outlet grating and other couplings in C.P. brass, including painting of fittings and cutting and making good the walls and floors wherever required :				
a		i	Range of three half stall urinals with 10 litre P.V.C. automatic flushing cistern-white	each	3	9,093.00	27,279.00
8	HSR	22.119.2	Providing and fixing PTMT towel rail complete with brackets fixed to wooden cleats with CP brass screws with concealed fittings arrangement of approved quality and colour. : 600 mm long towel rail with total length of 645 mm, width 78 mm and effective height of 88 mm, weighing not less than 190 gms.	each	2	353.00	706.00
9	HSR	22.10.1.3	Providing and fixing Stainless Steel A ISI 304 (18/8) kitchen sink as per IS:13983 with C.I. brackets and stainless steel plug 40 mm, including painting of fittings and brackets, cutting and making good the walls wherever required : kitchen shink with drain board				
a		a	510x1040 mm bowl depth 200 mm	each	1	4,026.00	4,026.00
10	HSR	22.210.4	Providing and fixing mirror of superior glass (of approved quality) and of required shape and size with plastic moulded frame of approved make and shade with 6 mm thick hard board backing :				
a		a(ii)	Rectangular shape 1500x450 mm	each	3	1,253.00	3,759.00
11	HSR	22.20.2	Providing and fixing in position super quality 65 mm i/d opening CP brass dome type hinged grating weighing about 750gram fixed in cement mortar 1:2 complete in all respect (as required by engineer in charge) :	each	3	67.50	202.50
12	HSR	22.81.1	Cutting chases in brick walls in cement or in floorfor embedding GI or HCI PIPELINE AND making good the same to its original conditions.:				
a		b	150 mm dia.	metre	3	9.00	27.00

13	HSR	22.20.1	Provinding and fixing in position C.I. plain Nahani Trap conforming to I.S.I. specifications and of self cleaning design with C.P. brass hinged grating with frame complete				
a		b	Providing and fixing 75 mm outlet plain nahani trap.	each	6	1,353.00	8,118.00
14	HSR	22.92.2	Making connection of G.I. distribution branch with G.I. main of following sizes by providing and fixing tee, including cutting andthreading the pipe etc. complete : 50 to 80 mm nominal bore	each	3	834.00	2,502.00
15	HSR	22.105.1	Providing and fixing C.P. brass long nose bib cock of approved quality conforming to IS standards and weighing not less than 810 gms.				
a		c	15 mm nominal bore	each	3	504.00	1,512.00
16	HSR	22.106.1	Providing and fixing C.P. brass long body bib cock of approved quality conforming to IS standards and weighing not less than 690 gms.				
a		a	15 mm nominal bore	each	3	440.00	1,320.00
17	HSR	22.38	Providing and fixing 8 mm dia C.P. / S.S. Jet with flexible tube upto 1 metre long with S.S. triangular plate to Eureopean type W.C. of quality and make as approved by Engineer - in - charge.				
a				each	3	238.00	714.00
18	HSR	22.107.1	Providing and fixing C.P. brass stop cock (concealed) of standard design and of approved make conforming to IS:8931.				
a		a	15 mm nominal bore.	each	3	500.00	1,500.00
19	HSR	22.12.1	Providing and fixing CP Brass Single lever telephonic wall mixer of quality & make as approved by Engineer in charge.				
a		b	15 mm nominal dia	each	3	5,164.00	15,492.00
20	HSR	22.51.1.1	Providing and fixing soil, waste and vent pipes :				
a		a	(100 mm dia) Sand cast iron S&S pipe as per IS: 1729	metre	105	816.00	85,680.00

21		22.54.1	Providing and fixing M.S. holder bat clamp of approved design to sand cast iron/ cast iron (spun) pipes comprising of M.S. flat brackets made of 50x5 mm flat of specified shape, projecting 75 mm outside the wall surface and fixed on wall with 4Nos., 6mm dia expansion hold fasteners, including drilling necessary holes in brick wall/ CC/ RCC surface and the cost of bolts etc. The pipes shall be fixed to the already fixed brackets with the help of 30 mm x1.6 mm galvanised M.S. flats of specified shape and of total length 420 mm and shall be fixed with M.S. nuts, bolts, & washers of size 25x6 mm, one bolts on each side of the pipe.				
		b	Total bracket length 580mm of approved shape and design for single 100 mm dia pipe	each	20	175.00	3,500.00
a		22.57.1.1	Providing and fixing heel rest sanitary bend : Sand cast iron S&S as per IS - 1729- 100 mm dia	each	6	407.00	2,442.00
b		22.58.1.1	Providing and fixing double equal junction of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete : 100x100x100x100 mm- Sand cast iron S&S as per IS - 1729	each	6	847.00	5,082.00
c		22.60.1.1	Providing and fixing single equal plain junction of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete.: 100x100x100x100 mm- Sand cast iron S&S as per IS - 1729	each	6	493.00	2,958.00
d		22.55.1.1	Providing and fixing bend of required degree with access door, insertion rubber washer 3 mm thick, bolts and nuts complete. : 100 mm dia : Sand cast iron S&S as per IS - 1729	each	6	373.00	2,238.00
g		22.76.1.1	Providing and fixing collar :: 100 mm dia : Sand cast iron S&S as per IS - 1729	each	12	291.00	3,492.00
22	HSR	22.85	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge. : internal work- exposed on wall				

a		22.85.6	50 mm nominal outer dia Pipes	metre	50	637.00	31,850.00
b		22.85.5	40 mm nominal outer dia Pipes	metre	15	421.00	6,315.00
c		22.85.4	32 mm nominal outer dia Pipes	metre	15	305.00	4,575.00
d		22.85.3	25 mm nominal outer dia Pipes	metre	40	228.00	9,120.00
e		22.85.2	20 mm nominal outer dia Pipes	metre	50	178.00	8,900.00
f		22.85.1	15 mm nominal outer dia Pipes	metre	50	128.00	6,400.00
23		22.87	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings This includes jointing of pipes & fittings with one step CPVC solvent cement, trenching, refilling & testing of joints complete as per direction of Engineer in Charge: External work				
		22.87.1	15 mm nominal outer dia Pipes	metre	10	100.00	1,000.00
		22.87.2	20 mm nominal outer dia Pipes	metre	10	144.00	1,440.00
		22.87.3	25 mm nominal outer dia Pipes	metre	10	198.00	1,980.00
		22.87.4	32 mm nominal outer dia Pipes	metre	30	267.00	8,010.00
		22.87.5	40 mm nominal outer dia Pipes	metre	50	367.00	18,350.00
		22.87.6	50 mm nominal outer dia Pipes	metre	100	582.00	58,200.00
		22.87.7	62.50 mm nominal outer dia Pipes	metre	10	1,209.00	12,090.00
		22.87.8	75 mm nominal outer dia Pipes	metre	10	1,558.00	15,580.00
		22.87.9	100 mm nominal outer dia Pipes	metre	5	2,221.00	11,105.00
		22.87.10	150 mm nominal outer dia Pipes	metre	5	4,633.00	23,165.00
24	HSR	22.78	Providing lead caulked joints to sand cast iron/centrifugally cast (spun) iron pipes and fittings of diameter :				
		22.78.1	100 mm	each	20	238	4,760.00
		22.78.2	75 mm	each	15	205	3,075.00
		22.78.3	50 mm	each	10	171	1,710.00
25	HSR	22.98	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end) :				
a		22.98.1	25 mm nominal bore	each	6	400.00	2,400.00

b		22.98.2	20 mm nominal bore	each	5	371.00	1,855.00
c		22.98.3	32 mm nominal bore	each	2	477.00	954.00
d		22.98.4	40 mm nominal bore	each	2	558.00	1,116.00
e		22.98.5	50 mm nominal bore	each	2	719.00	1,438.00
f		22.98.6	65 mm nominal bore	each	2	1,246.00	2,492.00
g		22.98.7	80 mm nominal bore	each	1	1,864.00	1,864.00
26		22.99	Providing and fixing gun metal non- return valve of approved quality (screwed end) :				
a		22.99.1.1	25 mm nominal bore - Horizontal	each	1	387.00	387.00
b		22.99.1.2	25 mm nominal bore - Vertical	each	1	410.00	410.00
c		22.99.2.1	32 mm nominal bore - Horizontal	each	1	525.00	525.00
d		22.99.2.2	32 mm nominal bore - Vertical	each	1	582.00	582.00
e		22.99.3.1	40 mm nominal bore - Horizontal	each	1	652.00	652.00
f		22.99.3.2	40 mm nominal bore - Vertical	each	1	812.00	812.00
g		22.99.4.1	50 mm nominal bore - Horizontal	each	1	950.00	950.00
h		22.99.4.2	50 mm nominal bore - Vertical	each	0	1,041.00	-

27	HSR	22.179.0	Constructing brick masonry chamber for underground C.I. inspection chamber and bends with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg), R.C.C. top slab with 1:1.5:3 mix (1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size), foundation concrete 1:5:10 fine sand : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 coarse sand), finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design: **With common burnt clay non-modular bricks of class designation 7.5**				
a		22.179.1.1	Inside dimensions 455x610 mm and 45 cm deep for single pipe line :	each	3	4,384.00	13,152.00
b		22.179.2.1	Inside dimensions 500x700 mm and 45 cm deep for pipe line with one or two inlets :	each	3	5,050.00	15,150.00
c		22.179.3.1	Inside dimensions 600x 850 mm and 45 cm deep for pipe line with three or more inlets :	each	3	5,797.00	17,391.00
28		22.180.0	Extra for depth beyond 45 cm of brick masonry chamber : With common burnt clay non-modular bricks of class designation 7.5				
a		22.180.1.1	For 455x610 mm sizer	Mtr	3	4,271.00	12,813.00
b		22.180.2.1	For 500x700 mm size	Mtr	3	4,653.00	13,959.00
c		22.180.3.1	For 600x850 mm size	Mtr	3	5,409.00	16,227.00
29	HSR	22.181	Providing and placing on terrace (at all floor levels) polyethylene water storage tank, IS : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	litre	2,000	7.00	14,000.00
30	HSR	30.110b	Providing and fixing in position automatic brass ball valves in tanks. (b) With Plastic Ball (ii) 20 mm internal diameter. [HSR 30.110 (b)	each	2	55	110.00

			(ii)].				
31	HSR	22.164.0	Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) all-round S.W. pipes including bed concrete as per standard design :				
a		22.164.1	100 mm diameter S.W. pipe	metre	50	491	24,550.00
b		22.164.2	150 mm diameter S.W. pipe	metre	75	601.00	45,075.00
c		22.164.3	200 mm diameter S.W. pipe	metre	195	700.00	1,36,500.00
d		22.164.4	250 mm diameter S.W. pipe	metre	50	810.00	40,500.00
32	HSR	22.163.0	Providing, laying and jointing glazed stoneware pipes class SP-1 with stiff mixture of cement mortar in the proportion of 1:1 (1 cement : 1 fine sand) including testing of joints etc. complete :				
a		22.163.1	100 mm diameter	metre	50	230.00	11,500.00
b		22.163.2	150 mm diameter	metre	75	351.00	26,325.00
c		22.163.3	200 mm diameter	metre	195	443.00	86,385.00
d		22.163.4	250 mm diameter	metre	50	652.00	32,600.00
33	HSR	30.114	Providing and fixing in position gully trap fixed in cement concrete 1:4:8 complete with HCI grating 150mmx 150mm cast Iron weighing approx 7.26kg and frame clear opening 300mmx 300mmand chamber including cost of brick work in cement mortar 1:5 cement concrete1:8:16 in foundations. And cement concrete 1:2:4 in coping around CI frame and cover etc. with three coats of black bitumestic superior paint of approved manufacture of all CI work as per standard design. Minimum depth of water should be 150mm with a minimum seal 50mm.:				
a			100 mm internal diameter.	each	2	166.00	332.00
34	HSR	22.21	Constructing brick masonry road gully chamber 50x45x60 cm with bricks in cement mortar 1:4 (1 cement : 4 coarse sand) including 500x450 mm pre-cast R.C.C. horizontal grating with frame complete as per standard design : With common burnt clay non-modular bricks of class designation 7.5				

a		22.205.1	With common burnt clay non-modular bricks of class designation 7.5	each	2	3,723.00	7,446.00
			TOTAL FOR PHE WORKS (PLUMBING)				9,55,889.50
			PART-2				
			RCC Pipe				
1	HSR	21.96.1	Providing lowering, cutting jointing and testing RCC pipe class NP3 as per IS-458-2003 which Spigot & socketted joints manufactured with ISI marked sulphate Resistance Cement as per ISI 12330 with rubber rings ISI marked antitermite as required at site, into trenches, for all depths and laying out the same to correct alignment and cutting of concrete bed and sides of trenches, if required, jointing with rubber rings in trenches and jointing with 1:1 1/2 cement sand mortar and with end dowels filled with 1:1 1/2 cement sand mortar and finishing the joints cutting and finishing the cut surface to a uniform finish etc. as fully described in HSR item No. 29.38, 29.44, 29.45 & 29.46 including cartage loading and unloading complete in all respects. the internal diametric of the sewer being				
		21.96.1	350mm	per mtr	50.00	1101	55,050.00
						Total	**55,050.00**
			Part -3				
			Detailed Estimate- Rain water harvesting pit				
1	HSR	33.6	Boring/drilling bore well of required dia for casing/ strainer pipe, by suitable method prescribed in IS: 2800 (part I), including collecting samples from different strata, preparing and submitting strata chart/ bore log, including hire & running charges of all equipments, tools, plants & machineries required for the job, all complete as per direction of Engineer-in-charge, upto 90 metre depth below ground level.				
(a)	HSR	33.6.1	All types of soil				
	HSR	33.6.1.	300 mm dia	metre	120.0	339.00	40,680.00

		1					
2	HSR	33.8	Supplying, assembling, lowering and fixing in vertical position in bore well, unplasticized PVC medium well casing (CM) pipe of required dia, conforming to IS: 12818, including required hire and labour charges, fittings & accessories etc. all complete, for all depths, as per direction of Engineer -in-charge.				
(a)	HSR	33.8.3	200 mm nominal size dia	metre	100.0	905.00	90,500.00
3	HSR	33.12	Supplying, filling, spreading & leveling stone boulders of size range 5 cm to 20 cm, in recharge pit, in the required thickness, for all leads & lifts, all complete as per direction of Engineer-in-charge.	cum	4.8	1023.00	4,941.09
4	HSR	33.13	Supplying, filling, spreading & leveling gravels of size range 5 mm to 10 mm, in the recharge pit, over the existing layer of boulders, in required thickness, for all leads & lifts, all complete as per direction of Engineer-in-charge.	cum	4.8	1023.00	4,941.09
5	HSR	33.14	Supplying, filling, spreading & leveling coarse sand of size range 1.5 mm to 2 mm in recharge pit, in required thickness over gravel layer, for all leads & lifts, all complete as per direction of Engineer -in-charge.	cum	4.8	1326.55	6,407.24
6	HSR	33.15	Gravel packing in tubewell construction in accordance with IS: 4097, including providing gravel fine/ medium/ coarse, in required grading & sizes as per actual requirement, all complete as per direction of Engineer-in-charge.	cum	4.8	1147.00	5,540.01
7	HSR	33.19	Development of tube well in accordance with IS : 2800 (part I) and IS: 11189, to establish maximum rate of usable water yield without sand content (beyond permissible limit), with required capacity air compressor, running the compressor for required time till well is fully developed, measuring yield of well by "V" notch method or any other approved method, measuring static level & draw down etc. by step draw down method, collecting water samples & getting tested in approved laboratory, i/c disinfection of tubewell, all complete, including hire & labour charges of air compressor, tools & accessories etc., all as per	Hrs	24.00	619.00	14,856.00

			requirement and direction of Engineer-in-charge.				
8	HSR	33.16.2	Providing and fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe, removable as per requirement, all complete for borewell of:				
(a)		33.16.2	150 mm dia	each	2.0	180.00	360.00
9	HSR	33.17	Providing and fixing M.S. clamp of required dia to the top of casing/ housing pipe of tubewell as per IS: 2800 (part I), including necessary bolts & nuts of required size complete.				
(a)		33.17.2	150 mm clamp	each	2.0	1173.00	2,346.00
10	HSR	33.18	Providing and fixing Bail plug/ Bottom plug of required dia to the bottom of pipe assembly of tubewell as per IS:2800 (part I).				
(a)	HSR	33.18.2	150 mm dia	each	2.0	232.00	464.00
11	HSR	22.201.3	Providing and fixing in position pre-cast R.C.C. manhole cover and frame of required shape and approved quality: H D - 20				
12	HSR	22.201.3.1	Circular shape 560 mm internal diameter (H D - 20)	each	1.0	1105.00	1,105.00
			SH-1: E A R T H W O R K				

13	HSR	4.12.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge. All kinds of soil	Cum	78.45	94.00	7,374.30
14	HSR	6.2 c	Extra for every 7.5 metres additional lead beyond 15 metres, but upto60 metres by manual mean	100 CUM	156.90	22.65	3,553.79
			SH-2: C O N C R E T E W O R K				
		6.1	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level				
15	HSR	6.1.6	1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size)	Cum	1.58	3,549.00	5,589.68
			SH-3: REINFORCED CEMENT CONCRETE				
16		6.29	Centering and shuttering including strutting, propping etc. and removal of form work for :				
	HSR	6.29.1	Foundations, footings, bases for columns	Sqm	16.47	158.00	2,602.26
17	HSR	6.29.2	Retaining walls, return walls, walls (any thickness) including attached pilasters, buttresses, plinth and string courses fillets, kerbs and steps etc.	Sqm	138.80	319.00	44,277.20
18		6.33	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.				-
	HSR	6.33.6	Thermo-Mechanically Treated bars of grade Fe-500D or more.	kg	2,431.00	69.00	1,67,739.00
							-

19		6.2	Providing and laying cement concrete in retaining walls, return walls, walls (any thickness) including attached pilasters, columns, piers, abutments, pillars, posts, struts, buttresses, string or lacing courses, parapets, coping, bed blocks, anchor blocks, plain window sills, fillets, sunken floor etc., up to floor four level, excluding the cost of centering, shuttering and finishing:				-
		6.2.1	1:1½:3 (1 cement : 1½ coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size).	cum	22.10	4,891.00	1,08,091.10
			GROSS TOTAL				**5,11,367.75**
			TOTAL FOR PHE WORKS (PLUMBING) &				**15,22,307.25**

Package - PPC HAFED FIRE FIGHTING		
Summary of Estimated Cost		
Sr. No.	**Description**	**Amount (Rs.)**
Bill No. 01	Tank Civil Works	6,12,233.00
Bill No. 02	FIRE FIGHTING	28,81,572.00
Bill No. 03	Electrical	2,45,730.00
	Grand Total	**37,39,535.00**

NAME OF PROJECT :- PPC HAFED			
SUMMARY OF COST FOR FIRE FIGHTING WORK			
S. No.	**DESCRIPTION**	**MR Amount (Rs.)**	**In Electrical scope**
1	SUB HEAD - I - (PUMPING EQUIPMENTS)	11,27,515.00	
2	SUB HEAD - II - (HYDRANTS SYSTEM)	4,37,403.00	
3	SUB HEAD - III - (PIPING, VALVES AND ACCESSORIES)	6,79,678.00	
4	SUB HEAD - IV - (FIRE EXTINGUISHERS)	46,976.00	
5	SUB HEAD - V - (MOTOR CONTROL PANELS)		2,45,730.00
6	SUB HEAD -VI - (SPRINKLERS ACCESSORIES)	4,90,000.00	
7	APPROVALS	1,00,000.00	
	TOTAL	**28,81,572.00**	**2,45,730.00**

NAME OF PROJECT :- PPC HAFED						
DETAILED ESTIMATE FOR FIRE FIGHTING EQUIPMENT , RING						
Item No		**Description Of Item**	**Qty.**	**Unit**	**Rate (Rs)**	**Amount (Rs)**
		SUB HEAD - I - (PUMPING EQUIPMENTS)				
	DSR _AOR2019	**FIRE FIGHTING SYSTEM**				
1	1	**Fire Pumps and Accessories**				
		Supplying, installation, testing and commissioning of Electric driven Main Fire Pump suitable for automatic operation and consisting of following, complete in all respects, as required :				
	a)	Horizontal type, multistage, centrifugal, split casing pump of cast iron body & bronze impeller with stainless steel shaft, mechanical seal conforming to IS 1520.				
	b)	Suitable HP Squirrel cage induction motor, TEFC, synchronous speed 1500 RPM, suitable for operation on 415 volts, 3 phase 50 Hz, AC supply with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.				
	c)	M.S. fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.				
	d)	Suitable cement concrete foundation duly plastered with anti vibration pads.				
	1.8	1620 lpm at 70 m Head	1	Set	330204.00	330204.00
		Note: Contractor shall include in his rates for providing pressure switches, pressure guages, wiring, cabling from pressure switch to panel etc. complete as required to operate the system automatic/manual. Pump shall be protected against running dry.				
2	DSR _AOR 2019 / 2	Supplying, Installation, Testing and Commissioning of **diesel engine driven main fire pumping set** complete in all respect as required suitable for automatic operation and consisting of following:				
		Horizontal type, multistage, centrifugal pump of cast of iron body and bronze impeller with stainless steel shaft, mechanical seal conforming to IS 1520.				

		Suitable HP, 1500 RPM water cooled with radiator, diesel engine conforming to relevant IS standard complete with auto starting mechanism, 12 /24 volts electric starting equipment, diesel tank, exhaust pipe extended upto 10 m outside pump house duly insulated with 50 mm thick glass wool with 1.0 mm thick aluminium sheet cladding, residential silencer, instruments and protection as per standard specification, stop solenoid for auto stop in the event of fault with audio indications, painted with post office red colour etc. as required.				
		M.S fabricated, common base plate, coupling, coupling guard, foundation bolts etc. as required				
		Suitable cement concrete foundation duly plastered and with anti vibration pads.				
	2.8	1620 lpm at 70 m Head	1	Set	590426.00	5,90,426.00
		Note: Contractor shall include in his rates for providing pressure switches, pressure guages, wiring, cabling from pressure switch to panel etc. complete as required to operate the system automatic/manual. Pump shall be protected against running dry.				
3	DSR _AOR 2019 / 3	Supplying, installation, testing and commissioning of electric driven pressurisation pump suitable for automatic operation and consisting of following, complete in all respects, as required : (Jockey Pump)				
		Horizontal type, multistage, centrifugal pump of cast iron body and bronze impeller with stainless steel shaft, mechanical seal conforming to IS : 1520.				
		Suitable HP squirell cage induction motor TEFC type suitable for operation on 415 volts, 3 phase 50 Hz AC supply with IP 55 class of protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS : 325.				
		M.S.fabricated Common base plate, coupling, coupling guard, foundation bolts etc. as required.				
		Suitable cement concrete foundation duly plastered and with anti vibration pads.				
	3.2	180 lpm at 70 m Head	1	Set	102391.00	1,02,391.00
		Note: Contractor shall include in his rates for providing pressure switches, pressure guages, wiring, cabling from pressure switch to panel etc. complete as required to operate the system automatic/manual. Pump shall be protected against running dry.				

5	**MR**	Fabricating, Supplying, Installation, Testing and Commissioning **Air Vessel** of continuous welded construction with flanged discharge header on the top of each riser fabricated out of 10 mm thick dished ends and 8 mm thick MS sheet, Air Release Valve complete with suitable drain arrangement with 25 mm dia gun metal wheel valve complete with all accessories etc. as required of the following sizes:				
5.1		1.2 Meter high and 250 mm dia.	1	Each	35875.00	35875.00
6	**MR**	Fabricating, Supplying, Installation, Testing and Commissioning **Air Vessel** of continuous welded construction with flanged discharge header in pump house fabricated out of 10 mm thick dished ends and 8 mm thick MS sheet, Air Release Valve, complete with drain arrangement with 25 mm dia gun metal wheel valve complete with all accessories etc. as required of the following sizes:				
6.1		2 Meter high and 450 mm dia suitable to operate Jockey Pump, Main Fire Pump & Diesel Engine Driven Fire Pump	1	Each	45000.00	45000.00
7	**MR**	Supply, Installation, testing and commissioning of pressure switches for Hydrant / Diesel Engine Driven Pump / Jockey Pumps, diaphragm type, adjustable range from 0-9 bar and a regulation range of 0.1 1.5 bar direct mounted SNAP acting type made from die cast aluminium with epoxy powder coated finish and SS316 diaphragm and other wetted parts, including necessary wiring upto control panel & other materials as required as per specifications.	3	Each	7873.00	23619.00
		TOTAL				**1127515.00**
		SUB HEAD - II - (HYDRANTS SYSTEM)				
1	**MR**	Supplying and fixing **Single Headed Internal Hydrant Valve** oblique pattern with instantaneous Stainless Steel coupling of 63 mm dia with cast iron wheel ISI marked, conforming to IS : 5290 (Type A), with 80 mm dia flanged inlet, with ABS cap and chain complete with all accessories etc. as required.	4	Each	4500.00	18000.00

2	**MR**	Supply, Installation, Testing and Commissioning of 100% synthetic **flax canvas** Non-percolating FIRE hose (Type A), I.S.I marked 63mm dia x 15m long with stainless steel male & female couplings (ISI marked) bound & riveted to hose pipes with copper rivets and copper wire as required.	4	Each	5025.00	20100.00
4	**MR**	Supplying and Fixing **First Aid Hose Reel**, wall mounting swinging type complete with drum & bracket of MS construction, spray painted in Post office Red, confirming to IS 884/1995 with upto date amendments, complete with the following as required.				
(a)		36 Meter long 20 mm dia water hose Thermoplastic (Textile reinforced) Type - 2 as per IS : 12585				
(b)		25 mm dia ball valve & nozzle.				
(c)		Drum and brackets for fixing the equipments on wall.				
(d)		Connection from riser with stop valve (gun metal) & M.S. Pipe	4	Each	7481.00	29924.00
5	**MR**	**SITC weather proof M.S cabinet size 1200 mm x 2100 mm x 600mm**				
		Supplying, installation, testing and commissioning of weather proof M.S cabinet size 1200 mm x 2100 mm x 600mm deep fabricated from 1.6mm thick M.S. sheets and M.S angle 40mmx40mmx6mm complete with glass, locking arrangements to accommodate the following: -				
a)		Gunmetal single headed Hydrant valve - 1 No.				
b)		Fire Hoses 63mm, 15 M long with accessories - 2 Nos.				
c)		Short branch - 1 No.				
d)		First Aid hose Reel - 1 No.				
e)		Fire Extinguisher - 2 Nos.				
f)		Fireman's Axe - 1 No.				
g)		Pressure Gauge - 1 No.				
		The cabinet shall be painted with one coat of primer and 2 coats of synthetic enamel paint of approved shade.	4	Each	5500.00	22000.00

6	**MR**	Providing and fixing **single gunmetal suction collecting head** as per IS: 904-1983, hose coupling (draw out connection) with female outlet as per 903 complete with 150 mm dia. G.I. Suction pipe (with puddle flange) with a foot valve with strainer complete as per drawings.	1	Each	5251.00	5251.00
9	**MR**	Supplying and fixing vane type water **flow switch** suitable for installation on 50 mm to 150 mm dia line for a service pressure upto 20 kg/sq. cm. of Potter / System sensor /Angus	4	Each	3732.00	14928.00
10	**MR**	Supplying and fixing 4 way 63 mm instantaneous **Fire Brigade Inlet Connection (FBIC)** comprising of gunmetal body and gunmetal instantaneous male inlet coupling confirming to IS:904 with plug and cap with chain as required with nuts & bolts and high pressure rubber gasket, suitable for 150 mm dia MS pipe connection etc. complete as required.	1	Each	8500.00	8500.00
	3.0	Supply, Installation testing & commissioning of Black Mild Steel Class 'C' (Heavy Duty) pipes conforming to IS : 1239 Part-I including cutting, threading, welding & all fittings like flanges, tees, elbows, bends junctions, reducers, ball valves etc. welded or screwed joints, clamps structural steel supports (as per TAC norms) or as required/ directed at site including cutting & making good the walls, floors, RCC work etc cutting chases & filling the same with cement concrete 1:3:6 (1 cement :3 coarse sand :6 graded stone aggregate 20 mm nominal size) (For Internal work).INCLUDING PAINTING				
	a)	25 mm dia (Nominal Bore)	300	RM	300	90000
	b)	32 mm dia (Nominal Bore)	50	RM	345	17250
	c)	40 mm dia (Nominal Bore)	50	RM	410	20500
	d)	50 mm dia (Nominal Bore)	50	RM	600	30000
	e)	65 mm dia (Nominal Bore)	50	RM	750	37500
	f)	80 mm dia (Nominal Bore)	50	RM	900	45000
50	g)	100 mm dia (Nominal Bore)	50	RM	1325	66250

	5.0	Providing and applying two coat of 4 mm thick 'PYPKOTE' antirust protection including primer and lap of 25 mm on M.S. pipe in trenches or complete including surface preparation coating and wrapping shall be confirm to ISI 10221 including conducting required Test.				
	b)	80 mm dia	20	RM	200	4000
	c)	100 mm dia	10	RM	220	2200
	d)	150 mm dia	20	RM	300	6000
		TOTAL				**437403.00**
		SUB HEAD - III - (PIPING, VALVES AND ACCESSORIES)				
		SLTC of M.S. pipe on surface				
1.	**MR**	Supplying, laying, fixing, testing and commissioning of following sizes (NB) of ISI marked heavy class M.S. pipes including cutting, threading, welding etc. and providing all fittings e.g. elbows, reducers, clamps, hangers, flanges, gaskets, nuts, bolts and washers etc. including painting of pipes and fittings with red paint over a coat of ready mixed primer, both of approved quality and shade including cutting holes and chases in brick or RCC walls/ slabs and making good the same etc. complete in all respect as required.				
		Note:-The Pipes of sizes 150 mm & below shall be M.S. 'C' class as per IS : 1239 and pipes size above 150 mm shall be welded black steel pipe heavy class as per IS: 3589, from minimum 6.35 mm thick M.S. Sheet for pipes upto 350 mm dia. and from minimum 7mm thick MS sheet for pipes of 400 mm dia and above.				
1.3		200 mm dia	5	Metre	1800.00	9000.00
1.4		150 mm dia	428	Metre	1250.00	535000.00
1.5		110 mm dia	10	Metre	1100.00	11000.00

3	**MR**	Supplying, Installation, Testing and Commissioning of **Butterfly valves of PN 1.6** rating of following sizes with nitrile Bronze / G.M. seat duly ISI marked and stainless steel stem with lever/gear operation and cast iron body in powder coated finish for fire fighting application complete in all respects confirming to IS: 13095 as required.				
3.1		150 mm dia	1	Each	4500.00	4500.00
3.2		100 mm dia	6	Each	2600.00	15600.00
3.3		80 mm dia	1	Each	2200.00	2200.00
4	**MR**	Providing, Installation, Testing and Commissioning of double flanged cast iron **Non-Return Valve,** PN 1.6 of following sizes confirming to IS : 5312 complete with rubber gasket, Gl bolts, nuts, washers etc. as required.				
4.1		100 mm dia	2	Each	3500.00	7000.00
5	**MR**	Providing, Installation, Testing and Commissioning of **Gun Metal / Bronze Ball Valves** with brass body chrome plated of following sizes as required.				
5.1		50 mm dia	2	Each	2085.00	4170.00
5.2		40 mm dia	2	Each	1416.00	2832.00
6	**MR**	Supplying and Fixing **Orifice Plate** made of 6 mm thick, upto 200 mm outer dia. stainless steel with orifice (internal dia.) of required size in between flange & landing valve of external and internal hydrant to reduce pressure to working pressure of 3.5 Kg / cm^2 complete as per specifications as required.	4	Each	659.00	2636.00
7	**MR**	Supply, Installation, Testing and Commissioning of 150 mm dia Bourden type, Stainless Steel dial type **Pressure Gauge** including brass isolation valve and siphon pipe having calibration of 0 - 16	4	Each	471.00	1884.00

		Kg / cm^2				
8	**MR**	Supplying, Installation, Testing and Commissioning of CI body flanged (both ends) type serviceable suction / **Y strainer** with (stainless steel / brass mesh) conforming to relevant IS specifications amended upto date complete including providing and fixing nuts, bolts, washers, gaskets etc. complete as required.				
8.1		150 mm dia	2	Each	9057.00	18114.00
9	**MR**	Supplying and Fixing of Fire Man's axe with heavy insulated rubber as per standard conforming to IS 926	4	Each	490.00	1960.00
11	**MR**	Providing & fixing double flanged Metallic expansion with M.S. fixed flanges (PN-1.6) joint (suitable for system test pressure) of standard length as per manufacturers specs including rubber gaskets, flanges, nuts, bolts and washers complete as required as per specifications.				
11.1		65 mm dia	1	Each	3326.00	3326.00
11.1		80 mm dia	1	Each	4258.00	4258.00
11.2		150 mm dia	2	Each	6133.00	12266.00
12	**MR**	Providing & fixing controlled percolation fire hose pipe (as per IS:8423) of 63 mm dia and 15 meter length rated for burst pressure of 3.5 Kg/sqcm. The hose shall be tested for flame resistance test in accordance to IS:8423. Hose shall be complete with ISI marked SS male & female coupling (IS:903) bound & riveted to hose pipe with copper rivets & 1.5 mm copper wire as required as per specifications. (Location : External fire hydrant)	4	Each	2803.00	11212.00
13	**MR**	Providing and fixing weather proof lockable cabinet of size not less than 0.9 x 0.6 x 0.5 mtr made out of MS sheet 2mm thick having central opening and 6 mm thick glazed glass doors (Two nos.) suitably marked on the outside with the letters "FIRE HOSE" including necessary locking arrangement and shall	2	Each	4240.00	8480.00

		be painted with one coat of primer and two coats of synthetic enamel paint of approved shade as required as per specifications.				
14	**MR**	Supply, Installation, Testing and Commissioning **External Yard Hydrant Stand Post** comprising of MS pipe 80 mm dia (heavy duty C class) from existing ring main to about 1 meter above ground level and Single Headed Yard Hydrant Valve with 80 mm dia flanged inlet, instantaneous SS coupling of 63 mm dia with cast iron wheel ISI marked, conforming to IS : 5290 (Type A), with ABS cap and chain etc. complete with all accessories as required.	4	Each	6060.00	24240.00
		TOTAL				**679678.00**
		SUB HEAD - IV - (FIRE EXTINGUISHERS)				
1	**MR**	Supply, installation, testing and commissioning of ISI marked (IS:15638) portable chemical fire extinguisher, water (gas pressure) type capacity 9 litres with gun metal cap and nozzle and complete in all respects including initial fill and wall suspension brackets as required as per specifications.	4	Each	2467.00	9868.00
2	**MR**	Providing and fixing fire extinguisher of carbon dioxide type consisting of brand new high pressure steel cylinder bearing IS: 7285 mark and having the approval of controller of explosives Nagpur, wheel type valve bearing IS:3224 mark internal discharge tube, 1 meter long high pressure discharge hose, non conducting horn, suspension bracket, fully charged bearing IS: making fixed to wall as directed.				
2.1		4.5kg capacity cylinder	4	Each	6458.00	25832.00
3	**MR**	ABC type extinguisher with cylinder fully charged with 4 Kg.	4	Each	2819.00	11276.00

		capacity.				
		TOTAL				**46976.00**
E		**SUB HEAD - V - (MOTOR CONTROL PANELS)**				
1		**Control Panel**				
	DSR_ AOR 2019/ 5	Fabrication, Supplying, Installation, Testing and Commissioning of **electrical control panel** of cubical construction, floor mounted type, fabricated out of 2mm. Thick CRCA sheet, compartmentalised with hinged lockable doors, dust and vermin proof, powder coated of approved shade after 7 tank treatment process, cable alley, inter-connection, having switchgears and accessories mounting and internal wiring, earth terminals, numbering etc. complete in all respect, suitable for operation on 415 V, 3 phase, 50 Hz. AC supply with enclosure protection class IP 42 as required.				
	5.6	**COMMON PANEL IN FIRE PUMP HOUSE**				
		250A, 50kA 4 Pole MCCB, Ics=100% Icu rating				
		Digital Voltmeter 0-500V with selector switch				
		Digital Ammeter (0-250 A) with selector swtich & CTs				
		LED type RYB phase indicating lamps, ON, OFF, trip				
		indicating lamps				
		Set of Copper Bus Bar 300A				
i)		**OUTGOING (Note : All outgoing feeders for pumps should have digital Ammeter with selector switches, and LED type ON, OFF, trip indicating lamps)**				
		Main Fire Pump				
ii)		125 A, 50kA TPN MCCB, Ics=100% Icu, with fully automatic Star/Delta starter suitable for 60 HP pump with overload protection, current sensing type single phase preventor complete with all acceessories and internal wiring required for automatic operation, selector switch for local/remote, auto/manual/OFF operation.				
iii)		**Jockey Pump**				

iv)		63 A, 50kA TPN MCCB, Ics=100% Icu, with suitable HP fully automatic Star/Delta starter with overload protection, current sensing type single phase preventor complete with all acceessories and internal wiring required for automatic operation, selector switch for local/remote, auto/manual/OFF operation.				
v)		**Diesel Engine Control.**				
vi)		Control for diesel engine comprising - Automatic/Manual selctor switch & 3 attempts starting device, timers and relays as required, push buttons, start/stop in manual mode Indicating lamp for high/ Low Lub. Oil pressure, High Water Temp and Engine on indication Battery charger suitbale for 12V/24 V DC with boost and trickle selector switch, 0-30 V DC volt meter, and 0-20 A DC Ammeter All standard relays and accessories for automatic **operation of diesel engine** **System Controller** Designing, Supply, Installation, Testing and commissioning of system controller to control operation of main electric fire pump, diesel pump, Pressurization pump, Terrace pump in sequence as per specification consisting of relays, timers. Sensors, annunciation window for fault indication, complete as per specification				
		Fire panel as above	1	Set	245730.00	245730.00
		TOTAL				**245730.00**
		SUB HEAD-VI (SPRINKLERS ACCESSORIES)				
	1	Providing and fixing 15 mm gunmetal **sprinkler head** with quartz bulb and set to operate at specified temperature pendent/ upright/ side wall /quick response as per instruction fixed with **loctite.** Temperature of operation 68 deg.C K-80				

	a.	Normal response Pendent type/ upright type	100	Nos	300.00	30,000.00
	a.	Normal response Pendent type	100	Nos	350.00	35,000.00
	b.	Normal response Side wall type	100	Nos	350.00	35,000.00
	c.	Extended throw normal response Side wall type.	40	Nos	750.00	30,000.00
	2	Providing & fixing 25mm dia. UL listed gunmetal inspector test and drain valve with integral sight glass connected to drain line complete in all respects.	20	Nos	450.00	9,000.00
	3	Providing and fixing electrically operated **flow indicating switches** model System Sensor in sprinkler branch line on each floor with necessary junction box installed in accessible place (Wiring from switches to panel and stair case pressurization not included)				0.00
	a.	100/65/50 mm dia.	20	Nos	7000.00	1,40,000.00
	4	Providing and fixing **gunmetal installation valve** with turbine type automatic alarm to be connected with control valve , drain valve, test valve and piping as per manufacturer's specifications complete in all respects.				0.00
	a.	150 mm dia.	4	Nos	45000	1,80,000.00
	5	Providing and fixing UL/Fm listed powder coated finish Escutcheon plate complete including fixing in position on pipe and ceiling complete in all respects. (Size=15NB)	50	Each	200	10,000.00
	6	Providing and fixing UL/Fm listed SS braided flexible pipe with accessories complete with all accessories specified in technical specifications(Size=15B)				0.00
		a. 780mm long	10	Each	900.00	9,000.00
		b. 1000mm long	10	Each	1200.00	12,000.00
		TOTAL				**490000.00**
		APPROVALS				
		Providing NOC/approvals from statutory authorities including preparation of shop drawings, approval drawings, report etc as may be required for approval.	1	LS	100000.00	1,00,000.00

PPC HAFED TANK ESTIMATE						
					CIVIL WORK	
S. No	**HSR**	**Description of Items**	**Unit**	**Rate**	**Qty.**	**Amount In Figure**
1		**SH-1: E A R T H W O R K**				
1	4.12.1	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge. All kinds of soil	Cum	94.00	104.72	9,843.68
2		**SH-2: C O N C R E T E W O R K**				
	6.1.4	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level				
1		1:3:6 (1 Cement : 3 coarse sand (zone-III) : 6 graded stone aggregate 20 mm nominal size)	Cum	3,881.00	4.28	16,602.92
3		**SH-3: REINFORCED CEMENT CONCRETE**				
		Centering and shuttering including strutting, propping etc. and removal of form for :				
1	6.29.1	Centering and shuttering including strutting, propping etc. and removal of form work for : **Foundations, footings, bases for columns**	sqm	158.00	110.00	17,380.00
2	6.29.2	Centering and shuttering including strutting, propping etc. and removal of form work for : **Retaining walls, return walls, walls (any thickness) including attached pilasters, buttresses, plinth and string courses**	Sqm	319.00	220.00	70,180.00

		fillets, kerbs and steps etc.				
3		Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth & above plinth level.				
(a)	6.33.6	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. : **Thermo-Mechanically Treated bars of grade Fe-500D or more.**	QTL	69.00	2,728.00	1,88,232.00
4	6.25.2	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying but excluding the cost of centering, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-in-charge. All works above plinth level upto floor IV level. (Note :- Cement content considered in this item is @ 330 kg/cum. Less cement used as per design mix is recoverable. However no extra payment shall be made if excess cement is used as per design mix).	cum	5,318.00	24.80	1,31,886.40
	6.26.1	Providing M-30 grade concrete instead of M-25 grade BMC/ RMC. (Note:- Cement content considered in M-30 is @	cum	60.00	24.80	1,488.00
4		**SH-4: WATER PROOFING**				

1	22.20.1	Providing and laying APP (Atactic Polypropylene Polymer) modified prefabricated five layer 3 mm thick water proofing membrane, black finished reinforced with non-woven polyester matt consisting of a coat of bitumen primer for bitumen membrane @ 0.40 litre/sqm by the same membrane manufacture of density at 25°C, 0.87-0.89 kg/ litre and viscocity 70-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc, and preparing the surface complete. The membrane parameter : Joint strength in longitudinal and transverse direction at 23°C as 650/ 450N/5cm. Tear strength in longitudinal and transverse direction as 300/250N. Softening point of membrane not less than 150°C. Cold flexibility shall be upto -2°C when tested in accordance with ASTM, D - 5147 : 3 mm thick.	sqm	425.35	80.00	34,028.00
5		**SH-8: FINISHING WORK**				
1	11.6.1	15 mm cement plaster on the rough side of single or half brick wall of mix : **1:4 (1 cement: 4 fine sand)**	Sqm	162.00	80.00	12,960.00

	11.58	Providing and fixing 1st quality ceramic glazed wall tiles conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shades except burgundy, bottle green, black of any size as approved by Engineer-in-Charge in skirting, risers of steps and dados over 12 mm thick bed of cement Mortar 1:3 (1 cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.	sqm	537.00	220.00	1,18,140.00
	22.20 0.3	Supplying and fixing C.I. cover without frame for manholes : 560 mm diameter C.I. cover (heavy duty) the weight of the cover to be not less than 108 kg	Nos	5,746.00	2.00	11,492.00
		Total				**6,12,233.00**