

FERTILISERS AND CHEMICALS TRAVANCORE LIMITED UDYOGAMANDAL – 683 501, KOCHI, KERALA

# Tender No : 04031/2020-2021/E21953

Name of work: Civil works for the construction of the additional (2x 5000 MT) sulphuric acid storage tank and allied structures at FACT -CD.

# PART – I, TECHNICAL



FOR C	TECHNI	CAL PROCUREMENT SPECIFICATION S – CONSTRUCTION OF TWO SULPH	N URIC ACID	32646-12-PS-00	)1			
	S	TORAGE TANK FOUNDATIONS		PAGE 1 OF 1	R2			
TPS NO.		32646-12-PS-001						
STATUS	5			IMITMENT				
ORIGINA	ATING DEPT.	CIVIL						
P.O / W.	O NO.							
PROJEC	т	CONSTRUCTION OF TWO SU (5000MT X 2) AT FACT CD	JLPHURIC AC	DID STORAGES				
LOCATION AMBALAMEDU, KOCHI, KERALA								
CLIENT M/S. FACT-CD								
PURCH	ASER	M/S. FACT-CD						
VENDOF	R							
ITEM: C FOUNE	IVIL WORK	S – CONSTRUCTION OF TWO SULPH		STORAGE TAN	NK			
2	25-07-2020	Revised As per Latest Soil Report	AVR	NJ	ASOK			
1	29-06-2020	Revised as per Tank Erection Requirement	AVR	NJ	ASOK			
0	18-06-2020	Original issue	AVR	NJ	ASOK			

DESCRIPTION



APPROVED

CHECKED

PREPARED

00FT004 / 94

REV.

DATE

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				N	o. of	Rev. No. with Issue				
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10	TECHNICA		<u>x</u>						1	
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1.1	32646-12-5	M-002	Schedule of Items of Work (I In priced)		- <del>-</del> 15	0	1	2		
1.2	1250001/10	2	Engineering Specification-Civil & Struct	tural	14	0	0	-	-	
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2.1	32646-12-D	G-00101	Details of Dyke Wall, Yard and Drains	Inhuric	1	0	0	0		
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2	25-07-2020	Revised as	s per Latest Soil Report A	VR	NJ		AS	ЭК		
1	29-06-2020	Revised as	s per Tank Erection requirement A		NJ		AS			
REV.	DATE		DESCRIPTION P	REPARED	CHE	CKED	AS	PROV	ED	
FACT E	ENGINEE	RING AND I	DESIGN ORGANISATION		1	FACT	FI	ED	0	

#### CIVIL WORKS FOR THE CONSTRUCTION OF THE ADDITIONAL (2X 5000 MT) SULPHURIC ACID STORAGE TANK AND ALLIED STRUCTURES AT FACT-CD

#### 1. INTRODUCTION

FACT Cochin Division proposes to construct Two additional SulphuricAcid Storage Tank of capacity 5000 MT and its allied components such as dyke wall, drains, pipe supports, stair cases and crossover platforms at FACT CD.

#### 2. SCOPE OF WORK

The work to be performed under this contract includes dismantling of some of the existing structures and execution of construction as defined in this document and as per the schedule of items of work and good for construction drawings.

#### 3. PROPOSED FACILITIES

As part of the construction of an additional Sulphuric Acid Storage Tank, following civil & structural works are proposed in the present tender:

- 3.1. Demolishing/Dismantling vehicle shed near to proposed additional sulphuric acid storage tank.
- 3.2. Casting of bored cast-in-situ concrete piles in appropriate depth and dimension for the proposed tank foundation as per Dwg No: 32646-12-DG-00102
- 3.3. RCC construction of Dyke wall on three sides and yard for the proposed Sulphuric Acid Storage Tank, as per the details indicated in Dwg No: 32646-12-DG-00101,
- 3.4. RCC construction of Storm water drains and drains connecting to reclamation pit for the proposed Tank with appropriate length and dimensions.

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REV	DATE	<b>REVISION DESCRIPTION</b>	PRPD	CHKD	APPRD
0	17/06/2020	Original Issue	AVR	NJ	ASOK
1	29/06/2020	Revised as per Tank Erection Requirement	AVR	NJ	ASOK

- 3.5. RCC construction of pipe sleepers (within yard) in appropriate locations with dimensions and other details.
- 3.6. RCC construction of stairs for providing access to the tank from outside the dyke wall
- 3.7. Structural steel construction of cross over platform and landing platform at specified locations inside dyke with dimensions

The scope of Construction of this Tender is indicated in Dwg No: 32646-03-AP-00001 as highlighted area. Construction of a portion of dyke wall and all allied works on the southern side of the proposed tanks are excluded from the scope of this tender for easy mobilisation of machineries and equipment for the Mechanical erection of Tank

The above referred work is not conclusive. Any other items of work as provided in the schedule of items of work and items for the successful completion of the project shall be under the scope of the Contractor

#### 4. GENERAL CONDITIONS

- 4.1. All Tools / tackles/ materials/scaffolding /machinery/ manpower, all incidental items not specified but implied necessary for the successful completion of the work etc shall be arranged by the Contractor.
- 4.2. Tenderers are advised to visit the site and get a clear idea of the work before quoting. The offers shall be, deemed to have been made with full knowledge of all features of the area as well as the procedures to be followed for executing the work.
- 4.3. All materials shall be subject to approval of Owner / Consultant and if any material is rejected the same shall be removed from site by the Contractor at his own cost.
- 4.4. The tender purpose drawings enclosed with the tender document are preliminary to indicate the scope of the job and are for tender purpose only which are not complete and final and do not show the full range of the work under the scope of the contract.
- 4.5. Dismantling shall be carried out only after thoroughly computing the quantities to be dismantled with the approval of engineer in charge.

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- 4.6. Work shall be carried out only on the basis of drawings marked "Good for Construction" with addition, alteration, modifications, if any made to aforesaid drawings as required from time to time and also according to other drawings that would be supplied to the contractor from time to time.
- 4.7. The schedule of items of work attached indicates the quantities of various items of work and the work shall be executed as per the detailed specification issued for each item of work.
- 4.8. Tenderer should consider that the entire job have to be carried out in the operating plant and the required safety measures shall be considered so that the work is completed without disturbing the routine operations.

### 5. TIME OF COMPLETION

- 5.1. The Contractor has to complete all the work as per the scope of job direction and instruction of the Engineer in charge.
- 5.2. The time of completion for the work shall be **6 Months** from the date of "work to proceed notice / intimation" by the Engineer-in-Charge.

### 6. MATERIALS

All materials used for construction shall be bought by the contractor with the approval of Engineer in-charge. The contractor shall furnish the product manual with full specification and application methods of materials to the Engineer in-charge and obtain his/her approval in writing before commencement of work

- 6.1. Due to time and space constraints, contractor is advised to use Ready mixed concrete of specified grade for reinforced concrete works. ULTRATECH / ACC / NEPTUNE are the recommended vendors for supply of ready-mix concrete to site. In case of machine mixed concrete, the contractor should get the design mix done through approved agencies/institutions and approval of Engineer-in-charge shall be obtained.
- 6.2. ULTRATECH / SANKAR / COROMANDAL / MALABAR / ACC / AMBUJA / BIRLA are approved brands of cement.
- 6.3. SAIL / RINL / TISCON / JINDAL / JSWare the only approved brands for HYSD reinforcement bars of Fe500D grade steel

6.4. SAIL / RINL / TISCON / JINDAL / JSWare the only approved brands for structural steel

6.5. ASIAN / BERGER / JOTUN / NEROLAC / ICI DULUX / SHALIMAR are the approved brands of Paint products. Thinner used for the painting work shall conform to the brand specified by the manufacturer in the product literature.

- 6.6. FOSROC / ACC / BASF / SIKA are approved brands for Epoxy bonding agents and Non-shrink grouts
- 6.7. HILTI is the only approved brand for post installation rebars / bolt anchoring using chemical or mechanical anchoring
- 6.8. ERCON is approved brand for FRP / GRP gratings. Additional brands with approval of engineer in-charge is permitted.

### 7. GUARANTEE PERIOD

7.1 Guarantee period of the above work will be 12 months from the date of completion of the work

	IVIL DEPARTMENT SCHEDULE OF ITEMS OF WORI			CUSTOMED		~	32646-1	12-SW-002 A R2
CIVIL	DEPARIMENT	SCHEDULE OF ITEMS OF WORK		CUSTOWER:		J	PA	GE 1 OF 15
NAME	E OF WORK: CIV	IL WORKS FOR THE CONSTRUCTION OF 2 AND ALLIED STRUCTURES AT	X5000 MT FACT CD	SULPHURIC A	CID STORAG	GE TANK	DAT	E: 25/07/2020
SL. NO. (1)		DESCRIPTION OF ITEM (2)	UNIT (3)	QUANTITY (4)	RA FIG.	TE (Rs) (5) WOF	RDS	AMOUNT(Rs) (6)
1	Surface dressing and inequalities rubbish, with in kinds of soil	of the ground including removing vegetation not exceeding 15cm deep and disposal of premises of FACT and lift up to 1.5m in all	Sqm	258				
2	Felling trees of ground level) i removing the re material and dia 60cm girth up to	girth (Measured at a height of 1m above ncluding cutting of trunks and branches, bots by uprooting, stacking of serviceable sposal of unserviceable material - Beyond and including 120cm girth.	Each	2				
3	Demolishing R.C including cutting disposal of unse as per direction of	C.C. work manually / by mechanical means and stacking of reinforcement bars and erviceable material with in premises of FACT of Engineer in-charge.	OB	EFIL	LED	IN		
4	Dismantling sto dismembering ar direction of Engli flats	eel work in single sections including nd stacking with in premises of FACT as per neer-in-charge. in Channels, angles, tees and	kg	2000				
5	Dismantling Ast valleys and gut premises of FAC	bestos sheet roofing including ridges, hips, ters etc, and stacking the material within T as directed by Engineer in-charge.	Sqm	80				
6	Dismantling W.0 dismantled mate of Engineer in- C	C. Pan of all sizes including disposal of rials i/c malba all complete as per directions charge	Each	1				

ARYA	NAVEEN	ASOK		
PRPD. BY:	CHKD. BY:	APPRD. BY:	FACT ENGINEERING AND DESIGN ORGANISATION	FEDO

	CIVIL						32646-2	12-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE	INS OF WO	JRK			PA	GE 2 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(0)
7	Disposal of unserviceab transport in approved m all lifts, comp - Item to be restricted ho vehicle of 3.	moorum / building rubbish / malba / similar le, dismantled or waste material by mechanical ncluding loading, transporting, unloading to unicipal dumping ground for lead up to 30km for plete as per directions of Engineer in-charge. Note applicable in urban areas having directions for burs for movement/ plying of load carrying motor 5cum or more.	Cum	51				
8	Casting 600 concrete pile through Dire 1/sec 2, hav using Portla river sand / or less size concrete as with High st to IS 1786 fe in the castin Engineerin-o The rate sh labour and mobilisation required dep other requi channels in arrangemen	mm diameter bored cast in-situ reinforced cement es in M35 grade ready mix concrete after boring ect mud circulation method as per IS 2911- Part ing minimum cement of 400 kg/cum of concrete, and Pozzolana cement conforming to IS 1489, manufactured sand conforming to IS 383, 20mm graded hard granite broken stones, admixtures to per IS 9103, water as per IS 456 and reinforced rength deformed bars of 500D grade conforming or the entire length of piles. All the materials used and of concrete shall be done with the approval of charge. all include the cost for all plants, tools, materials other services for boring the piles including and de-mobilisation of piling rigs, boring to the oth and stabilisation of hole with bentonite slurry or red material to suit site conditions, making n the ground, making service roads and ts for transportation and disposal of muck (The	Rm	2640	LED	IN		



	CIVIL						32646-12	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE		JRK			PAC	GE 3 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(0)
9	muck will be the respons causing env the concern well in adva the work), reinforceme ground expo after curing reinforceme 15m below c Chipping an to the cut mechanicall and exposir off any loos places point the Enginee Arranging a diameter 60 described in revision in machineries labour for k instruments gauge / LV	e treated as owned by the contractor and it will be ibility of the contractor to dispose the muck without ironment damage with necessary permission from ed authority and consultant / client to be informed ance on the disposal methodology before starting cleaning the bores with water, lowering the nt cages, concreting, excavating and levelling the osing piles to a depth of 100mm below cut-off level g and gaining sufficient strength. Rate of nt alone shall be paid extra - For piles of length cut-off level. (payment shall be made for length of ut off level only) d removing weak concrete at the top of RCC piles off level in line and levels carefully, manually / y without damaging the remaining portion of pile ng the reinforcement, cleaning the reinforcement se concrete particles and removing the debris to ted out within the project premises as directed by r in-charge. and conducting routine tests on single pile of 00mm and length up to 15m below cut off level n Item above as per IS: 2911 (Part-IV) latest cluding all required arrangements materials, s such as test cap, loading platform, hire and entledges, cost of all materials, tools and plants, for loading and recording settlements with dial DTS (calibrated), and labour charges, submitting	Each	<b>54 1</b>	LED	IN		



	CIVIL						32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE	INS OF WO	JRK		PAGE 4 OI		GE 4 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)
	reports etc 600mm dia which the exceeds the	complete as per technical specifications for piles for a maximum load of 2400 kN or the load at maximum settlement of test loading in position permissible value.	Date	45				
11	Charges for required dia the area, ca types such a be treated responsibilit causing envi- the concern well in adva the work) in- of labour, er for abandor for empty be of casting to piles	r empty boring through various strata to the meter of pile specified in the Item above, clearing ollecting, conveying and disposal of muck of all as liquid, fluid, solid and spoil earth (The muck will as owned by the contractor and it will be the y of the contractor to dispose the muck without rironment damage with necessary permission from ed authority and consultant / client to be informed ance on the disposal methodology before starting cluding hire charges for tools and plants, rigs, cost tc. complete for all depth. (Payment will be made hed pile due to reasons attributable to owner and bring involved in between ground level at the time he piles and cut-off level of piles.) 600 mm dia.	Rm	15 E FIL	LED	IN		
12	Earth work excavator) / in all kinds of bottoms, lift soil and disp premises of strutting, sh bailing out v	in excavation by mechanical means (Hydraulic manual means in foundation trenches or drains, of soil, including dressing of sides and ramming of up to 1.5m, including getting out the excavated posal of surplus excavated soil as directed with in FACT and close timbering in trenches including oring and packing cavities wherever required and water to keep the excavated trenches suitable for	Cum	1151				



							32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE		JKK			PAG	GE 5 OF 15
(1)		( <b>2</b> )	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG. W		ORDS	(6)
	concreting.							
13	Excavating including ex ramming of the excavate layers not e each deposing of premises of but not exce	trenches of required width for pipes, cables, etc kcavation for sockets, and dressing of sides, bottoms, depth up to 1.5 m, including getting out ed soil, and then returning the soil as required, in xceeding 20 cm in depth, including consolidating sited layer by ramming, watering, etc. and of surplus excavated soil as directed, within FACT - Pipes, cables etc. exceeding 80 mm dia. eding 300 mm dia	RM	10				
14	Charges for	rolling with power roller of minimum 8 Tonnes for	Cum	251				
	banking exc	avated earth in layers not exceeding 20 cm in		F FII		INI		
15	Filling availa plinth, sides in depth, co watering	ble excavated earth (excluding rock) in trenches, of foundations etc. in layers not exceeding 20cm nsolidating each deposited layer by ramming and	Cum	433				
16	Charges for approximate as directed applicable in for movement or more.	or conveying the surplus earth to places ly 30 kms away and dumping at low lying places by the Engineer in-charge. Note - Item to be urban areas having directions for restricted hours nt/ plying of load carrying motor vehicle of 3.5cum	Cum	718				
17	Supplying a sand includi complete.	nd filling in basement with clean river sand / M- ng watering, ramming, consolidating and dressing	Cum	256				



	CIVIL						32646-	12-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF ITE		JRK			PA	GE 6 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)
18	Cement cor cement: 3 nominal size charges for consolidating of water, oil, trenches, e specification foundation / are furnishe DA-002.	acrete work in 1:3:6 mix (1 Portland Pozzolana coarse river sand/manufactured sand: 6 20mm e graded hard granite broken stones) including all mixing concrete, necessary shuttering, laying, g, curing, removal of shutters, cost for bailing out liquid mud etc. from all sources in excavated pits, etc. complete at all levels as per standard s and as directed by the Engineer in-charge for levelling course etc. Approved make of materials d in Specific requirements of work – 32646-12-	Cum	252				
20	Providing ha Nominal siz compacting stones and crushed ago shall be wat into the voi process till a right up to t materials an Providing 5	ard core layer of required thickness using 40mm ze graded hard granite broken stones after the underlying soil, spreading and levelling the then spreading a layer of 6mm downgraded gregates on top of the broken metal layer and it ered in order to force the crushed fine aggregates d spaces of the broken stone and repeat the all the voids are filled with crushed fine aggregates he edges of hard core layer, including cost of all d labour charges etc., complete 0mm thick bitumen sand mix with blown type	Sqm	E FIL 831	LED	IN		
20	bitumen of bitumen/cum to be used kg/10sq.m. o surfaces, h	penetration 85/25 and clean river sand (120kg. n of sand) over a tack coat (total industrial asphalt l at 62.5kg /10sqm of surface (including 2.5 of tack coat) including all charges for cleaning the eating bitumen, mixing, laying, consolidating,						



	CIVIL			אפר			32646-1	2-SW-002 A R2
DEP	ARTMENT			JKK		PA		GE 7 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)
	finiching of	complete						
21	Supplying a resistant co- manufacture thickness of make of ma work	and providing high build epoxy based chemical ating for outer surface of tank foundation as per es specification to achieve a minimum dry film f 500 microns in two or more coats. Approved aterials are furnished in Specific requirements of	Sqm	831				
22	Acid proof lining after cleaning the cement finished surface well with water and allowing to dry, brushing and removing all dust, apply two coats of approved quality bitumen based primer conforming to IS. 1580 as per manufacture's specification, applying 12 mm thick asphalt membrane with hot melt asphalt free from filler conforming to IS. 1580, then laying acid resistant tiles of class II quality conforming to IS. 4860 over a bed of 6 mm thick potassium based silicate cement mortar conforming to IS. 4832 - part. I & 4441 and joints 5 mm thick, raking the joints to full depth from the top surface, removing the raked-out mortar and filling the entire depth of joints with Furan base resin cement mortar conforming to IS. 4832 - part. II including acid washing curing at a per relevant IS. 4443 specifications at all			460 EFIL	.LED	IN		
23	23 Supplying and laying HDPE film of 1000micron thickness confirming to IS 10889 for laying over the pile cap as per manufacturer's specification and direction of engineer in charge including replacing damaged sheets during installatio / lining work) (only covered area will be measured flat and n			831				
		FACT ENGINEERING AND DESIG						FEDO

	CIVIL						32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE		JRK			PA	GE 8 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)			FIG. W		ORDS	(0)
	extra payme	nt will be made for joint / lap)						
24	Providing ar cement con finishing an 1:1.5:3 (1 ce aggregate 2	nd laying in position specified grade of reinforced crete, excluding the cost of centering, shuttering, d reinforcement - All work up to plinth level : ement : 1.5 coarse sand (zone-III): 3 graded stone 0 mm nominal size).	Cum	545				
25	Reinforced cover slab u than 25% conforming granite brok mix, weigh b the designa RMC, mixing required, consolidating to provision unloading, b (Exposed su with no blen Minimum C less cement separately. 1) only be u	cement concrete work of M25 grade for precast using Portland pozzolana cement containing more of fly ash, river sand / manufactured sand to IS 383 and 20mm nominal size graded hard en stones including all charges for designing the batching, including installation of batching plant at ited location in the site premises or arranging g concrete, cost of adding concrete admixtures as transporting, formwork, laying, vibrating, g, curing with minimal use of potable water subject n of IS 456, handling, transporting, loading, keeping and fixing in position, at all levels etc., ut excluding cost of providing reinforcements. Infaces of pre-cast elements shall have good finish nish or mark on the finished surfaces) NOTE- (1) ement content shall be @ 330 kg/cum. Excess/ s used as per design mix is payable/ recoverable (2) Fly ash conforming to grade I of IS 3812 (Part- ised as part replacement of OPC as per IS: 456. nding with cement to be ensured in accordance	Cum	12 E FIL	LED	IN		



DEPARTMENT       PAGE 9 OF 15         OF 15         (1)       (2)       (3)       (4)       (5)       (6)         With clauses 5.2 and 5.2.1 of IS:456 - in the items of BMC and RMC - for cover slabs (50mm to 100mm thick) on drain. Approved make of materials are furnished in Specific requirements of work - 32846-12-DA-002.       Cu.m       202       FIG.       WORDS         26 Providing and laying in position ready mixed M-30 grade correct for reinforced cement concrete work, using fly ash and cement content as per approved design mix, and 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, shuttend photoritoms as per 3 per 10's 10's 10's accelerate / retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer in - charge. NOTE- (1) Minimum Cement content shall be @ 340 kg/cum. Excess/ less cement used as per direction of the Engineer in - charge. NOTE- (1) Minimum Cement content shall be @ 340 kg/cum. Excess/ less cement used as per direction of the Engineer in 0 PC cas per 15 x456. Uniform blending with cement to be ensured in accordance with clauses 5.2 and 5.2.1 of IS x456 in the items of BMC and RMC – for all works are furnished in Specific requirements of work – 32846-12- DA-002       87       Image: Engineer in 2 part in the internet of work – 32846-12- DA-002         27 Providing and laying in position ready mixed M-30 grade		CIVIL						32646-1	2-SW-002 A R2
(1)       (2)       (3)       (4)       (5)       (6)         with clauses 5.2 and 5.2.1 of IS:456 - in the items of BMC and RMC - for cover slabs (50mm to 100mm thick) on drain. Approved make of materials are furnished in Specific requirements of work – 32646-12-DA-002.       Cu.m       202       (6)         26       Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Ify ash and cement content as per approved design mix, and 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, and femotement, 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. NOTE- (1) Minimum Cement content shall be @ 340 kg/cum. Excess/ less cement used as per design mix is payable/ recoverable separately. "(2) Fly ash conforming to grade I of IS 3812 (Part-1) only be used as part design mix is payable/ recoverable separately. "(2) Fly ash comming to grade I of IS 3812 (Part-1) only be used as part design mix is payable/ recoverable separately. "(2) Fly ash comming to grade I of IS 3812 (Part-1) only be used as part design mix is payable/ recoverable aspents of materials are furnished in Specific requirements of work - 32646-12- DA-002       67       87         27       Providing and laying in position ready mixed M-30 grade       Cu.m       87	DEP	ARTMENT	SCHEDULE OF THE		JRK			PA	GE 9 OF 15
(1)       (2)       (3)       (4)       FIG.       WORDS       (6)         with clauses 5.2 and 5.2.1 of IS.456 - in the items of BMC and RMC -for cover slabs (50mm to 100mm thick) on drain. Approved make of materials are furnished in Specific requirements of work - 32646-12-DA-002.       Cu.m       202       202         26       Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using fly ash and cement content as per approved design mix, and 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, and reinforcement including cost of admixtures in recommended propriors 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. NOTE- (1) Minimum Cement content shall be @ 340 kg/cum. Excess/ less cement used as per design mix is payable/ recoverable separately, "(2) Fly ash conforming to grade I of IS 3812 (Part-1) only be used as part replacement of OPC as per IS: 456. Uniform blending with cement to be ensured in accordance with clauses 5.2 and 5.2.1 of IS:456 in the items of BMC and RMC – for all works up to plinth level except pile cap. Approved make of materials are furnished in Specific requirements of work – 32646-12- DA-002       87          27       Providing and laying in position ready mixed M-30 grade       Cu.m       87	(1)		(2)	(2)	(4)	(5)			(6)
with clauses 5.2 and 5.2.1 of IS:456 - in the items of BMC and RMC -for cover slabs (50mm to 100mm thick) on drain. Approved make of materials are furnished in Specific requirements of work – 32646-12-DA-002.       Cu.m         26       Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using fly ash and cement content as per approved design mix, and 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, and fainforement, 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. NOTE- (1) Minimum Cement content shall be @ 340 kg/cum. Excess/ less cement used as per design mix is payable/ recoverable separately. "(2) Fly ash conforming to grade I of I S312 (Part 1) only be used as part replacement of OPC as per IS: 456. Uniform blending with cement to be ensured in accordance with clauses 5.2 and 5.2.1 of IS:456 in the items of BMC and RMC – for all works up to plinth level except pile cap. Approved make of materials are furnished in Specific requirements of work – 32646-12- DA-002       B7       B7	(1)		(2)	(3) (4)		FIG.	W	ORDS	(6)
	26	with clauses RMC -for of Approved requirement Providing a concrete for and cemer manufacture to site of wo agitated mix grade for re of R.M.C. f cost of cento of admixture accelerate without impa Engineer in shall be @ design mix conforming replacemen cement to 1 5.2.1 of IS:2 up to plinth are furnishe DA-002 Providing a	5.2 and 5.2.1 of IS:456 - in the items of BMC and cover slabs (50mm to 100mm thick) on drain. make of materials are furnished in Specific s of work – 32646-12-DA-002. Ind laying in position ready mixed M-30 grade r reinforced cement concrete work, using fly ash at content as per approved design mix, and ed in fully automatic batching plant and transported ork in transit mixer for all leads, having continuous ker, manufactured as per mix design of specified inforced cement concrete work, including pumping rom transit mixer to site of laying, excluding the ering, shuttering, and reinforcement, including cost es in recommended proportions as per IS : 9103 to / retard setting of concrete, improve workability airing strength and durability as per direction of the - charge. NOTE- (1) Minimum Cement content 340 kg/cum. Excess/ less cement used as per is payable/ recoverable separately. "(2) Fly ash to grade I of IS 3812 (Part-1) only be used as part t of OPC as per IS: 456. Uniform blending with be ensured in accordance with clauses 5.2 and 456 in the items of BMC and RMC – for all works level except pile cap. Approved make of materials ed in Specific requirements of work – 32646-12- nd laying in position ready mixed M-30 grade	Cu.m	202 E FIL	LED	IN		
		Floviding a	nu laying in position ready mixed M-30 grade	Cu.III	01				



	CIVIL							
DEP	ARTMENT	SCHEDULE OF TH		JRK			PAC	GE 10 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(0)
	concrete for and cemen manufacture to site of wo agitated mix grade for re of R.M.C. fr cost of cent of admixture accelerate without impa Engineer in shall be @ design mix conforming replacement cement to I 5.2.1 of IS:4 above plinth in Specific re	r reinforced cement concrete work, using fly ash at content as per approved design mix, and ed in fully automatic batching plant and transported ork in transit mixer for all leads, having continuous ker, manufactured as per mix design of specified inforced cement concrete work, including pumping rom transit mixer to site of laying, excluding the ering, shuttering and reinforcement, including cost es in recommended proportions as per IS : 9103 to / retard setting of concrete, improve workability airing strength and durability as per direction of the - charge. NOTE- (1) Minimum Cement content 340 kg/cum. Excess/ less cement used as per is payable/ recoverable separately. (2) Fly ash to grade I of IS 3812 (Part-1) only be used as part t of OPC as per IS: 456. Uniform blending with be ensured in accordance with clauses 5.2 and 56 - in the items of BMC and RMC – for all works a level . Approved make of materials are furnished equirements of work – 32646-12-DA-002	OB	EFIL	.LED	IN		
28	Providing a concrete for and cemer manufacture to site of wo agitated mix grade for re	nd laying in position ready mixed M-35 grade r reinforced cement concrete work, using fly ash at content as per approved design mix, and ed in fully automatic batching plant and transported ork in transit mixer for all leads, having continuous ker, manufactured as per mix design of specified inforced cement concrete work, including pumping	Cum	920				



	CIVIL						32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF TH	-145 OF W0	JRK			PAG	E 11 OF 15
(1)		(2)	(2)	(4)		(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)
	of R.M.C. fr cost of centre of admixture accelerate without impa Engineer in shall be @ design mix conforming replacement cement to I 5.2.1 of IS:4 Approved requirement	rom transit mixer to site of laying, excluding the ering, shuttering, and reinforcement, including cost as in recommended proportions as per IS : 9103 to retard setting of concrete, improve workability airing strength and durability as per direction of the - charge. NOTE- (1) Minimum Cement content 350 kg/cum. Excess/ less cement used as per is payable/ recoverable separately. "(2) Fly ash to grade I of IS 3812 (Part-1) only be used as part t of OPC as per IS: 456. Uniform blending with be ensured in accordance with clauses 5.2 and 56 in the items of BMC and RMC – for pile caps , make of materials are furnished in Specific s of work – 32646-12-DA-002	OB	E FIL	LED	IN		
29	Add for using and above t	ng extra cement in the items of design mix over he specified cement content therein.	kg	101675				
30	Providing fo necessary p posts etc wi planks for b /curing at a and walls. fo	rm work to cement concrete and RCC works with olywood / steel sheet, steel joists, runners, struts, th adjustable spans and telescopic posts, wooden eam sides etc. including removal after completion Il levels - foundation footings, bases of columns or mass concrete with straight sides	Sqm	159				
31	Providing fo necessary p posts etc wi planks for b /curing at a	rm work to cement concrete and RCC works with blywood/steel sheet, steel joists, runners, struts, th adjustable spans and telescopic posts, wooden eam sides etc. including removal after completion Il levels - wall (any thickness) including attached	Sqm	607				



CIVIL								32646-12-SW-002 A R2		
DEP	ARTMENT	SCHEDULE OF THE		JKK			PAC	GE 12 OF 15		
(4)			(2)	(4)	(5)		(5)			(C)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)		
	nilasters hu	tteresses plinth and string courses etc								
<ul> <li>32 Providing form work to cement concrete and RCC works with necessary plywood / steel sheet, steel joists, runners, struts, posts etc with adjustable spans and telescopic posts, wooden planks for beam sides etc. including removal after completion /curing at all levels - foundation footings, pile caps, RCC kerb wall around pile cap, bases of columns and walls. for mass concrete with circular sides</li> </ul>				242						
33	Providing fo necessary p posts etc wi planks for be curing at all and Struts	rm work to cement concrete and RCC works with olywood/steel sheet, steel joists, runners, struts, th adjustable spans and telescopic posts, wooden eam sides etc. including removal after completion / levels - Columns, Pillars, Piers, Abutments, Posts	sqm	<sup>27</sup> E FIL						
34	Providing fo necessary posts etc wi planks for be /curing at al staircases	brm work to cement concrete and RCC works with plywood / steel sheet, steel joists, runners, struts, ith adjustable spans and telescopic posts, wooden beam sides etc. including removal after completion Il levels - Stairs, (excluding landings) except spiral-								
35 Supplying , fabricating, conveying and fixing reinforcement to RCC works at all levels with high strength deformed bars Fe500D grade Thermo Mechanically Treated (TMT) bars conforming to IS 1786 including all charges for uncoiling and straightening rods, cutting rods, bending cold, placing in position and supplying & tying with black annealed tying wire of 16 gauge, etc. complete. Approved make of materials are										



	CIVIL			עסר			32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF THE		JKK			PAG	E 13 OF 15
(1)			(2) (4)			(5)		(6)
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)
	furnished in	Specific requirements of work – 32646-12-DA-002	Carro	40				
36	Supplying Isophthalic less than 6 38mm heigh crossbars no of 500kg/sq span of 130 bonded grit structural sto clamps, lock have to be rigidly fixed arrangemen 1mtr (Cross retardant me than or equi meeting AS more than Approved r	and fixing pultruded GRP gratings made of polyester resin containing glass fibre content not 0% and having fire retardant characteristics, of at with I bar spacing not exceeding 40mm c/c and ot exceeding 90 mm c/c, suitable for imposed load m of colour grey and designed for a max support 00mm over cable trenches / drains / stairs with antiskid surface including fixing to the existing eel frames / RCC walls by means of SS hold down king arrangement etc. For step ladders, gratings fabricated as per site measurement and shall be to the existing structural by suitable locking t. 2 Piece locking system of size 700 wide (I-bar) x s Rod) Length. The GRP material shall be fire eeting ASTM E84 Class A with Flame Spread less al to 25 & Smoke Density ±200 and UV resistant TM G154 with flexural strength not reducing by 7% on accelerated UV radiation exposure. make of materials are furnished in Specific s of work – 32646-12-DA-002.	Sqm	40	LED	IN		
37	Supplying, or section men rails vertica bolts and r drilling hole cleaning the	conveying fabrication and erection of MS single abers such as channels, guard rail, MS angle hand ls, etc. with fixtures such as end stops, clamps, nuts etc. including charges for cutting, splicing, es as required, fixing to lines and levels and proughly with power tools and painting with two	kg	6636	336			



	CIVIL						32646-1	2-SW-002 A R2
DEP	ARTMENT	SCHEDULE OF TH	-145 OF W0	URK			PAC	GE 14 OF 15
(1)		(2)	(2)	(4)		(5)	·	(6)
(1)		(2) (3) (4)		FIG.	W	ORDS	(0)	
38	coats of red oxide zinc chromate primer ( one shop coat and one coat after fixing / erection) Approved make of materials are furnished in Specific requirements of work – 32646-12- DA-002, Refer painting specs for applying priming coats							
30	MS plates, etc. in RCC for cutting, v exposed sur paint of app oxide zinc c materials ar 32646-12-D coats	A-002, Refer painting specs for applying priming	° OB	EFIL	.LED	IN		
39	Providing ar nuts and wa applying pe surface of be	nd fixing mild steel round holding down bolts with asher plates complete to all lines and levels and troleum jelly / grease after erection on exposed olts to prevent corrosion	kg	66				
40	Painting of s the steel sup a) One inter of 70-micror b) One coat 40-microns I c) One coat microns DF Approved m	structural steel work over priming coats (paid with oply item) as follows: mediate coat of Micaceous Iron Oxide epoxy paint of DFT of two pack polyamide cured epoxy finish paint of DFT t of aliphatic acrylic polyurethane finish paint of 40- f ake of materials are furnished in Specific	Sqm	159				



CIVIL								32646-12-SW-002 A R2	
DEP	ARTMENT	SCHEDOLE OF III		UKK			PAGE 15 OF 15		
(1)		(2)	(2)	(4)		(5)		(6)	
(1)		(2)	(3)	(4)	FIG.	W	ORDS	(6)	
	requirements of work – 32646-12-DA-002, Refer painting specs for applying finishing coats								
41	Supplying and grouting pockets, base plates, etc. at all levels Cum 2 for static equipment / structural steel supports using non- shrink grouts. Approved make of materials are furnished in Specific requirements of work – 32646-12-DA-002.								
42	Providing ar R.C.C. pipe of cement n sand) incluc R.C.C. pipe	Providing and laying Non Pressure NP-3 class (Medium duty) R.C.C. pipes including collars/spigot jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete: 300mm dia.							
43	Providing, laying and fixing 150mm diaGL pipe (medium class) in ground complete with GI fittings including trenching 75cm deep and re-filling etc. as required and directed by Engineer in-charge		LED	IN					



#### CONTENTS

- 1.0.0 SCOPE
- 2.0.0 CLASSIFICATION OF BUILDING AND GENERAL REQUIREMENTS
- 3.0.0 CODES AND DESIGN LOADS
- 4.0.0 SITE CLEARING, EARTH WOK, BACK FILLING
- 5.0.0 FOUNDATIONS
- 6.0.0 CONCRETE WORK
- 7.0.0 STRUCTURAL STEEL WORK
- 8.0.0 MASONRY WOK
- 9.0.0 ROOFING AND ROOFING TREATEMENT
- 10.0.0 DOORS, WINDOWS, VENTILATORS
- 11.0.0 FLOORING AND FLOORING FINISHES
- 12.0.0 FINISHING WORK
- 13.0.0 PROTECTIVE LINING
- 14.0.0 SANITARY AND WATER SUPPLY
- 15.0.0 ROADS
- 16.0.0 DRAINAGE SYSTEM AND CABLE TRENCHES
- 17.0.0 LIQUID RETAINING STRUCTURES
- 1.0.0 SCOPE
- 1.1.0 This document gives the engineering specification pertaining to Civil Engineering works. This document is meant for attaching along with the turn key package for various works in order to get uniform bid from the bidders to the extent possible. These specifications give the general requirements for design and material classification for different works.
- 1.1.1 The specifications given are not conclusive an additions required in the specifications shall be supplemented to suit to be project require meant by bidder mentioning the deviations and additions in separate statement to be attached along with the bids.
- 1.2.0 The engineering specifications covered in this document are listed below.
- 1.3.1 Classifications of buildings and general requirements
- 1.3.2 Codes and design loads
- 1.3.3 Site clearing earth work, back filling
- 1.3.4 Foundations
- 1.3.5 Concrete works
- 1.3.6 Structural steel works
- 1.3.7 Masonry works
- 1.3.8 Roofing and Roofing treatment
- 1.3.9 Doors, Windows, Ventilators
- 1.3.10 Flooring and Flooring finishes
- 1.3.11 Finishing work
- 1.3.12 Protective lining
- 1.3.13 Sanitary and water
- 1.3.14 Roads
- 1.3.15 Drainage system and cable trenches

0	01/09/2018	Revised & Issued for ISO 9001:2015	HOD (C)	GM (E)	GM (F)
REV	DATE	<b>REVISION DESCRIPTION</b>	PRPD	CHKD	APPRD
FAC		RING AND DESIGN ORGANISATION		FEI	$\mathbf{OO}$

1.3.16	Liquid retaining structures
1.4.0	The contractor shall be responsible for the complete design of all civil structures of the project
_	mentioned in the bid document. Issue these specifications do not absolve responsibility of the
	contractor with respect of the structural stability a suitable adoption of the engineering
	contractor with respect of the structural stability a suitable adoption of the engineering
	specifications.
1.5.0	A brief specialization of the work along the approximate bill of quantities of major items of
	work viz. RCC, Brick and rubble masonry and concreting ,doors and windows etc are to be
	submitted by the bidder along with the offer.
160	Whenever civil scope drawings are issued along with these specifications all designs shall be
1.0.0	carried out to suit the civil scope drawing in addition to the engineering specification
4 7 0	the same divide some drawing in addition to the engineering specification
1.7.0	in case civil scope drawing details and engineering specifications differ the details given in the
	civil scope drawings shall be followed for the design.
1.8.0	The specification for different work / structures pertaining to a particular project shall be
	provided in the data sheet "civil and structural works" (Ref. format No.12FT018) and shall
	attached
200	
2.0.0	CLASSIFICATION OF DUILDING AND GENERAL REQUIREMENTS
2.1.0	CLASSIFICATIONS OF BUILDING
2.1.1	Туре А
	RCC Framed structure with masonry walls
2.1.2	Туре В
	Building with RCC floor /roof supported on load bearing wall
213	
2.1.5	Type C Building with stand solvern stand reaf two and with AC short reafing Masser wells sta
2.1.4	Туре D
	As per Type a but with AC sheet cladding.
2.1.5	Туре Е
	As per Type C but with RCC columns
216	
2.1.0	As nor Type C but with AC sheet cladding
2.2.0	GENERAL REQUIREMENTS FOR BUILDINGS
2.2.1	The clear height of building shall not be less than 2.75 m generally. The size of a building
	shall not be less than 9.50m <sup>2</sup> where there is only one room and where there are two rooms
	one shall not be smaller than 9.50m² and other not less 7.50m². Minimum width shall be 2.4m.
222	The size of bath rooms shall not be less than 1.5m x1.20 or 1.8m <sup>2</sup> the combined bath room
2.2.2	and water closet shall have a floor area of not less than $2.80m^2$ with a minimum width of 1.2
	and water closet shall have a nool alea of not less than 2.0011 with a minimum within 01.2
	m a water closet area of 1.1 m <sup>2</sup> . The height of bath room of water closet shall not be less than
	2.2 m.
2.2.3	Every bath room or water closet shall have at least one wall open to external air and shall not
	open in to a kitchen by a door or any other opening.
224	Rooms used as control rooms, MCC, compressor rooms etc, shall be provided with two doors
225	Minimum width of stairs shall be 1 m
226	The minimum width of treads without nosing shall be 25 cm for internal stairs
2.2.0	Misimum vient of treats without nosing shall be 25 cm for internal stalls.
2.2.7	winimum rise for stairs shall be15cm for stairs of public building and residential building and
	18 cm for stairs of plant buildings.
2.2.8	Minimum treads of stairs shall 30cm for public buildings and 25cm for plant buildings
2.2.9	The minimum clear head room in a passage under a stair case landing and the minimum
	clear head room in stair case shall be 2 20m
2210	Hand rails shall be provided with in a minimum beight of 100cm and shall be firmly supported
2.2.10	Commentaries shall be provided with in a minimum height of roughl and shall be infilly supported
2.2.11	Sump, Tank, Pit, or openings in ground or in a floor shall be covered or fenced securely.

- 2.2.12 Minimum width of steel ladder shall be 45 cm.
- 2.2.13 Maximum spacing of rungs for steel ladder shall be 200 mm.
- 2.2.14 where the height of steel ladder exceeds 2.4m cages shall be provided.
- 2.2.15 all rails on which a travelling crane moves shall be of proper size and adequate strength. The rail shall have an even running surface .Every such rail or track shall be properly laid and adequately supported.
- 2.2.16 General requirements of building are not conclusive and shall satisfy the prevalent municipal/statutory bodies'.

#### 3.0.0 CODES AND DESIGN LOADS

3.1.0 The design of structures foundations, etc. shall be as per latest relevant IS codes. Items not covered in the IS codes can be designed based on other international codes like BS codes American codes etc. or other accepted engineering practices some of the relevant IS codes for designs are listed below.

1	Structural safety of buildings loading standards	IS 875(Part I to IV)
2	Earthquake resistant design of buildings	IS1893
3	Plain and Reinforced Concrete	IS 456
4	Concrete structures for storage of liquid	IS 3370(Part I to IV)
5	Design of reinforced concrete shell structures and folded plates	IS 2210
6	Designs of reinforced concrete chimneys	IS 4998
7	Design of reinforced concrete bins (silos) for Bulk food grain storage	IS 4995
8	Structural safety of buildings masonry walls	IS 1905
9	Structural safety of building foundations	IS 1904
10	Design and construction of spread o foundation	IS 1080
11	Design and construction of machine foundation	IS 2974(Part I to V)
12	Design and construction of raft foundation	IS 2950
13	Design and construction of pile foundation	IS 2911 (Part I to IV)
14	Basic requirement of water supply, drainage and sanitation	IS 1172
15	Water supply in buildings	IS 2065
16	Design and construction of septic tanks	IS 2470
17	Building drainage	IS 1742
18	Structural steel in general building construction	IS 801
3.2.0	The materials used, construction practices, testing procedures etc.	shall also conform
	relevant IS codes. Only tested quality material shall be used. Some of t	he relevant codes for
	commonly used materials and construction practices are listed below.	
1	earthquake resistant construction of building	IS 4326
2	Cold twisted steel bars	IS 1786
3	Mild steel and medium steel bar for reinforcement	IS 432(Part I)
4	Fabric for concrete reinforcement	IS 1556
5	Structural steel	IS 226
6	Burnt clay building bricks	IS 3495(Part I to IV)
7	Hollow light weight concrete block	IS 2185(Part I)
8	Specifications for concrete masonry unit	IS 2185 (Part II)
9	Construction of stone masonry	IS 1597(Part I & V)
10	Brick work	IS 2212
11	Preparation and use of masonry mortars	IS 2572
12	Construction of hollow concrete bock masonry	IS 2572
13	Plastic pipe work for water supply	IS 7634(part I to III)
14	LDPE pipe for portable water supply	IS 3076
15	HDPE pipe for portable water supply	IS 4984

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MANA Sì	AGEMENT /STEM	CIVIL & STRUCTURAL WORKS	PAGE 4 OF 14		
16	Unplasticis	ed PVC pipes for portable water supply	IS 4985		
17	Constructio	on of refuse duct for malty storied Building	IS 6924		
18	Cement an	d cement lime plastic finishes	IS 1661		
19	Painting co	ncrete masonry and plastered surface	IS 2395(Part I & II)		
20	Painting in	ferrous metals in buildings	IS 1477(Part I&II)		
21	White wash	ning & colour washing	IS 6278		
22	Laying in s	tu concrete flooring	IS 2571		
23	Selection o	f industrial floor finishes	IS 4971		
24	Aluminium	doors, windows and ventilators	IS 1948		
25	Aluminium	doors for industrial building	IS 1949		
26	Steel door,	windows and ventilators	IS 1038		
27	Steel windo	bws for industrial building	IS 1361		
28	Timber doc	or, windows and ventilators frame	IS 4021		
29	A sid resist	ielied and glazed shutters	IS 1003 (Part I&II)		
30	Aciu resista	ant DICKS	IS 4000		
2 20	The list of	esistant montais	15 4632(Part 1 to 11)		
3.30	Purro of In	given is not conclusive. Related codes and other relevant			
340			pecifications.		
341	Design loa	de			
0.1.1	In addition	to dead, live, wind or earth quake loads, as per Indian sta	indard codes the building		
	and structu	ures shall be designed for additional loads due to crane	es mono rails equipment		
	(including i	mpact and vibrations if any) platforms etc as per actual	requirements.		
3.4.2	Load comb	inations	·		
	Load comb	pinations shall be as started in a relevant Indian standa	rd and recommendations		
	and combir	nations specified by the equipment supply if any.			
3.4.3	Wind and E	Earth quack loads			
	Unless oth	erwise specified wind and earth quack effect on structur	es on structures shall be		
	analysed b	ased on relevant Indian standard codes and necessary	modification factors may		
	be applied	according to specific recommendations , if any			
3.4.4	Dynamic lo	ads			
	Whenever	dynamic loads act on a structure the effect same shall be	considered in the design		
0.4.5	along with	the static live and wind or earth quack load.			
3.4.5	Analysis of	Structures	nationa chall ha mamant		
	Frame ana	iysis shall be carried out for all framed structures. All con	nections shall be moment		
	above	s. However bracing may be provided wherever deemed			
346	In case of	computer aided analysis /designs all relevant backups	such as load calculation		
0.4.0	flow charts	computer dates etc shall be furnished. Computer	outputs shall be in clear		
	easily unde	erstanding able formats and shall be submitted in proper b	ound volumes.		
		······································			
4.0.0	SITE CLEA	ARANCE, EARTH WORK AND BACK FILLING			
	The specif	ication covers the requirements regarding site clearance	es, earth work back filling		
	etc. to be d	lone at site.			
4.1.0	Excavation	shall be carried out to true line and levels in all type	of soil except hard rock		
	requiring b	lasting.			
4.2.0	When har	d rock is encountered the surface shall be levelled/ber	nched as directed by the		
	engineer- i	n- charge			
4.3.0	4.3.0 All arrangements for drainage to keep the pits dry and required dewatering to be included				
	the quoted	rate.			

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4.4.0

All shoring and strutting required for holding the size of excavation from collapse to be

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included in the guoted rate 4.5.0 Removal of rubbish, slush, etc. from site to be included in the rate. 4.6.0 Back filling to be carried out using selected earth from excavation of good sand brought from outside. 5.0.0 FOUNDATIONS This specification covers the requirement governing design of foundations of varies structures. 5.1.0 All designs shall be done based on relevant Indian standard codes. 5.2.0 All foundations shall be done designed to suit the soils conditions. For this purpose the bidder may visit the site and get familiarized with soil conditions by conducting soil exploration work, if necessary. When soil investigation reports are available, the design is to be done as recommended in the report. 5.3.0 All underground pits, slumps, etc, shall be designed to take care of the uplift forces due to buoyancy. 5.4.0 All foundations shall rest on firm original ground. 5.5.0 Unless otherwise recommended in the soil investigation report, all foundations shall extend at least 60 cm below natural ground level. On rock or weather resisting natural ground, removal of top soil may be all that is required. Foundations in any type of soil shall go below the zone significantly weakened by root holes or cavities produced by burrowing animals or worms. 5.6.0 If the sub soil is of aggressive nature sulphate resisting cement shall be used for foundations/ underground structures. 5.7.0 The size, thickness and concrete mix for building and equipment foundations shall be capable to transfer the load on the sub soil. 5.8.0 PCC 1:4:8 shall be used for leveling course, except for liquid retaining structures. The thickness of leveling course shall be 80mm and minimum 150mm thick when used as structural element. Leveling course below liquid retaining structures shall be of 1:3:6 mix 5.9.0 The minimum cover of 75mm shall be provided for foundations pockets to the edge of foundations. 5.10.0 The foundations for machinery and allied equipment shall be designed as recommended by equipment suppliers. Provision for isolation pads, vibration dampeners, bearing pads, springs etc, shall be provided as per equipment manufacturers drawing. 5.11.0 For dynamic loaded foundations grouting shall be with non-shrink, high strength, free flow, cementitious grout like Conbextra GP1, Shrinkkomp, etc. for static loaded foundation, grouting shall be with cement grout or jelly concrete sand grout. 6.0.0 CONCRETE WORKS This specification covers the requirements governing the design of concrete structures for buildings, equipment foundations, storages, chimneys, etc. 6.1.0 All design shall be done based on the relevant Indian standard codes. 6.2.0 **DESIGN CRITERIA** All design shall be carried out based on relevant IS codes and sound engineering practices. The structure shall be designed based on the correct evaluation of all loads imposed on the structure. The static equilibrium of the structure must be adequate against the different type of loading. 6.3.0 MINIMUM THICKNESS AND DIMENSIONS

Minimum thickness of various components of the structure is given below. Floor slabs including slabs on ground 10cms

15cms Column footing Underground pit slab walls 50cms Minimum dimension of beam / column 200mm 80mm Levelling course 6.4.0 Minimum cover reinforcement shall be as per provisions in relevant IS codes. However for works against earth faces, corrosive environment, etc., the cover shall be increased by 30mm than the code provisions. 6.5.0 MINIMUM HEIGHT OF PLINTH / PEDESTAL. The minimum height of plinth / pedestal above finished grade or floor level shall be as follows. 1. Building plinth 300mm above nearest road or pavement level 2. Pedestals / encasements for structural columns Open area 300mm Covered area 150mm 3. Pedestals for all equipment as required but not less than 300mm Open area Cover area as required but not less than 150mm 4. Stair pedestal 150mm 5. Ladder pedestal 150mm 6.6.0 GROUTING 6.6.1 For structural columns as required but not less than 25mm 6.6.2 For equipment as required but not less than 25mm 6.6.3 The specification for grout shall be either 1:1 cement grout or readymade non shrink grout to suit the type of equipment to be grouted. 6.7.0 CONCRETE MIX 6.7.1 Levelling course of mix not leaner than1:4:3 shall be provided under foundations other than water retaining structures. 6.7.2 M 15 or higher grade concrete shall be used for RCC works. When nominal mix is adapted minimum concrete mix shall be1:2:4. Under any circumstances minimum cement content shall not be less than 330 kg/m^3. 6.7.3 Richer concrete mix shall be adopted wherever required to suit the design requirement. 6.8.0 REINFORCEMENT RODS 6.8.1 The reinforcement rods for concrete shall be as follows. Main bars in columns, footings, Cold twisted steel bars. slabs, foundations, etc. Lateral ties, stirrups, etc Cold twisted steel bars/mild steel bars. Reinforcement for floors Mild steel bars/steel fabric 6.9.0 **EXPANSION JOINTS** 6.9.1 Expansion joints in concrete structures shall be provided as per relevant IS code provisions at suitable intervals. Bitumen impregnated fiber boards of approved manufacture as per IS 1838 shall be used as fillers for expansion joints. The gap between the expansion joints shall be thoroughly cleaned and the bitumen fiber boards placed in position as per manufacturer's specification.

- 6.9.2 The expansion, contraction and construction joints, etc. for water retaining structures shall be provided as per the codal provisions. All water bars specified shall be PVC.
- 7.0.0 STRUCTURAL STEEL WORKS.

This specification covers the requirements governing the design of steel structures.

7.1.0 All design shall be done based on the relevant Indian standard code.

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7.2.0	MINIMUM THICKNESS OF STEEL	
	For gussets, stiffeners, plate guides, etc. 8mm	
	For base plates 10mm	
7.3.0	SLENDERNESS AND DEPTH RATIO.	
	The slenderness ratio of main members in tension and compres	sion shall be in accordance
	with IS 800. The following limiting ratios of depth to span shal	I be considered as general
	guide.	
	Trusses 1	/10
	Rolled beams and girders for ordinary Floors and rafters 1	/24
	Supporting floor beams for vibrating Machinery 1	/15
	Roof purlins and girts 1	/45
	Cable columns 1	/30
	Gantry girders (rolled sections) 1	/15
	Gantry girders (built up) 1	/12
7.4.0	CONNECTIONS	
	The connections shall be welded as far as possible. Field conn	ections shall be made with
	black bolts for ladders, hand rail posts, stair stringers removable	e members and floor plates,
	platform forming members 200mm and under in size, purlins, g	irts and minor pipe support
	members that require not more than three bolts per connection.	The minimum size of bolts
7 5 0	shall be 16mm unless limited by the size of the connected parts.	
7.5.0 7.5.1	MATERIAL	and plates shall conform to
7.5.1	Unless otherwise specified, steel or not rolled structural shapes	and plates shall conform to
752	IS 220 / 2002. Stool tuboo for structural nurnees shall conform to IS 1161	
7.5.2	High Strength holts shall conform to IS 3757	
7.5.5	Bolts shall conform to IS 1367	
7.5.4	ERRECTION LOADS	
1.0.0	All loads to be carried by the structure or any part if it due t	o storage or positioning of
	construction material and erection equipment including all load	s due to operation of such
	equipment shall be considered as erection load. Proper provisi	on shall be made including
	temporary bracings to take care of stresses due to erection load	s. The structure as a whole
	and all part of the structure in conjunction with temporary	bracings shall capable of
	sustaining this erection load without exceeding the permissible	stresses. Dead loads. wind
	loads and all such parts of live load as would be imposed on the	structure during the period
	of erection shall be taken as acting together with the erection load	d.
7.7.0	TEMPERATURE EFFECTS	
	Expansion and contraction due to changes in temperature on	the material of a structure
	shall become decisive in design and adequate precautions shall	be made for such effects.
7.8.0	FLOOR COVERING	
	Gratings or chequered plates shall be used for covering .grating	gs / chequered plates shall
	be designed for a full live load plus a point load of 500kg minimur	n.
7.9.0	PAINTING, GALVANIZING, FIRE PROOFING	
7.9.1	All fabricated structural steel, unless galvanized shall receive	a shop coat of primer and
	painted as per specification.	
7.9.2	Steel which is to be fire proofed (marked FP on design dra	wings) shall be fabricated
	unpainted and shall be given a coat of cement wash before e	encasement in fire proofing
	material.	

8.0.0 MASONRY WORKS

8.1.0 This specification covers the requirements governing design of masonry structures.

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- 8.2.0 All design shall be based on relevant Indian standard codes.
- 8.3.0 RANDOM RUBBLE MASONRY
- 8.3.1 The minimum thickness of wall / foundation shall be 38 cms.
- 8.3.2 The thickness shall be determined based on the loading and its slenderness ratio as per the codal provisions.
- 8.3.3 The mortar for the masonry shall be 1:6 cement mortar.
- 8.3.4 All exposed faces of rubble masonry shall be pointed with cement mortar 1:3.
- 8.3.5 Wherever plastering is required the same shall be of cement plaster 1:4 mix, 15 mm thick.
- 8.4.0 BRICK MASONRY
- 8.4.1 The minimum thickness of wall shall be 20cm for load bearing walls and 10cm for partition walls.
- 8.4.2 The thickness shall be determined based on the loading and slenderness ratio as per codal provisions.
- 8.4.3 The mortar for the masonry shall be in cement mortar 1:6 for thickness 20cm and above and 1:4 for thickness 10cm.
- 8.4.4 All fair faces of masonry shall be plastered with cement mortar 1:4 mix 12mm thick and rough surfaces with cement mortar 1:4, 15mm thick.
- 8.4.5 Minimum strength of bricks used shall be of class 35.
- 8.5.0 GENERAL REQUIREMENTS.
- 8.5.1 Points of concentrated stress involved such as corners, openings and interesting where cracking is likely to occur shall be strengthened with steel reinforcement or PCC 1:2:4 mix. The thickness of load bearing walls shall be sufficient at all points to keep the combined stresses due to live, dead and other loads within permissible limits.
- 8.5.2 Where high strength bricks are used richer mix cement mortar shall be used.
- 8.5.3 All doors, windows and ventilator openings shall be provided with RCC lintels of required thickness.
- 9.0.0 ROOFING AND ROOF TREATMENT.

This specification covers the specification to be followed for providing roofing ad roof treatments for different structures.

- 9.1.0 ROOFING
- 9.1.1 RCC roof

Minimum thickness 10cm and grade M 15. Slope of 1/200 shall be provided for flat roofs. An integral coat of cement plaster in cement mortar 1:3 average 6 mm thickness to be done on the top of slab.

#### 9.1.2 AC sheet roofing

Unless otherwise mentioned the thickness of roofing sheet shall be 6 mm. Slope of the roof shall not less than 18 degrees. Half round a cave gutter with down shall be provided. Bolts for fixing AC sheets shall be GI with rubber capping to prevent seepage. Wherever necessary specials such as barge board, corner pieces apron piece, north light curve, ventilation curve, etc., shall be provided. Where natural lighting is required not less than 2% of the area shall be provided with translucent FRP sheets (1mm thick).

9.2.0 WATER PROOFING OR WEATHER PROOFING.

#### 9.2.1 Type 1

Provide six course water proofing treatment using tar felt (type 3, gade1) and residual blown bitumen and provided with 50 mm thick hollow clay tiles set in cement mortar and joints sealed with bitumen compound grade A.

9.2.2 Type 2

Water proofing treatment using admixtures like "ALGIPROOF" as per manufacturer's specification and provided with 50mm thick hollow clay tiles and joints sealed with bitumen sealing compound.

10.0.0 DOORS / WINDOWS / VENTILATORS.

This section covers the specification to be followed for various types of Doors, Windows and Ventilators.

- 10.1.0 STEEL DOORS, WINDOWS AND VENTILATORS.
- 10.1.1 This shall be made of standard section conforming to IS 1038 or hollow metal frames sections confirming to IS 4351. Necessary fixtures such as mortice lock for door closers etc shall be provided.
- 10.1.2 For control rooms like MCC, control room, etc., minimum 2 doors shall be provided on opposite sides.
- 10.2.0 ALUMINIUM DOORS, WINDOWS AND VENTILATORS.
- 10.2.1 This shall be made of aluminum box or Z section confirming to relevant IS codes. The sections used shall be of approved brand and design. Necessary fixtures like mortice lock, handles, peg stays, floor spring, etc. shall be provided.
- 10.2.2 For control rooms, MCC and operations area like pump house, compressor house, DG set room etc. glazing provided shall be of 5.5 mm thick wire glass.
- 10.2.3 For air conditioned rooms air lock facility shall be provided if specified.
- 10.3.0 ROLLING SHUTTERS.
- 10.3.1 For storage god owns, ware houses and plants where equipment are to be taken, steel rolling shutters of required size confirming to IS 6248 shall be provided.
- 10.4.0 WOODEN DOORS, WINDOWS AND VENTILATORS.
- 10.4.1 The timber shall be used as specified. Only well-seasoned timber shall be used. The frames shall be of minimum 100 x 70mm. The shutters used shall be one of the followings.
  - 1. Panelled shutters for doors with 100 x 35 mm frames, 18 mm panel and bottom rail with 150x35mm. There shall be a minimum of 5 panels per shutter.
  - 2. Flush door shutter of block board core construction, 35 mm thick with teak veneered face.
  - 3. For windows and ventilators the shutter shall be glazed with 70 x 80 mm frames and 4 mm thick plain or ground glass. When specified, necessary window bars / grills of approved design shall be provided.
  - 4. For toilet PVC doors (PVC frames and shutter) of approved make or steel paneled shutter doors shall be used as specified.

#### 11.0.0 FLOORING AND FLOOR FINISHES.

This section covers the specification to be followed for different flooring and floor finishes works.

11.1.0 Type 1

150 mm thick macadam sub base, over which 150 mm thick PCC 1:3:6 mix finished with 20mm cement mortar 1:3.

11.2.0 Type 2

150 mm thick macadam sub base over which 100 mm thick PCC 1:3:6 finished with 25 to 40 mm thick IPS.

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- 11.3.0 Type 3
   150 mm thick macadam sub base and 100 mm thick RCC floor with reinforcement of 20 kg/m<sup>3</sup> and finished with 6 mm integral coat of cement mortar 1:3.
- 11.4.0 Type 4 150 mm thick PCC 1:4:8 mix, finished with 20 mm thick plastering 1:3 and a floating coat.

11.5.0	Type 5 100 mm thick PCC 1:4:8, finished with 20 mm thick. terrazzo tiles of approved design (minimum mosaic thickness 6 mm) set in cement mortar 1:5, 18 mm thick
11.6.0	Type 6
	100 mm thick PCC 1:4:8 finished with 7 mm thick approved brand ceramic tiles set in cement mortar 1:3 and using cement grout and joints finished with tile mate or equivalent.
11.7.0	Туре 7
12.0.0	100 mm thick PCC 1:4:8 finished with 20 mm thick cement plaster in two coats mixed with red oxide at 3.5 kg/bag of cement and polished.
12.0.0	FINISHING WORKS
1210	
12.1.0	
12.1.1	Plastering to brick masonry, minimum 12 mm thick using cement mortar 1.4
1212	Type 2
	Two coats plastering to brick masonry works, minimum 20 mm thick and 3 mm second coat
12.1.3	Type 3
12.2.0	Plastering to underside of RCC with cement mortar 1:3, 10 mm thick
12.2.0	7 mm thick ceramic tile dadoing over plastering for a beight of 15 m from floor level using
	approved brand tile
12.3.0	PAINTING
12.3.1	Type 1
	Painting with two or more coats of water proof cement paint approved brand and shade over
	a coat of cement primer.
12.3.2	Туре 2
	Two coat of plastic emulsion paint (medium quality) of approved brand and shade over a coat of primer.
12.3.3	Type 3
	Two coats of oil bound washable distemper of approved brand and shade over a coat of
10.0.4	primer.
12.3.4	Type 4
1235	Two of more coals of white washing / color washing with quick lime mixed with strainer.
12.3.5	Two costs of Zinc chromate primer and two costs of approved quality and shade synthetic
	enamel paint for steel structure.
12.3.6	Type 6
	Two coats of Zinc chromate primer and two coats of approved quality and shade chemical
	resistant enamel paint for steel structures.
12.3.7	Type 7
	Two coats of Zinc chromate primer and two coats of approved quality and shade chlorinated
	rubber paint for steel structures including surface preparation by sand blasting / rubbing with
	emery paper.
12.3.8	Туре 8
	Two coats of approved quality epoxy paint over two coats of primer as per the
	manufacturer's specification for steel structure including surface preparation using sand
	blasting / rubbing with emery paper.
12.3.9	Туре 9
	Two coats of approved quality wood primer and two coat approved quality and shade
	synthetic enamel paint for wood work including surface preparation.

12.3.10	Type 10 Two coats of poly Urethane (clear) mat finish over primer coat as per manufacturer's
1240	specification including surface preparation.
12.4.0	
12.4.1	False ceiling using 4 mm thick plain AC sheets on steel frame work
12.4.2	Type 2 False ceiling using 4 mm thick plain AC sheet on Aluminum frame work
12.4.3	Type 3 False ceiling using 4 mm thick plain AC sheet on wooden frames
12.4.4	Type 4 False ceiling using 12 mm thick pre laminated phenol formaldehyde bonded particle board
12.4.5	Type 5
	clips, suspenders etc, of approved make like 'LUXALOL' and approved shape.
13.0.0	PROTECTIVE LINING This section covers the specification for various types of protective linings used for different
	purposes.
13.1.0	TYPE 1
	40 mm thick acid/alkali resisting lining (class 2) over bitumen primer 10 mm mastic membrane, potassium base silicate cement molten base and joints filled with phenolic resin cement 20 mm depth.
13.2.0	Type 2 40 mm thick acid/alkali resisting lining (class 2) over bitumen primer 10 mm mastic membrane, potassium base silicate cement molten base and joints filled with CNSL.
13.3.0	Type 3 Epoxy lining 3 mm thick with hardener resin filled mix of approved make as per
13.4.0	manufacturer's specification Type 4
	50 mm thick mastic lining over bitumen primer
13.5.0	Туре 5
	Bitumen sand mix lining 25 mm to 50 mm thick using residual blown type bitumen and course sand
14.0.0	WATER SUPPLY AND SANITARY WORKS.
	This section covers the general requirements regarding the design of water supply and sanitary works.
14.1.0	WATER SUPPLY
14.1.1	All external water lines shall be of HDPE class 4 quality with required fittings laid through
14.1.2	All internal water lines shall be of PVC class 4 quality pipes. Wherever possible internal
4440	water lines shall be concealed
14.1.3	at supply point, minimum residual pressure at a discharge of (0.35 kg/cm <sup>2</sup> ), height of building pressure drop due to various losses, etc. The C valve of the pipe may be taken as
1111	per supplier's specification.
14.1.4	water mains at branching points and at different floor levels so that repair works can be attended by isolating such portion.

	14.1.5	When uninterrupted water supply is not available, overhead water tank (PVC) of required capacity (minimum 1000 liters) shall be provided. Provision of scour, over flow, etc. shall be provided
	14.1.6	Where sufficient pressure is not available for water necessary sump tank with pumping arrangement shall be provided with overhead water tank
	14.2.0	SEWAGE LINES
	14.2.1	All sewage lines outside the building shall be of glazed stone ware with a minimum diameter of 100 mm.
	14.2.2	Inspection chambers with RCC cover slabs shall be provided at all junctions.
	14.2.3	The outlets for closets and urinals shall be connected to inspection chambers located as close as possible to the building.
	14.2.4	Building outlets from water closet and urinals only shall be taken to the septic tank.
	14.2.5	Outlet from washbasins, sinks, bath rooms, etc. shall be connected to the drains through a chamber.
	14.2.6	When separate drainage scheme is provided all effluents can be connected to the same.
	14.2.7	All internal outlets of washbasin, closets, sinks, etc. shall be of PVC Class 1 minimum 75 mm.
	14.2.8	Necessary floor traps, gully traps (PVC shall be provided for all fittings like wash basin, urinal, toilet, bath room, etc.)
	14.2.9	Necessary ventilation pipe 75 mm dia. PVC with ventilating cowls and mosquito proof net shall be provided.
	14.2.10	External sewage lines shall be provided with manholes located not more than 30 m and at all junctions/change of directions.
	14.2.11	When the change of elevation is more than 1.5 m drop man holes shall be provided.
	14.2.12	Wherever necessary septic tanks of required capacity provided as per the relevant IS codes
		with provision for soak pit/dispersion trench.
	14.2.13	All toilet fittings required like water closet, urinals, wash basin, low level flush tank, etc., shall be of approved quality and make vitreous chinaware. Unless otherwise specified all fitting
		shall be of white colour.
	14.2.14	Necessary fittings such as pillar cock, stop cock, waste coupling of basin shower heads and connection pipes with nuts shall be of best quality chromium plated brass.
	14.2.15	Towel rails shall be of anodized aluminium.
	14.2.16	Wash basin shall be provided with 4 mm thick mirror (size 450 mm x 300 mm) with plywood backing.
	14.2.17	Soap trays of vitreous china ware to be provided for bath rooms.
	14.2.18	Urinals shall be of wall mounted front lipped urinal. Where urinal partitions are required it shall be of marble slab 25 mm.
	14.2.19	The finished floor level of toilet shall be kept 20 mm below the adjoining floor level by
		providing necessary sunken slabs.
	15.0.0	ROAD WORK
		All design shall be done based on the relevant Indian standard codes and high way
	1510	
ļ	15.1.0	Width of primary roads as specified
ļ	15.1.2	Width of secondary roads as specified
ļ	15.1.3	Inside edge turning radius for primary roads 6500 mm
	15.1.4	Road camber
		a IBM road 1/30 to 1/48
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SYS	STEM			FAGE 13 OF 14
	b	Bituminous road	1/48 to 1/60	
	С	Concrete road	1/70 to 1/80	
15.1.5	Maximum	drop of from centre to eda	ge : 150mm	
15.1.6	Ruling gra	adient on plan ground	: 1/30	
15.1.7	Limiting g	radient on plain ground	: 1/20	
15.1.8	In emban at minimu	kments RCC guards stone im spacing of 3 meters.	e 250mm dia shall be provided	on either side of the road
15.1.9	Culverts s	shall be designed for IRC l	pading depending on the type o	f road.
15.2.0	WATER E	BOUND MACADAMSUB B	ASE (SOILING)	
15.2.1	In filled u	p soil and black cotton so for a thickness of 230 mr	il WBM sub base shall be don n	e using 90 mm to 40mm
15.2.2	In cutting stone agg	area where soil is loose v gregate for a thickness of 1 y rock/ hard laterite/hard ro	 VBM sub base shall be done u 50 mm. WBM sub base need n ock.	sing 90mm to 40mm size ot be provided where soil
15.3.0	WATER E	BOUND MACADAM BASE	COURSE (METALING)	
15.3.1	Provide a including	nd lay water bound maca sorting spreading to templ and consolidating blinding	dam base course with stone ag ate and consolidating with road p material 115 mm thick	ggregate 63mm to 40mm I roller complete including
15.4.0	WBM BAS Provide a	SE COURSE (REMATALL nd lay WBM base course	ING) over scarified metalled surface	e with stone aggregate 50
	mm to 20	mm size, 75 mm thickness	;	
15.5.0	BITUMEN	N SURFACE FINISHING		
15.5.1	Bitumen of Provide a (60% 25 m <sup>2</sup> and co approved of 0.75kg/	concrete surfacing and lay 50 mm thick bitur mm nominal size ) per 10 purse sand 2.4 m <sup>3</sup> per 10 quality at 56 kg/m <sup>3</sup> of st /m <sup>3</sup> including finishing, etc.	nen concrete surfacing using 0m <sup>2</sup> and course sand 40% 20r 0m <sup>2</sup> provided. With host S90/A one aggregate and 128 kg/ m <sup>3</sup> complete.	stone aggregate 4.8 m <sup>3</sup> nm nominal size per 100 90 or equivalent bitumen of sand over a tack coat
15.6.0	The reinfo thick. The more than the centre be20mm course of mixes. Th	and shall be reinforced cement concrete su e concrete shall be reinforced of 4.5 the concreting shall be e. Along the length of the wide and shall be filled w f 80mmthick shall be pro- be surface of the road shall	rfacing shall be done using M1 red using welded fabric if the wi be done strip viz a longitudinal j road joints shall be provided ev with the pre moulded expansion by ided below the reinforced sh be rough finished.	5 mix concrete, 150 mm dth of the carriage way is joints shall be provided in rery 15 m. The joints shall n joints strips. A levelling ab using 1:4:8 concrete
16.0.0	BUILDING	G AND STORM WATER D	RAINAGE	ne storm water drainage
10.1.1	system.	water conected from the		ie storm water urainage
16.1.2	Sufficient	number of down water pip	es shall be provided to drain o	ut the water from the roof

- depending upon the roof area and intensity of rain fall. 16.1.3 The minimum diameter of down water pipes shall be 100mm and shall be of PVC.
- 16.1.4 Drains shall be laid under the building only in unavoidable circumstances.
- 16.1.5 Where it is necessary to lay drain under a building, following conditions shall be satisfied
  - Pipe shall be of cast iron А
  - В The drain shall be laid in a straight line at a uniform gradient
  - С Means of access in the form of materials shall be provided at each and immediately outside the building.

- 16.1.6 All drain pipes shall be designed to discharge three times of the dry weather flow flowing half full with a minimum self-cleaning velocity of 0.75 m/second.
- 16.1.7 Storm water drains outside the building shall be rubble or brick with 15 mm thick cement plastering of 1:4 mix two coats for rubble masonry and 12 mm thick cement plastering of 1:4 mix two coats for brick masonry drains RCC drains of mix 1:2:4 can also adopted.
- 16.1.8 Effluent drains shall be suitably lined if required based on process requirement.
- 16.1.9 The minimum slope of drains shall be 1/300. Cover slabs with adequate thickness and reinforcement shall be provided at road crossing and at places specified to suit project requirement.
- 16.1.10 Reinforced cement concrete or cast iron pipe of suitable diameter with sufficient earth custom can also be provided depending on the conditions outside the building.
- 16.2.0 CABLE TRENCHES
- 16.2.1 Cable trenches shall be provided inside the plant building and outside the plant buildings to suit the Electrical requirements.
- 16.2.2 The cable trenches are usually constructed either in brick masonry or reinforced cement concrete depending on the size of cable trenches and space availability. For brick masonry cable trenches the bed slab shall be of cement concrete 1:3:6 mix 150mm thick.
- 16.2.3 For fixing cable racks in cable trenches 150 x 150 x 8 mm thick MS insert plate shall be provided in the side wall of RCC cable trenches in brick masonry cable trenches the insert shall be provided by giving by giving 200 x 200 mm size
- 16.2.4 Reinforced cement concrete cover slabs or chequered plate of suitable size and thickness shall be provided as specified.
- 16.2.5 A bed slope of 1/400 provided
- 17.00 LIQUID RETAINING STRUCTURES

This section covers the requirements governing the specifications to be followed for design and construction of liquid retaining structures

- 17.1.0 Design be conforming to IS 3370 Part I to IV (latest)
- 17.2.0 M20 grade concrete with minimum cement concrete of 363 kg/m<sup>3</sup> or 1:1 ½:3 nominal mixes shall be used.
- 17.3.0 for tanks resisting on grounds 1:3:6 mix levelling course shall be provided.
- 17.4.0 The provisions regarding expansion joints, construction joints bitumen painting above levelling course etc. shall be made as per code.
- 17.5.0 PVC water bars 230 mm wide shall be used where ever necessary.
- 17.6.0 All embedded parts such as nozzles, pipes, bolts, etc shall be provided at the time of concreting.
- 17.7.0 Plastering with cement mortar 1:4, 10 mm thick mixed with admixtures like impermo, acco proof, etc shall be provided for inside hydro test only.
- 17.8.0 All leaks or wetting noticed during hydro test shall be rectified as per approved methods, using approved materials.

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- 1. Introduction
- 2. Scope
- 3. Materials
- 4. Installation
- 5. General Requirements for Piling
- 6. Relevant Standards and Codes of Practice

# **1.0 INTRODUCTION**

This document defines the scope of works for RCC bored cast in-situ regular piles and its specific requirements for the proposed Sulphuric Acid Tank Foundations at FACT-CD.

# 2.0 SCOPE

2.1 General

Contractor's scope include construction of bored cast in-situ piles of the specified type as per the design and construction drawings provided and detailed specifications including supply of all materials and labour for the work.

The scope of working general consists of constructing regular RCC pile foundations for the pipe supports. The diameter of the pile shall be600mmand the depth of termination shall be as specified and as indicated in the drawings. The quantities mentioned in the schedule of rates are approximate and the payment shall be made for the actual executed quantities based on the approved drawings and site conditions.

The work involves but not limited to the following:

 (i) Construction of bored cast in-situ pile foundations of diameter 600 mm for the pipe supports with depth of termination around 15 m below cut off level.

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- (ii) Clearing the muck from site after completion of piling works
- (iii) Chipping of top concrete in the pile up to cut off level and clearing the debris
- (iv) Exposing the reinforcement of the pile for anchoring in to the pile cap

## 2.2 Surveying and Staking

It is the responsibility of the contractor to bring to site all surveying instruments necessary for the marking out, fixation of levels, etc. and conduct the survey operations with utmost accuracy. Contractor shall put-up stable bench marks. as necessary for the work. Client / Consultant will be present when this work is being carried out and will inspect all these operations with the Contractor's assistance. The contractor shall be entirely responsible for accurate setting out of the work and he shall at his own expense make good any defects arising from errors in line and levels.

## 2.3. Dewatering

Dewatering of accumulated water in all locations on job site from whatever source or cause until the virtual completion of the entire work shall be done by the contractor at his own expense and shall not be paid separately. The rates quoted by the contractor shall be deemed to be inclusive of the same.

## **3.0 MATERIALS**

All materials which may be used in the piling work shall be of standard quality conforming to IS or equivalent unless otherwise approved by the Engineer-in-Charge. The contractor shall get all materials approved by Engineer-in-Charge prior to its procurement and before the actual use. The Engineer-in-Charge shall have the right to determine whether all or any of the materials offered or delivered for use in the works are acceptable. Any material brought to site and not conforming to specification and instruction of Engineer-in-charge shall be rejected and the contractor shall have to remove the same immediately from site at his own expense.

## 3.1 Drilling Fluid

#### ENGINEERING SPECIFICATION-CONSTRUCTION OF BORED CAST IN-SITU REGULAR PILE FOUNDATIONS

Bentonite, as supplied to the site and prior to mixing, shall be in accordance with Annex - D of IS: 2911 (Part-1/ Section2) for regular piles and Annexure – E of IS: 2911 Part – 3 for under reamed piles. A certificate shall be obtained by the Contractor from the manufacturer of the bentonite powder, showing the properties of each consignment delivered to site. This certificate shall be made available to the Engineer-in-charge on request. Bentonite shall be mixed thoroughly with clean fresh water to make a suspension which will maintain the stability of the pile bore hole for the period necessary to place concrete and complete construction. Where saline or chemically contaminated ground water occurs, special precautions shall be taken to modify the bentonite suspension so as to render it suitable in all respects for the construction of piles, without any extra cost.

The frequency of testing drilling fluid and the method and procedure of sampling shall be proposed by the Contractor prior to the commencement of the work. The frequency may subsequently be varied as required, depending on the consistency of the results obtained. Control tests shall be carried out on the bentonite suspension, using suitable apparatus. The density of freshly mixed bentonite suspension shall be measured daily as a check on the quality of the suspension being formed. Tests to determine density, viscosity, pH value, etc. shall be applied to bentonite supplied to the pile boring. For average soil conditions the results shall generally be within the ranges specified in IS: 2911. The tests shall be carried out until a consistent working pattern has been established, taking into account of the mixing process, any blending of freshly mixed bentonite suspension and previously used bentonite suspension and any process which may be used to remove impurities from previously used bentonite suspension. When results show consistent behaviour, tests to determine density shall be carried out as agreed with the Engineer-in-charge. In the event of a change in the established working pattern, tests for viscosity and pH value shall be reintroduced for a period if required. The costs for all tests shall be borne by the Contractor.

### 3.2. Cement

### 3.2.1 General

The cement used shall be Portland pozzolana cement conforming to IS: 1489 and the make of the same shall be approved by the Engineer in charge.

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## 3.2.2 Tests after Delivery

Each consignment of cement may, after delivery on the site at the discretion of the Engineer in-Charge, be subjected to any or all of tests and analysis required by the relevant Indian Standard Specifications. Facilities for testing shall be provided by the Contractor at his own cost.

## 3.2.3 Storage at the Site

The cement shall be stored in a suitable weather-tight building and in such a manner as to permit easy access for proper inspection to prevent deterioration due to moisture and to minimize warehouse deterioration. Cement of different type and brands shall be kept in separate storage. All accepted cement stored on the site shall be arranged in batches, and used in the same order as received from the manufacturer. The contractor shall maintain a cement register, in which all entries shall be completed day to day showing the quantities received, date of receipt, source of dispatch, type of cement, etc. and also the daily cement consumption on site. The register shall be accessible to the Engineer-in-charge for his verification.

## 3.2.4 Rejection of Cement

The Engineer-in-charge may reject any cement as a result of any tests thereof, notwithstanding the manufacturer's certificate. He may also reject cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or other causes. Any cement which is considered defective by the Engineer-in-charge shall be promptly removed from the site of work by the contractor at his own expense.

## 3.3 Aggregates for Concrete

## 3.3.1 General

Coarse and fine aggregates for concrete shall conform in all respect to IS: 383, "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete". Aggregates shall be obtained from a source known to produce those satisfactory for



#### ENGINEERING SPECIFICATION-CONSTRUCTION OF BORED CAST IN-SITU REGULAR PILE FOUNDATIONS

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concrete. Aggregates shall consist of naturally occurring sand and granite/basalt trap stone, crushed or uncrushed, or a combination thereof. They shall be chemically inert, hard, strong, dense, durable, clean and free from veins, adherent coatings and shall be of limited porosity. Flaky and elongated pieces shall not be used. The source of aggregates shall be approved by the Engineer-in-Charge and shall not be changed during the course of the job without his approval. Rejected aggregates shall be removed from the work site by the contractor at his own expense.

## 3.3.2 Deleterious Materials

Aggregates shall not contain any harmful materials such as iron pyrites, coal, mica, shale or similar laminated materials, clay, alkali, soft fragments, sea shells, organic impurities etc. in such quantities as to affect the strength or durability of the concrete. In addition to the above, for reinforced concrete, any material which might cause corrosion of the reinforcement and aggregates which are chemically reactive with the alkalis of cement shall not be used. The maximum quantities of deleterious materials in the aggregates, as determined in accordance with IS: 2386 (Part-II) "Methods of Test for Aggregates for Concrete", shall not exceed the limits given in Table-I of IS: 383. The sum of the percentages of all deleterious materials shall not exceed five. Deleterious materials also include material passing 75 micron IS sieve.

# 3.3.3 Coarse Aggregates

Coarse aggregate is aggregate most of which is retained on 4.75 mm IS sieve. These may be obtained from crushed or uncrushed granite/basalt trap stone and may be supplied as single sized or graded aggregates given in Table-II of IS: 383. The Engineerin-Charge may allow all-in-Aggregate to be used provided they satisfy the requirements of clause 4.4 and T able-IV of IS 383.

# 3.3.4 Fine Aggregates

Fine aggregate is aggregate most of which passes 4.75 mm IS Sieve but not more than 10% pass through 150 microns IS Sieve. These shall comply with the requirements of grading zones I, II and III and given in Table-III of IS: 383. Fine aggregate conforming to grading zone IV shall not be normally used in reinforced concrete unless tests have

been made by the contractor to ascertain the suitability of the proposed mix proportion and approved by the Engineer-in-Charge. Fine aggregate shall consist of natural sand resulting from natural disintegration of rock and which has been deposited by streams or glacial agencies, or crushed stone sand or crushed gravel sand.

## 3.3.5 Sampling and Testing

In case of doubt the Engineer-in-Charge may require the contractor to carry out tests, at the contractor's expense in accordance with – IS: 516 – Method of Tests for Strengths of Concrete; and IS: 2386-Method of Tests for Aggregates for Concrete.

## 3.3.6 Storage of Aggregates

The contractor shall at all times maintain at the site of work such quantities of aggregate as are considered by the Engineer-in-Charge to be sufficient to ensure continuity of work. Each type and grade of aggregate shall be stored separately on hard firm ground having sufficient slope to provide adequate drainage to rain water. Any aggregate delivered to site in a wet condition or becoming wet at site due to rain shall be kept in storage for at least 24 hrs. to obtain adequate drainage, before it is used for concreting, or the water content of mix must be suitably adjusted as directed by Engineer-in-Charge.

### 3.4 Water

Water used for concrete shall be clear and free from injurious amounts of Oil, Acid Alkali, Organic matters or other harmful substances in such amount that may impair the strength or durability of structure. Potable water shall generally be considered satisfactory for mixing and curing concrete. The Engineer-in-Charge may require the contractor to prove at latter's expense, that the concrete mixed with water proposed to be used should not have a compressive strength, lower than 90% of the strength of concrete mixed with distilled water. The Engineer-in-Charge may require the

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contractor to get the water tested from an approved laboratory at his own expenses and in case the water contains any sugar or an excess of acid, alkali, any injurious salts, etc. the Engineer-in-Charge may refuse to permit its use.

### 3.5 Admixtures

Admixtures may be used in concrete only with the approval of Engineer-in-Charge.

## 3.6 Reinforcement

## 3.6.1 General

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil grease or other coatings, which may impair or reduce bond and shall conform to latest revisions of the following IS specifications. Fe 500D grade high strength deformed bars with elongation more than 14.5% & conforming to other requirements of IS 1786.

The reinforcements shall be made into cages sufficiently rigid to withstand handling without damage. In case the reinforcement cage is made up more than one segment, the same shall be assembled by providing necessary laps preferably by welding. Stirrups to the main bars shall be tack welded.

Care shall be taken to ensure that the reinforcement bars do not come closer while the cage is lowered down the hole. Proper cover and central placement of the reinforcement shall be ensured by use of suitable concrete spacers or rollers, specifically for the purpose.

## 3.6.2 Welding

Field welding of reinforcing bars will not be permitted without the written consent of the Engineer-in-charge. Where welding is permitted it must be at staggered locations. Tests shall be made to provide that the joints are of the full strength of bars connected. Welding of reinforcement shall be done in accordance with the recommendation of IS: 2751.

3.6.3 Storage

The steel reinforcement shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion.

## 3.6.4 Joints in Reinforcement

Joints in longitudinal steel bars will be permitted unless otherwise specified. Joints in reinforcement shall be such that the full strength of the bar is effective across the joint and shall be made so that there is no relative displacement of the reinforcement during the construction of the pile.

## 3.7 Concrete

## 3.7.1 General

The grade for reinforced concrete shall be M30having a minimum compressive strength of 30 N/sq. mm at 28 days. The cement for concrete shall be Portland pozzolana cement and the cement content shall be governed by Design Mix or a minimum cement content not less than 400 kg/cum for tremie concreting whichever is higher. The Engineer-in-charge may allow marginal adjustment in water/cement ratio to obtain concrete of good workability.

## 3.7.2 Slump of Concrete

Slump of concrete shall range between 150 to 180 mm at the time of pouring depending on the manner of concreting.

## 4.0 PILE INSTALLATION

## 4.1 General

Installation of piles shall be carried out in accordance with the approved pile lay out drawings. Cut-off level of the piles shall correspond to those given in the working drawings. To ensure dense and sound concrete at the cut-off level, concreting shall extend above cut-off level while casting the piles. However, no extra payment shall be made for this and the rate quoted shall be inclusive of this. In case the reinforcement cage is made up of more than one segment, the same shall be assembled by welding only, before lowering, as per IS: 456-2000 by providing necessary laps. The vertical reinforcement shall project 50 times its diameter above the cut-off level. Concrete shall

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be placed by tremie. All precautions for obtaining clean and sound pile shaft shall be strictly observed. For tremie concreted piles, a sample of drilling fluid shall be taken from the base of the borehole by means of an approved sampling device in the first few piles and at suitable interval of piles thereafter. Concreting shall not proceed if density of fluid exceeds 1120 kg/cu.m.

## 4.2 Workmanship

## 4.2.1 Setting Out

The contractor shall check the casing position for each pile during and immediately after placing the casing, and agree it with the Engineer in charge.

### 4.2.2 Diameter of Piles

The diameter of pile shall be as specified in the drawing.

## 4.2.3 Equipment and Accessories

The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the subsoil conditions and the method of installation, etc. These shall of standard type and shall have the approval of the Engineer-in-Charge. The capacity of the rig shall be adequate so as to reach the desired depth. Provision shall be kept for chiseling within the borehole in case of any underground obstruction/hard strata. However, chiseling shall be carried out only with the approval of Engineer-in-Charge. In case pile is required to be socketed in medium or good quality rock strata, the equipment mobilized shall have adequate capability to do so up to the required socket length.

## 4.2.4 Control of Alignment

The piles shall be installed as accurately as possible as per the designs and drawings. The permissible positional deviations shall be governed by IS: 2911 (Part I /Sec.2). In case of piles deviating beyond such permissible limits, the piles shall be replaced or supplemented by additional piles, as directed by the Engineer-in-Charge.

## 4.2.5 Boring

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The boring operations shall be done by percussion type rigs or rotary rigs using direct mud circulation or reverse mud circulation methods to remove the cuttings and the equipment and construction shall be as per IS:2911 (Part I / Se. 2).

## 4.2.6 Temporary Casings

Temporary casing of approved quality shall be used to maintain the stability of pile excavation which might otherwise collapse. Minimum length of two meters temporary casing as specified in the standard shall be inserted in each bored pile unless otherwise specified and additional length of temporary casing may be used depending on the nature of soil strata, ground water level, etc. without any extra cost. Temporary casings shall be free from significant distortion. They shall be of uniform cross-section throughout each continuous length. During concreting they shall be free from internal projections and encrusted concrete which might prevent the proper formation of piles.

## 4.2.7Boringnear recently cast Piles

Piles shall not be bored so close to other piles which have recently been cast and which contain workable or unset concrete that a flow of concrete could be induced from or damage caused to any of the Piles.

## 4.2.8 Stability of pile bore using drilling fluid

Where the use of drilling fluid is approved for maintaining the stability of a boring, the level of the fluid in the excavation shall be maintained so that the fluid pressure always exceeds the pressures exerted by the soils and external ground water, and an adequate temporary casing shall be used in conjunction with the method to ensure stability of the strata near ground level until concrete has been placed. The fluid level shall be maintained, at a level not less than 1 m, above the level of the external ground water. In the event of a rapid loss of bentonite suspension from the pile excavation, the excavation shall be back filled without delay and the instructions of the Engineer in charge shall be obtained before excavation at that location is resumed, without any extra cost.

### 4.2.9 Spillage and Disposal

All reasonable steps shall be taken to prevent the spillage of bentonite suspension on the site in areas outside the immediate vicinity of boring. Discarded bentonite shall be removed from the site without delay.

## 4.2.10 Pumping from Bore Holes

Pumping from a bore hole shall not be permitted unless a casing has been placed into a stable stratum which prevents the flow of water from other strata in significant quantities into the boring, or unless it can be shown that pumping will not have a detrimental effect on the surrounding soil property.

## 4.2.11 Continuity of Construction

A pile constructed in a stable cohesive soil without the use of temporary casing or other form of support shall be bored and concreted without prolonged delay and in any case soon enough to ensure that the soil characteristics are not significantly impaired.

4.2.12 Cleanliness of Pile Bases

On completion of boring, loose, disturbed or remolded soil shall be removed from the base of the pile.

## 4.3 Concreting of Piles

## 4.3.1 General

Method of placing and the workability of concrete shall be such that a continuous monolithic concrete shaft of the full cross section is formed. Concrete shall be placed without such interruption as would allow the previously placed batch to have hardened. The method of placing shall be approved. Contractor shall take all precautions in the design of mix and placing of the concrete to avoid arching of the concrete in a casing. No spoil, liquid or other foreign matter shall be allowed to contaminate the concrete. Care shall be exercised to preserve correct cover and alignment of reinforcement and avoid any damage to it throughout the complete operation of placing the concrete.

The top of the pile shall be brought up above the cut off level minimum as specified in IS: 2911 Part – 1/ Sec. 2 and IS: 2911 Part -3 so as to permit removal of all laitance and weak concrete before capping and to ensure good and sound concrete at the cut off level for proper embedment into the pile cap. Any defective concrete in the head of the completed piles shall be cut-away and made good with new concrete.

## 4.3.2. Workability of Concrete

Slump of concrete shall range between 100 to 180mm depending on the manner of concreting. Slump measured at the time of discharge into the pile boring shall be in accordance with IS 2911.

## 4.3.3. Compaction

Internal vibrators shall not be used to compact concrete unless the contractor is satisfied that they will not cause segregation or arching of the concrete and unless the method of use has been approved.

## 4.3.4 Placing Concrete in Dry Borings

Approved measures shall be taken to avoid segregation and bleeding and to ensure that the concrete at the bottom of the pile is not deficient in grout.

## 4.3.5 Placing Concrete under Water or Drilling Fluid

Concrete to be placed under water or drilling fluid shall be placed by tremie and shall not be discharged freely into the water or drilling fluid. Before placing concrete, measures shall be taken to ensure that there is no accumulation of silt or other material at the base of the boring and the Contractor shall ensure that heavily contaminated bentonite suspension, which could impair the free flow of concrete from the pipe of the tremie, has not accumulated in the bottom of the hole.

A sample of the bentonite suspension shall be taken from the base of the boring using an approved sampling device. If the specific gravity of the suspension exceeds 1.12 the placing of concrete shall not proceed. In this event the Contractor shall modify or replace the bentonite as approved to meet the specification. The slurry should be maintained at 1.5m above the ground water level. The concrete shall be a rich

coherent mix of high workability in accordance with the standards. The concrete shall be placed in such a manner that segregation does not occur. During and after concreting care shall be taken to avoid damage to the concrete from pumping and dewatering operations.

The hopper and pipe of the tremie shall be clean and watertight throughout. The pipe shall extend to the base of the boring and a sliding plug of polystyrene or similar material lighter than water and approved by the Engineer-in-charge shall be placed in the pipe to prevent direct contact between the first charge of concrete in the pipe of the tremie and the water or drilling fluid. The pipe shall at all times penetrate in to the concrete, which has previously been placed, and shall not be withdrawn from the concrete until completion of concreting. At all times a sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the water or drilling fluid. The internal diameter of the pipe of the tremie shall be not less than 150 mm for concrete made with 20 mm aggregate and not less than 200 mm for concrete made with 25 mm aggregate. It shall be so designed that external projections are minimized, allowing the tremie to pass through reinforcing cages without causing damage. The internal face of the pipe of the tremie shall be free from projections.

### 4.4 Extraction of Casing

Temporary casings shall be extracted while the concrete within them remains sufficiently workable to ensure that the concrete is not lifted.

## 4.5 Concrete Level

When the casing is being extracted a sufficient quantity of concrete shall be maintained within it to ensure that pressure from external water, drilling fluid or soil is exceeded and that the pile is neither reduced in section nor contaminated. No concrete shall be placed in the boring once the bottom of the casing has been lifted above the top of the concrete; it shall be placed continuously as the casing is extracted until the desired head of concrete is obtained.

Adequate precautions shall be taken in all cases where excess heads of water or drilling fluid could be caused as the casing is withdrawn because of the displacement

of water or fluid by the concrete as it flows into its final position against the walls of the shaft. Where two or more discontinuous lengths of casing (double casing) are used in the construction the proposed method of working shall be approved.

### 4.6 Water level

In the event of the ground water level being higher than the required pile head casting level shown on the Drawings, the Contractor shall submit his proposals for approval prior to placing concrete. The pile head shall not be left below the ground water level unless approved precautions are taken. All costs due to this shall be included in the quoted rate of piling item.

## 4.7 Temporary backfilling above Pile Casting Level

After each pile has been cast any empty bore remaining shall be protected and shall be carefully backfilled as soon as possible with approved materials, as directed by the Engineer-in-Charge.

### 4.8 Termination of Piles

Piles shall be terminated at the depth specified in the drawings. Standard Penetration Test (SPT) shall be conducted at the termination depth as directed by the Engineer in charge and the number of blows shall be recorded. The termination depth in all cases shall be certified by Engineer-in-Charge and shall be binding on the tenderer.

## 4.9 Measurement of Piles

The piles shall be measured and paid for the actual pile length from pile tip to the cut off level, as per the approved Good for Construction Drawings and the final pile casting data sheet approved by the Engineer-in-Charge. Payment shall be made separatelyfor empty boring, if any, above the cut off level. Piles showing unsatisfactory results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by engineer-in-Charge at no additional cost to the owner.

The quoted rate for bored cast in situ piles shall be exclusive of reinforcement conforming to IS 1786 – Fe 500D bars. However, measurement/payment for

reinforcement used shall be made through a separate item available in the schedule of rates.

## 4.10 Replacement of Rejected Piles

Piles/boring/casing that are defective or exceed the tolerances specified above shall be left in place or pulled out as directed by the Engineer in charge without adversely affecting the performance of adjacent piles. In case the piles/casing cannot be removed they shall be cut out as directed by Engineer In Charge. Voids resulting from rejected borings or extraction of the piles or casings shall be filled with gravel or sand and the method shall be approved by the Engineer in charge.

## 4.11 Defective Piles

Defective piles shall be removed or left in place, as judged convenient by the Engineerin-Charge, without affecting the performance of adjacent piles and the capping above and additional piles shall be provided to replace them as directed by the Engineer in charge.

# 4.12 Recording of Data

A competent supervisor shall be present to record the necessary information during the installation of piles. The data to be recorded shall include:

- a) The dimensions of the piles, including the reinforcement detail and the mark of the pile
- b) For under reamed piles length, diameter of stem and bulb, number of bulbs, type of pile, reinforcement, etc.
- c) The boring method employed.
- d) The type of soil in which pile is terminated
- e) The depth bored.
- f) The depth of water table
- g) When drilling mud is used, the specific gravity of the fresh supply and contaminated mud in the borehole before concreting is taken up, in case of first few piles and subsequently at suitable interval of piles.

h) The time taken for concreting

- i) The cut-off level/working level, and
- j) The consumption of cement
- k) Any other important observations

Typical data sheets of recording piling data shall be as given in Appendix-D of IS: 2911 (Part I/ Sec.2). Any deviation from the designed location, alignment or load carrying capacity of any pile shall be noted and promptly reported to the Engineer-in-Charge.

## 5.0GENERAL REQUIREMENTS FOR PILING

- The tenderer shall, before tendering, inspect the site and get himself acquainted with the site conditions, access to the site, etc.
- Sufficient number of piling rigs with all accessories to complete the entire job as per the time schedule shall be provided. The Contractor shall also mobilize sufficient spares, cutting tools, etc. to avoid any stoppage of work.
- The reinforcement shall be adequately secured and held in position by metal chairs and spacers. Ties of inter-sections shall be made with 16 SWG soft black annealed binding wire.
- The contractor must obtain the approval of the Engineer-in-Charge for the reinforcement placed, before any concrete is placed in the forms. The reinforcement shall be free from loose rust or scale or other coating that will destroy or reduce bond.
- Concrete spacer blocks of the same strength as parent concrete shall be used to ensure correct cover to the reinforcement. The clear cover shall be as shown on the drawings or as per instructions of the Engineer-in-Charge.
- All the reinforcing bars shall be so tied as to form a rigid cage to prevent displacement before or during concreting.
- The entire responsibility for piling as per relevant Indian Standards, Technical specifications and as per good Engineering practices to suit the site condition shall rest with the Contractor.
- The diameter and concrete mix for the piles as envisaged in the schedule shall be kept as it is, but the length and number of piles mentioned in the tender schedule is only indicative and may vary as per the site conditions.

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- All piles shall be cast to the minimum level above cut-off as specified in IS Codes. After stripping to cut-off level, the concrete at this level shall be dense and sound. The tenderer shall decide the actual extra height of pile above cut-off level to achieve the above.
- The length of pile for payment purposes shall be measured only from cut-off level. The tenderer shall take into account the extra height of concrete above cut-off level and the rates quoted shall include the cost of this extra concrete.
- No payment shall be made for rejected or defective piles due to faulty construction and for reasons attributable to the Contractor.
- Payment for reinforcement shall be on the basis of weight. The weights shall be derived from the sizes and the corresponding unit weights given in the Bureau of Indian standards(IS1786 for deformed steel bars) Standard hook lengths, spacer bars and authorized laps only will be included in the weight calculated. Binding wires will not be weighed nor otherwise measured. Measurement for weight shall not include cutting allowance, wastage etc.
- The contractor 's quoted rate should include the cost of the following;
  - a. Boring in all types of soils
  - c. Provision of all equipment, labour, material, etc.
  - d. Cement cube compressive strength testing and test certificate charges to be borne by the Contractor, not less than three samples(nine cubes) / each pile (at least two samples for 28 days test and one for 7 days test)
  - e. Mechanical transportation and disposal of debris, muck, excess earth (If any) from pile boring etc., away from the site to locations approved by the Engineer-in-charge within the site boundary, including loading and unloading of the same shall be done by the Contractor
  - f. Standard Penetration Tests (SPT) to be conducted during boring at termination stage at free of cost with for at least 25% of the total number of piles or as directed by the Engineer in charge.
  - g. Plasticiser / admixtures, if required, may have to be used by the Contractor to achieve required slump as approved by the Engineer in charge.

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- h. Casting extra length of pile above cut off level to permit removal of all laitance and weak concrete as specified in IS 2911 part1 / Sec 2 and IS: 2911 Part -3.
- i. Chipping off weak concrete to cut off level exposing the reinforcement rods and cleaning the same.
- j. Bailing out of water / liquid mud from all sources and causes.

k. Temporary casing pipes in required length as per site conditions and as per the standards.

I. Making temporary road/ bunds for shifting materials, machineries, equipment, muck etc. and demolishing the same after completion of work.

m. Providing sufficient protection to nearby pipe line / equipment, cables, buildings and other structures.

- Pumping and bailing out of water, shoring, strutting, etc., if found necessary, for successful and speedy operation of work shall be carried out by the contractor and cost of such works shall be included in the rates quoted for piling. Extra claims whatsoever on all subsidiary works pertaining to pilling work shall not be entertained.
- All the excavated materials including debris, loose earth, muck,etc. shall be carted away and disposed off by the contractor out of the premises to any suitable place within the site boundary as directed by the Engineer in charge.
- The Contractor shall provide all equipment, tools and plants required for the work and rates shall include the cost of bringing the equipment, etc, to site, proper maintenance and removal of the same after completion of work.
- Control of Piling Installation shall be as per the relevant IS Codes (IS 2911 (part 1 / section2 and IS: 2911 Part 3). Piles that are defective shall be left in places as judged by the Engineer in charge and additional piles shall be cast to replace them at no extra cost.
- Adequate length of bars to be left over the cut-off level of the pile to develop anchorage in the pile caps as specified.
- Rig register and weekly report as per the format, approved by Client / Consultant shall be submitted to Engineer in-charge of the project.

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- Reinforcement placed in the pile shall be paid for separately for the actual quantity of reinforcement placed in the pile exclusive of couplings, welded joints, spacer bars and binding wire as stipulated in the relevant specifications for reinforcements.
- All piles shall be concreted to a level above the specified pile cut off elevation as specified in the standards. Before casting the pile cap, this excess concrete shall be cut off up to pile cut off elevation.
- Piles shall be cut off at level and elevation shown or specified in the Drawings. Care shall be taken not to damage the reinforcement or the concrete below cut off elevation during such stripping operations. Where stripping to be done to a level lower than the specified cut off elevation to obtain dense and sound concrete, the Piling Contractor shall built up the pile up to cut off elevation at his own cost.
- Upon completion of the piling work, all casing equipment, construction tools, protective covering and debris resulting from the piling operations shall be removed from the works site to the satisfaction of Engineer in charge.

# 6.0 RELEVANT STANDARDS AND CODES OF PRACTICE

## I. AGGREGATES, CEMENT& CONCRETE

- 1. IS:456 -Code of practice for plain and reinforced concrete.
- 2. IS:4925 -Specification for concrete batching and mixing plant.
- 3. IS:2386 -Methods of test for aggregates for concrete (Part 1 to 8)
- 4. IS:516 -Method of test for strength of concrete.
- 5. IS:1199 Method of sampling and analysis of concrete.

6. IS:9013 -Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.

- 7. IS:383 -Specification for coarse and fine aggregate from natural source for concrete.
- 8. IS:6461 -Glossary of terms relating to cement concrete (Part 1 to 12)

9. IS:5891 -Specification for Hand operated concrete Mixers.

10. IS:1200 -Method of measurement of building and civil engineering works. (Part 1 to 26)

11. IS:2722 -Specification for portable swing weigh Batchers for concrete.

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12. IS:650 -Specification of standard sand for testing of cement.

13. IS:7320 -Specification for concrete slump test apparatus.

14 IS:1489 - Specification for Portland Pozzolana cement

15. IS:1791 -Specification for batch type concrete mixers.

16. IS:5892 -Specification for concrete transit mixers and Agitators.

17. IS:3025 -Methods of sampling and test (physical and chemical) for water used in industry.

18. IS:9103 - Specification for admixtures for concrete.

19. IS:4082 -Recommendations on stacking and storage of construction materials at site

II. IRON AND STEEL

1. IS:2502 -Code of practice for bending and fixing of bars for concrete reinforcement.

2. IS:2751 -Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.

3. IS:1786 -Specification for High strength deformed steel bars and wires for concrete reinforcement.

4. IS:432 -Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

## III. FOUNDATION ENGINEERING

2. IS:2911 -Code of practice for design and construction of pile foundations. (Part 1 / Section 2) Part.1 - Concrete piles.-Section 2 -Bored cast-in-situ piles.

5. IS:2911 -Code of practice for design and construction of pile foundations. Part 4 - Load test on piles.

SAFETY

1. IS:5121 -Safety code for piling and other deep foundations.

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#### GENERAL NOTES

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- 1. ALL DIMENSIONS AND LEVELS ARE IN MM.
- 2. MIX OF CONCRETE FOR PILE & CAP SHALL BE M35.
- PILES ARE OF BORED CAST-IN-SITU TYPE CONFORMING TO IS 2911-PART-1/SECTION2 AND LOAD TESTS ARE AS PER IS: 2911 (PART IV)
- THE REINFORCEMENT CAGE SHALL BE KEPT 150 MM. ABOVE THE BOTTOM OF BORE HOLE TO ENSURE ADEQUATE CLEAR COVER AT THE BOTTOM.
- 5. FOR CONCRETING OF PILES TREMIE METHOD SHALL BE USED. PRIOR TO BEGINING OF CONCRETING USING TREMIE PIPE, PILE BORE SHALL BE FLUSHED CLEAN, UNTIL NO SOIL PARTICLES COME OUT OF THE PILE BORE FROM THE DRILLING MUD BEING CIRCULATED.
- 6. THE TOP OF THE PILES SHALL BE CHIPPED OFF TO OBTAIN A HORIZONTAL PLANE TILL SOUND
- CONCRETE IS MET WITH. TOP SURFACE OF PILE SHALL BE FINISHED SMOOTH AND LEVEL. 7. Y-INDICATES HIGH STRENGTH DEFORMED BARS Fe 500 GRADE CONFORMING TO IS.1786
- 8. CEMENT FOR PILING SHALL BE PORTLAND POZZOLANA CEMENT CONFORMING TO IS: 1489
- 9. GRADE ELEVATION  $\pm 0.00$  corresponds to finished ground level at the tank farm area.
- FOR LOCATION REFER DRG. No.32646-03-AP-00001
   ALL PILES SHALL BE GIVEN A MINIMUM SOCKETING DEPTH OF 1 X DIA OF PILE INTO THE ROCKY STRATA

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										FOR TENDER PURPOSE	ONLY ~	/ 17.06.202	20
										PRELIMINARY ADVANCE	COPY		
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						SCALE	1:100	FACT ENGIN	IEERING & DESIGN	ORGANISATION			
						DATE	13.06.2020	UDYOGAMANDAL	RS AND CHEMICALS IR	KERALA			
						DRAWN	KAVITHA	PROJECT NAME	CONSTRUCTION OF TWO SA TANKS(2x		CT NO	32646	
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<u>K DETAILS</u>	
TYPE –	CONE ROOF
SIZE –	ID 22MØ X 9M HEIGHT
NOMINAL CAPACITY	3421 Cu. M
MATERIAL SHELL, ROOF & BOTTOM ROOF SUPPORT STRUCTUREIS	IS 2062 Gr. E250C (FULLY KILLED QUALITY) IS 2062 Gr. E250C (FULLY KILLED QUALITY)
DESIGN STD.	API 650 TWELFTH ED. & NACE 0294:200

									SCALE	1:500
									DATE	18.06.2020
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_		LIST OF UNITS		7	
	UNIT NO.	DESCRIPTION	REMARKS	-	
	1	CENTRAL SUBSTATION	EXISTING		F
	2	ELECTRICAL REST ROOM	EXISTING		
	3	ELECTRICAL OFFICE	EXISTING		
	4	11KV CAPACITY YARD	EXISTING		
	5	OLD SHED			
	6	PARKING SHED	TO BE DEMOLISHED	-	
	7	DINING HALL	EXISTING	-	
	8	SULPHURIC ACID TANKS (2NOS)	NEW	-	E
	9	DYKE WALL	NEW	-	
-	10	RECIRCULATION PIT	NEW		
	11	SULPHURIC ACID TANKS	EXISTING		
	12	POTASH STORAGE GODOWN	EXISTING	-	
	13	PUMP HOUSE	NEW	-	
GEND: -	_				С
		NEW FACILITY			
		EXISTING FACILITY			
DTES: -					В
FINISHE	NATE 10000.00	DENORTH, 10000.000 EAST, 10.12 ELEVAT	TANK AREA HOLD		
FACT THE FE JDYOGA PROJECT TITLE: ARE	ENGINEER RTILISERS MANDAL NAME: CONSTR (2×50 EA PLOT PL	ING & DESIGN ORGANISA AND CHEMICALS TRAVANCORE KE UCTION OF 2 ADDITIONAL SULPHURIC ACID DOOMT) STORAGE AT FACT CD AN - ADDITIONAL SULPHURIC	TION LTD RALA PROJECT NO: 32646 ACID TANK AT CD		A
SHEET 1	OF 1 DRG.	NO. 32646-03-AP-00001		REV.	