GOVERNMENT OF MIZORAM
OFFICE OF THE CHIEF ENGINEER, PHE DEPARTMENT
MIZORAM, AIZAWL.

NOTICE INVITING TENDER NO. 1 of 2012

Sealed tender in two parts (Technical Bid and Price Bid) are hereby invited by Chief Engineer PHE Mizoram, on behalf of the Governor of Mizoram for the works mentioned below. Details can be obtained from the Office of the Undersigned from 1st August, 2012 to 17th September, 2012 during office hours on all working days.

1 Name of Work: Greater KHAWZAWL Water Supply Scheme

2 Estimated Cost: Rs. 9,97,14,688.00

3. Time of completion: 30 (thirty) months.

4. Earnest money deposit: Rs. 20,00,000/-(Rupees twenty lakh)
5. Cost of tender papers: Rs. 1500/-(Rupees fifteen hundred)

6. Issue of tender paper: From 1st August, 2012 on all working days

7. Last date of receipt of tender: 17th September, 2012 at 12:00hrs

8. Date and time of opening of Tender: 17th September, 2012 at 13:00hrs

9. The Chief Engineer, PHED Mizoram does not undertake any responsibility for loss or delay in receipt of tender documents sent by post.

10. The Chief Engineer Public Health Engineering Department, Mizoram reserves the right to reject any or all the tenders without assigning any reason thereof.

Sd/- (LALMUANZOVA)
Chief Engineer, PHED
Mizoram, Aizawl.

Memo No. M-11011/44/2010-CE/PHED/102 Dated: 1st August 2012

Copy to:

1. PS to Minister PHED, etc., for kind information of the honorable Minister,
2. Engineer-in-Chief, PHED for kind information.
3. Chief Engineer, M & I, PHED for kind information.
4. The Director, I & PR, Mizoram, Aizawl for kind information with a request to publicize the same in three leading local daily news papers for three consecutive issues. A copy of Press Tender Notice is enclosed herewith.
5. The State Informatic Officer, NIC, Mizoram State Unit, Aizawl for kind information with a request to advertise the NIT in the Mizoram website.
6. All Superintending Engineers under PHE Department for information.
7. All Executive Engineers under PHED for information.
8. Office file for record.

Chief Engineer, PHED
Mizoram, Aizawl.

TABLE OF CONTENTS

SECTION - I. General Instructions to Bidders

1. Scope of Bid & Funding

1.1 The **Public Health Engineering Department, Government of Mizoram**, intends to execute the Greater Khawzawl Water Supply Scheme (Pumping), through eligible Contractor.

1.2 The Department invites the TENDER for the items of work as specified in Section II: Scope of Work and Section – III: Price schedule.

1.3 The Project is funded by Ministry of Urban Development, Government of India under '10% lump sum fund for NE States'.

2. Eligible Bidders

2.1 A Bidder may be a natural person, private entity, government-owned entity.

2.2 Bidder, and all parties constituting the Bidder, shall have the indigenous nationality of India. A Bidder is deem to have the nationality of India if he is a citizen or is constitute or incorporate and operates in conformity with the provisions of the laws of India.

2.4 Government-owned enterprises shall be eligible if they are: (i) legally and financially autonomous, (ii) operate under the principles of commercial law, and (iii) are not dependent agencies of the Department.

2.5 A Bidder having experience in executing this type of work is preferred. List of such contracts executed by the bidder and the contract value duly countersigned by executing Agency may be furnished along with the bid.

2.6 The Bidder should have qualified Engineers in his pay roll. List of such Engineers with names and qualification shall be appended in the bid.

2.7 Where the Bidder is a manufacturer of major equipments like, pumps, electric motors, transformers, diesel engines generators, etc., he should have capability to manufacture the equipments as required for the subject application. Document to that effect may be submitted along with the bid. Where the Bidder is not a manufacturer of Major items of the equipments, he shall have to produce documents/certificate of understanding with the manufacturer of the equipments that they shall support the Bidder to supply, erect, test and commission the equipments.

2.8 The Bidder should be financially sound and must be able to execute the contract, if awarded, as per the work program approved by the Department with his own resources without interruption in between payment of Running Bills. The Bidder's annual turn-over for the last consecutive three years should not be less than 30% of the Tender Amount.

2.9 The bidder should be well equipped with the following Tools and Plants (T&P), which are required for executing this contract. Document to prove his possession/formal agreement with the other party having the T&Ps that they shall place the T&P at their disposal should be enclosed in his bid: Excavator – 1 No, Truck

of not less than 40Qntl carrying capacity-1No., Diesel Engine Gen set of not less than 7.5KVA-1No., Welding Generator with output of up to 400ampere-1No.

2.10 A Bidder that does not conduct business within the State of Mizoram, shall submit evidence that it will open its office and be represented by responsible Agent, equipped and able to carry out the obligations prescribed in the Conditions of Contract.

3. Eligible Goods

3.1 The Pumps, the prime mover (electric motor), Diesel Engine Gen Set and all related components shall be of reputed company's make. Technical brochure and relevant literature of the manufacturing company and technical data sheet shall have to be submitted along with the bid. These machineries for the contract shall have to be tested at manufacturer's test bed by the Department's personnel before dispatch. The incidental expenditures for the tests shall be at the cost of the contractor.

3.2 All the pipes intended for supply to this contract shall be subjected to 3rd Party Inspection/DGS & D inspection. The cost of such inspection shall be at the cost of the contractor.

4. Bidding Document

4.1 The Bidding Document consist of the followings:

A. TENDER DOCUMENT: VOLUME - I

Section – I: General Instructions to Bidders
Section – II: Scope of work of Greater Khawzawl WSS.
Section - III : Price Schedule
Section – IV: General Conditions of Contract
Section – V: Prescribed forms and formats.

B. TENDER DOVUMENTS: VOLUME – II

Engineering Designs and Estimates.

4.2 The Bidding Document obtained directly from the Department shall, only be accepted.

4.3 At any time prior to the deadline for submission of the Bids, the Department may amend the Bidding Document by issuing addenda.

4.4 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document directly from the Department.

4.5 To give reasonable time to the prospective Bidders in preparing the Tender, the Department may, at its discretion, extend the deadline for the submission of the Tender.

5. Bid preparation

5.1 All costs associated with the bid preparation and submission shall be borne by the Bidder. The Department shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

5.2 Prospective Bidders may visit the project site before submitting the tender to ascertain the site condition. Visit of the site shall help in exploring the basic on-site data that are required for making responsive Bid. The expenses for the purpose shall however be at the cost of the prospective Bidder.

5.3 The bidder must sign each pages of NIT document as a token of his

acceptance to the conditions of the NIT.

5.4 The current sales Tax/VAT clearance certificate or latest copy of sales tax/VAT return must be attached with the tender.

5.5 Tender must indicate the detail postal address. Letter posted by ordinary post to this address shall be deemed to have been received by the contractor.

5.6 Any documents appended in the tender must be initialed with seal on each page by the contractor with date, month and year. If this is not satisfied then the tender may be treated as cancelled.

5.7 Every correction, if any, in the tender must be initialed with date.

5.8 The TENDER shall be addressed and submitted to the Chief Engineer, PHED, Mizoram, Aizawl

5.9 Rates should be quoted both in figures and in words. In case any discrepancies arrived out of the quoted price provision of CPWD Manual shall be applied.

6. Submission of Tender.

6.1 Tender should be submitted in 2(two) separate sealed envelopes marked 'ENVELOPE 'A' (Technical Bid) and 'ENVELOPE 'B' (Price Bid). Name of the work and NIT No., shall also be clearly mentioned in the tender as well as on the sealed envelope containing tender.

6.2 The envelope 'A' (Technical Bid) shall contain the following documents:

i) Earnest Money Deposit,
ii) Qualification and experiences, if any,
iii) His approach to the work,
iv) Technical designs of Pumps, Electric Motors, Diesel engine generating set, Pumping mains, Valves, Power Transformers, etc.
v) Technical brochures, data sheets, specifications, etc of major equipments.
vi) Company's certification that they will render technical supports in supply, installation and commissioning of the respective major equipments intended to be supplied in the contract
vii) Income Tax clearance Certificate in case of non-tribal tender
viii) Lists of qualified Engineers in the payroll of Bidder.
ix) Valid PAN No./Sale tax clearance certificate.
x) Proposed payment terms
xi) Any other information the Bidder wishes to incorporate

6.3 The envelope 'B' (Price Bid) shall contain duly signed Tender document, price bid as per the format, amount and discounts, if any, offered by the Bidder.

6.4 The Bidder shall submit all required tender documents. Incomplete tender is liable to be rejected for want of adequate information.

6.5 Tenderer may also submit his proposed terms of payment.

6.6 The tender so received after the due date and time shall not be accepted.

7. Language of Bid

7.1 The Bid, as well as all correspondences and documents relating to the Bid exchanged by the Bidder and the Department, shall be in **English.**

8. Bid Prices and Discounts

8.1 The prices and discounts quoted by the Bidder shall conform to the requirements specified below:

i) All items must be listed and priced separately in conformity with the Price Bid Submission form. If a Price Bid shows items listed but not priced, their prices shall be assumed to be included in the prices of other items.

ii) The Bidder may quote any unconditional discounts and the methodology for their application.

iii) Prices quoted by the Bidder shall be FIRM during the entire time of completion of the Contract which is 30(thirty) months from the date of signing Contract Agreement and not subject to variation on any account.

iv) The total aggregate of the quoted price should not be higher nor lower than the estimated cost by more than 10%. The total aggregate of quoted price above or below more than 10% of the estimate cost shall be rejected.

9. Currencies of Bid

9.1 Bid prices shall be quoted in Indian Rupees.

10. Period of Validity of Bids

10.1 Bid documents shall remain valid at least for 6(six) months from the date of opening the bid. A Bid that is valid for shorter period shall be rejected.

11. Earnest Money

11.1 The Bidder shall furnish as part of its bid, an earnest money amounting to Rs. 20,00,000/-(Rupees twenty lakh) only in the form of Call Deposit at any Nationalized Banks pledged in favour of Chief Engineer, PHE Department, Mizoram Aizawl.

11.2 Any Bid not accompanied by Earnest Money shall be rejected.

11.3 The Earnest Money of unsuccessful Bidders shall be returned promptly upon the successful Bidder furnishing the signed Contract Agreement.

11.4 The Earnest Money of the successful Bidder shall be retained as part of the security deposit.

11.5 The Earnest Money shall be liable to be forfeited;

(a) if a Bidder withdraws its Bid during the period of bid validity specified by the Bidder, or

(b) if the successful Bidder fails to sign the Contract;

12. Bid Opening

12.1 The Department shall conduct the bid opening in public at the address, date and time specified in the NIT**.** Bidders or their representatives may remain present at the time of opening the tender.

12.2 On the day of opening the tender, envelope 'A' shall only be opened. The envelope 'B' shall be opened subsequently only if

the assessment of the envelope 'A' is satisfactory.

13. Comparison of Bids

13.1 The Department shall compare all substantially responsive bids to determine the lowest-evaluated bid

14. Department's Right.

14.1 The Department reserves the right to accept or reject any Bid, and to annul the bidding process and reject all Bids at any time prior to the award of Contract, without thereby incurring any liability to the Bidders.

14.2 At the time the Contract is awarded, the Department reserves the right to increase or decrease the quantity of Goods originally specified in the items of work, without any change in the unit prices or other terms and conditions of the Bid and the Bidding Document.

15. Award Criteria

15.1 The Department shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated Bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

15.2 Prior to the expiration of the period of bid validity, the Department shall notify the successful Bidder, in writing, that its Bid has been accepted and issue Letter of Intent.

15.3 Until a formal Contract is prepared and executed, the notification of award shall constitute a binding Contract.

16. Confidentiality of contract documents

16.1 All documents, correspondence, decisions and orders concerning the contract shall be considered as confidential and/or restricted in nature by the contractor and he shall not divulge or allow free access to others.

17. Signing of Contract

19.1 The Department shall promptly after notification, send the Contract Agreement to the successful Bidder.

Section – II, Scope of work of Greater Khawzawl WSS and technical specification

1. INTRODUCTION:

It is proposed to pump water from river Tuichang to Arro hill and then tap by gravity to Sipaitlang of Khawzawl to meet the domestic water requirement. The Raw water shall be pumped from river Tuivawl up to the proposed treatment plant which is 50m static head. The raw wáter shall be treated and stored in the Clear Water Sump (CWS). The treated wáter shall again be pumped through 835m static head from CWS up to the intermédiate sump at Arro hill and then finally tap by gravity to the Main Reservoir at Sipaitlang. The pumping machineries shall be driven by 3phase electric supply @ 415V. However, a Diesel Generator shall also be needed to drive the Pumps in times of power failure from the Grid.

The portion of work viz. **Construction of Intake Structures, Footpath along pumping main, Providing and laying of Raw and Clear Water Pumping Main, Construction of Treatment Plants, Pump Houses, Supply and installation of Pumping Machineries, etc.,** are proposed to be allotted to the eligible contractor.

2. Extent and Scope of Works:

The scope of work under this Contract includes construction of all related works in the proposed scheme including necessary design, and other works listed herein or any other works necessary to achieve the objective to deliver 2.7MLD of treated water in safe engineering practices. The Department visualizes the following works:

2.1. Intake arrangement: The works of Intake arrangement includes the following ítems:

i) RCC diversión weir across the river Tuichang with its wing walls (Refer NIT document Vol – II, Chapter -I).
ii) RCC intake jackwell cum pumphouse (Refer NIT document Vol – II, Chapter – II)
iii) Raw Water Pumping Machineries. (Refer NIT document Vol – II, Chapter – III)

2.2. Treatment Plant: The Works of Water treatment plant includes the following ítems:

i) Receiving Chamber with cascade aerator and parshall flume: (Refer NIT document Vol – II, Chapter – IV)
ii) Hopper bottom type vertical flow sedimentation tank aided by tube settler: (Refer NIT document Vol – II, Chapter – V)
iii) Rapid sand filtration plant with attached Chemical house: (Refer NIT document Vol – II, Chapter – VI)

2.3. Clear Water sump: (Refer NIT document Vol – II, Chapter – VII)

2.4. Clear wáter Pump Houses:(Refer NIT document Vol – II, Chapter – VIII)

2.5. Clear water pumping Machineries (Refer NIT document Vol – II, Chapter – IX)

2.6. Erection and commissioning: (Refer NIT document Vol – II, Chapter – X)

2.7. Pumping/Rising Mains: (Refer NIT Document Vol-II, Chapter- XI)

i) Raw Water Pumping/Rising Main

ii) Clear Water Pumping/Rising Main

2.8. Approach Road: (Refer NIT Document Vol-II, Chapter – XII)

i) Approach road between clear wáter pumping station to raw wáter pumping station

ii) Footpath along clear wáter pumping main.

2.9. Power Supply (Ref NIT Document, Vol – II, Chapter – XIII)

i) 33KV Transformer Sub-Station: (Refer NIT document Vol – II, Chapter – XII)

Section – III: Price Schedule

Sl. No.	Description of Item of Works			Unit	Quantity	Estimate amount
1	**Approach Road.**					
	a)	Approach road to intake from clear water pumping station including construction of culverts		Rm	500	387,362.00
	b)	Footpath along clear water pumping main		Rm	4300	278,179.00
	c)	RCC humepipe culvert				160,000.00
2	**Intake Structures**:					
	a)	Diversion submersible weir		Job	1	3,619,732.00
	b)	Intake Jack-well and pump house		Job	1	495,983.00
	c)	Raw water pumping machineries :				
		i.	Raw water submersible pump	Set	2	1,504,300.00
		ii.	Diesel engine generating set.	Set	1	1,250,000.00
3	**Treatment Plant**					
	a)	Stilling chamber and cascade aerator		Job	1	421,400.00
	b)	Sedimentation tank with tube settler		Job	1	2,994,651.34
	c)	Rapid sand filter unit with chemical house		Job	1	3,987,567.00
4	**Clear Water Sump**			Litre	130000	999,815.00
5	**Pump House:**					
	a)	Clear water pump house		Job	1	2,138,388.00
	b)	Shed for DG Set.		Set	1	568,336.00
6	**Pumping Machineries:**					
	i)	Design, Supply, Installation, Testing and commissioning of electrically driven Horizontal multi-stage Centrifugal Pump having discharge capacity of 81 m3/hrs against …..m head complete with all mechanical and hydraulic equipments and accessories for clear wáter pumping.		Set	2	12,117,600.00
	ii)	Design, supply, installation, testing and commissioning of Diesel Engine Generating set 1MVA capacity, 3Ph, 415V,		Set	1	4,990,000.00

		including all electrical accessories, diesel tanks, etc.			
7	**Pumping Main:** Providing, Laying, Jointing by welding of pumping main line of suitable pipe with all connected Works like thrust blocks/ anchor blocks, drain outlet with required valves and other protective devices for wáter hammer, air valves, etc.				
	a)	Raw water pumping main	Rm	550	2,718,507.00
	b)	Clear wáter pumping main	Rm	4500	44,932,868.00
8	**33/3.3KV Sub-Station**: Design, Supply, Erection, Testing and commissioning of 33/3.3KV Sub-Station including installation of 1.0MVA Transformer for pump, 33/.44 KV, 250 KVA Auxilliary Transformer for lighting and 33/.44KV, 100KVA transformer for raw water pump with all necessary protection devices, Cabling Works, etc., complete.		Job	1	16,150,000.00
		TOTAL			**99,714,688.00**

(Rupees Nine crore ninety seven lacs fourteen thousand six hundred eighty eight) only.

Section - IV. General Conditions of Contract

1.	**Scope of Works**	1.1. The Goods and Related Services in this contract shall be as specified in Section III - Items of work and price schedule.
		1.2. Unless otherwise stipulated in the Contract, the Scope of Works shall include all such items not specifically mentioned in the Contract but that can be reasonably inferred in the Contract as being required for attaining delivery and completion of the works as if such items were expressly mentioned in the Contract.
2.	**Contract Price**	2.1. The Contract Price shall be as specified in the Agreement subject to any additions and adjustments thereto, or deductions there from, as may be made pursuant to the Contract.
		2.2. Prices charged by the Contractor for the Goods delivered and the Related Services performed under the Contract shall not vary from the prices quoted by the Contractor in its bid.
3	**Office for correspondence**	3.1 The Contractor shall establish an office at Khawzawl headed by a responsible officer who shall be able to represent the Contractor. Requisite engineers and other supporting staff shall also be deputed at all times as may be required for the steady and successful execution of the project.
4	**Terms of Payment**	4.1 The Contract Price shall be paid in Indian Rupees.
		4.2 As stipulated in the Contract.
5	**Infrastructure for execution of works**	5.1 PHE Department shall provide necessary infrastructures facilities to Contractor such as approach to site, power supply from grid at one point within site boundary. However, non availability of the power supply from grid shall not be considered a valid reason for inhibiting the commencement or subsequent progress of work. The Contractor may arrange necessary Generating Set for power supply back up.
6	**Completion Drawings**	6.1 After successful testing and commissioning, the contractor shall submit completion drawings, showing clearly all dimensions, sizes, locations of all works and installation as per actual work executed.
7	**Engineering Drawings**	7.1 All necessary detailed Engineering Drawings with design calculation should be submitted within three months after the date of signing contract arrangement.
8	**Security**	8.1 PHED shall help provide security & safety for all the personnel of the Contractor & its associates, plant & machinery and material deployed on the project.
9	**Insurance**	9.1 The contractor shall take comprehensive insurance covering for transit, storage, erection, commissioning, workmen compensation on personal accidents and construction equipment for use of

		construction site valid up to date of successful commissioning and full completion.
10	**Inspections and Tests**	10.1 The Contractor shall, at its own expense, arrange for tests, if insisted by the PHE Department either third party inspection by DGS&D/RITES or inspection and testing by PHE Engineers at manufactures works before dispatch of equipments to be supplied for the Project. All certificate/performance tests, mechanical properties used in the equipment shall be submitted to the Engineer-in-charge by the contractor. The materials/equipments shall only be accepted only on production of such documents.
		10.2 The Department or its designated representative may attend the tests and/or inspections.
		10.3 Whenever the Contractor is ready to carry out any such test and inspection, it shall give a reasonable advance notice, including the place and time, to the Department. The Contractor shall obtain from the manufacturer any necessary permission or consent to enable the Department or its designated representative to attend the test and/or inspection.
11.	**Security Deposit**	11.1 A security deposit @ 5% (five percent) of the contract value of the civil works will be deducted from each payment to contractor against the bill submitted by the contractor. The same may be released after three months from the date of successful testing and commissioning.
12	**Time of completion**	12.1 The time for completion of all works including successful testing, commissioning and trial run shall be 30 (thirty) calendar months including monsoon month reckoning from the date of signing the contract agreement whichever comes later. Program of the works in standard PERT / CPM chart should be submitted by the contractor within three months after the date of signing contract agreement.
13	**Training of Department's personnel**	13.1 After successful testing of the equipments, the contractor shall train the operation and maintenance staff of PHE Department at free of cost for a period of one month.
14	**Liquidated Damages**	14.1 If the Contractor fails to complete the work or any schedule portion of the work within the period specified in the Contract, the Department may without prejudice to all its other remedies under the Contract, deduct from the Contract Price, as liquidated damages, a sum equivalent to 0.5% of the Contract Price per week up to maximum of 10% of the contract price until actual completion. Once the maximum is reached, the Department may terminate the Contract. The amount of liquidated damage may be adjusted against any sum payable to the contractor under this or any other contract with the department.
15	**Warranty**	15.1 The Contractor warrants that all the Goods are new, unused, and of the most recent or current models, and that they incorporate all recent improvements in design and materials, unless provided otherwise in the Contract.

	15.2	The warranty shall remain valid for a minimum of twelve (12) months after the Goods, or any portion thereof as the case may be, have been delivered to and accepted at the final destination.
16 Force Majeure	16.1	The Contractor shall not be liable for forfeiture of its liquidated damages or termination of contract for the default if its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.
	16.2	For purposes of this Clause, "Force Majeure" means an event or situation beyond the control of the Contractor that is not foreseeable, is unavoidable, and its origin is not due to negligence or lack of care on the part of the Contractor. Such events may include, but not be limited to, acts of the Department in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions, and freight embargoes.
	16.3	If a Force Majeure situation arises, the Contractor shall promptly notify the Department in writing of such condition and the cause thereof. Unless otherwise directed by the Department in writing, the Contractor shall continue to perform its obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.
17 Extension of Time	17.1	If at any time during performance of the Contract, the Contractor should encounter conditions impeding timely completion of Works, the Contractor shall promptly notify the Department in writing of the delay, its likely duration, and its cause. As soon as practicable, after receipt of the Contractor's notice, the Department shall evaluate the situation and may at its discretion extend the Contractor's time, in which case the extension shall be ratified by the parties by amendment of the Contract.
	17.2	Except in case of Force Majeure, any delay by the Contractor in the performance of its obligations in the Contract, shall render the Contractor liable to the imposition of liquidated damages, unless an extension of time is agreed upon.
18 Arbitration	18.1	If any dispute or difference whatsoever arises between the parties out of or relating to the work execution, meaning, scope, operation or effect of this contract or the validity or the breach, the matter shall be settled by arbitration in accordance with the provision of the arbitration and Conciliation Act 1996 as amended thereon. The place of arbitration shall be within the State of Mizoram.
19 Mobilization advance	19.1	Mobilization advance limited to 10% of contract amount at 10% simple interest can be sanctioned to the contractors on specific request as per term of the contracts.
	19.2	The mobilization advance shall be released after obtaining a bank Guarantee bond from a schedule bank for the amount to be released and valid for the contract period. This shall be kept renewed time to

	time to cover the balance amount likely period to complete recovery together with interest.
	19.3 It shall be ensured that at any point of time, Bank Guarantee is available for the amount of outstanding advance.
	19.4 The recovery shall commence after 10% of work is completed and the entire amount together with interest shall be recovered by the time 80% of the work is completed.
20 Income Tax	20.1 Deduction of income tax will be made at two percent (2%) of the gross amount of each bill in excess of Rs5000/- or as per advice of the income Tax Authority.
21 Termination	21.3 Termination for Default 21.3.1 The Department, without prejudice to any other remedy for breach of Contract, by Notice of default sent to the Contractor, may terminate the Contract in whole or in part: i) if the Contractor fails to deliver any or all of the Goods within the period specified in the Contract, or within any extension thereof granted by the Department. (ii) if the Contractor fails to perform any other obligation under the Contract. 21.3.2 In the event the Department terminates the Contract in whole or in part, the Department may continue the work upon such terms and in such manner as it deems appropriate, and the Contractor shall be liable to the Department for any additional costs incurred.
	21.4 Termination for Insolvency: The Department may at any time terminate the Contract by giving Notice to the Contractor if the Contractor becomes bankrupt or otherwise insolvent. In such event, termination will be without compensation to the Contractor, provided that such termination will not prejudice or affect any right of action or remedy that has accrued or will accrue thereafter to the Department.

Section – IV

Prescribed forms and Formats.

(Price Bid Submission Sheet)

NIT No.: ----------
Job ID: Greater Khawzawl WSS.

To:

The Chief Engineer,
Public Health Engineering Department,
Mizoram, Aizawl - 796001,

Sir,

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Tender Document, including Addenda

(b) We offer to execute works in conformity with the terms & conditions of the contract and in accordance with the Schedule of the items of works: Works of Greater Khawzawl Water Supply Scheme.

(c) Our Bid shall be valid for a period of _____days from the date fixed for the bid submission deadline, and it shall remain binding upon us at any time before the expiration of that period;

(d) Our firm has not been declared ineligible by the PHE Department;

(e) We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed.

(f) Our Prices are FIRM and valid till the scheduled completion time of 30(thirty) months from the date of signing contract agreement.

(g) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.

Signature……
Name……
Duly authorized to sign the Bid for and on behalf of……..

Date ……..

(Technical Bid Submission Sheet)

NIT No.: ----------
Job ID: Greater Khawzawl WSS.

To:

The Chief Engineer,
Public Health Engineering Department,
Mizoram, Aizawl - 796001,

Sir,

We, the undersigned, declare that:

a) We have examined and have no reservations to the Tender Document, including Addenda.

b) We offer to execute works in conformity with the terms & conditions of the contract and in accordance with the Schedule of the items of works: Works of Greater Khawzawl Water Supply Scheme.

c) Our Bid shall be valid for a period of _____days from the date fixed for the bid submission deadline, and it shall remain binding upon us at any time before the expiration of that period;

d) Our firm has not been declared ineligible by the PHE Department;

e) We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed.

f) I/ We do hereby submitted the following documents:

i) Earnest Money Deposit,
ii) Qualification and experiences, if any,
iii) Our approach to the work,
iv) Technical designs of Pumps, Electric Motors, Pumping mains,Valves, Power Transformers, etc.
v) Technical brochures, data sheets, specifications, etc of major equipments.
vi) Company's certification that they will render technical supports in supply, installation and commissioning of the respective major equipments intended to be supplied in the contract
vii) Income Tax clearance Certificate in case of non-tribal tender
viii) Lists of qualified Engineers in the payroll of Bidder.
ix) Sales tax/VAT clearance certificate.
x) Proposed payment terms
xi) Any other information the Bidder wishes to incorporate.

Signature……
Name……
Duly authorized to sign the Bid for and on behalf of……..

Date …….

(To be produced in Company's letter head)

Company's Authorization

NIT No.: ----------
Job ID: Greater Khawzawl WSS

To:

The Chief Engineer,
Public Health Engineering Department,
Mizoram
Aizawl- 796001,

We, <*Name of manufacturer*>, are official manufacturer of <*Name of Product*> having factories at …….The machinery tendered by <*name of Bidder*> is manufactured by us and is within our range of production.

We further affirm that we are willing to sell our product to <*name of bidder*> and shall extend support in installation, testing and commissioning at site including supports in after sales services as deemed necessary.

Signed …….
Name……..
Designation……
Seal……..

Format for Price Bid Submission

NIT No……..

JOB ID: Greater Khawzawl Water Supply Scheme

Sl. No.	Description of Item of Works	Unit	Quantity	Rate (Rs)		Amount	Justification for variation of cost as in NIT Document Vol. II, if vary.
				Figure	Words		
1	**Approach road**						
	a. Construction of approach road from Clear water pumping station to raw water pumping station	Rm	550				
	b. Construction of footpath along pumping main	Rm	4500				
	c. Construction of RCC Culvert.						
2.	**Intake Structures**: Construction, Sypply, Installation and commissioning of:						
	a. Diversion weir.	JOB	1				
	b. Intake Jackwell cum pump house	JOB	1				

	c. Raw water Submersible pump set, 20KW with discharge capacity of 63.05m3/hr against the total head of 59.53m	Set	2				
	d. Diesel engine generating set of 75KVA	Set	1				
3.	**Treatment Plant:** Construction, testing and commissioning of 2.9 MLD capacities Water Treatment Plant of the following units.						
	a. Stilling basin with cascade aerator and parshall flume	JOB	1				
	b. Sedimentation unit aided by tube settler.	JOB	1				
	c. Rapid sand filter plant with chemical house.	JOB	1				
4.	**Clear Water Sump:** Construction of RCC Clear Water Sump 1,30,000 Liters Capacity.	JOB	1				

5.	**Pump House:** Construction and commissioning of Pump House						
	a) Shed for D.G Set	Job	1				
	b) Clear water pump house	Job	1				
6.	**Pumping Machineries:**						
	i) Design, Supply, Installation, Testing and commissioning of electrically driven Horizontal multi-stage Centrifugal Pump having discharge capacity of 58,7m3/hr against total head of 867.12m complete with all mechanical and hydraulic equipments and accessories for clear water pumping.	JOB	2				

	ii) Design, supply, installation, testing and commissioning of 1.5MVA Diesel Engine Generating set with output of 3phase current, 3.3KV capable of driving the Clear Water Pumping Machineries including all electrical accessories, diesel tanks, etc.	JOB	1				
7.	**Pumping Main:** Providing, Laying, Jointing by welding of pumping main line of suitable pipe with all connected Works like thrust blocks/ anchor blocks, drain outlet with required valves and other protective devices for wáter hammer, air valves, etc.						
	a) Raw wáter pumping main	Rm	550				
	b) Clear wáter pumping main	Rm	4500				

8.	**33/3.3KV Sub-Station**: Design, Supply, Erection, Testing and commissioning of 33/3.3KV Sub-Station including installation of 1.5MVA Tranformer, 250 KVA and 100KVA auxilliary Transformer with all necessary protection devices, Cabling Works, etc., complete.	JOB	1				
	TOTAL						

Signature……..

Name/Name of Firm……

Designation:……..

Date:……..

Place……

TABLE OF CONTENTS

CHAPTER – I

RCC DIVERSION WEIR ACROSS THE RIVER TUICHANG

DETAILED ESTIMATE FOR CONSTRUCTION OF RCC WEIR AT RIVER TUICHANG FOR KHAWZAWL WSS(PUMPING)															
Sl. No	**DISCRIPTION**											**Qnty**	**Unit**	**Rate**	**Amount**
1/ 2.06	Earthwork in excavation over areas (exceeding 30cm in depth, 1.5m in width as well as 10sqm on plain) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposal earth to be levelled and neatly dressed.														
	(a) Ordinary and hard soil.														
				3	x	30.00	x	1.20	x	1.00	=	90.00	m^3	432.38	38,914.20
2/ 2.07	Earthwork in excavation in foundation trenches or drains etc. including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.														
	(,c) Hard rock (blasting prohibited)														
				2	x	30.00	x	1.20	x	2.50	=	180.00	m^3	658.48	118,526.40
3/ 2.07	Providing and laying cement concrete 1 : 2 : 4.etc, excluding cost of centering and shuttering in -														
	(a) all work upto foundation & plinth level.														
				2	x	30.00	x	1.20	x	0.10	=	7.20			
						30.00	x	4.00	x	0.10	=	12.00			
						30.00	x	9.50	x	0.10	=	28.50			
						30.00	x	2.00	x	0.10	=	6.00			
										Total	=	53.70	m^3	5606.32	301,059.38
4/ 5.43	Providing and laying machine batched, machine mixed and machine vibrated design mix M-25 grade reinforced cement concrete excluding cost of centering and shuttering and reinforcement in-														
	(a) all work upto foundation & plinth level.														
				2	x	30.00	x	1.20	x	0.15	=	10.80			
	2	x	30.00	x	0.50	x	1.20	x	0.15	=	5.40				
				2	x	30.00	x	0.50	x	2.80	=	84.00			
						30.00	x	4.00	x	0.30	=	36.00			
						30.00	x	0.50	x	0.68	=	10.13			
						30.00	x	0.50	x	0.50	=	7.50			
						30.00	x	9.00	x	0.20	=	54.00			

				22	x	30.00	x	0.15	x	0.10	=	9.90			
						30.00	x	2.00	x	0.30	=	18.00			
										Total	=	235.73	m^3	6847.68	1,614,169.37
5/ 5.06	HYSD bars reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.10mm Dia # @150mm c/c.														
	$2\times\left(\frac{30.00}{0.15}+1\right)\times 1.20$						=			482.4	Rm				
	$2\times\left(\frac{1.20}{0.15}+1\right)\times 30.00$						=			540	Rm				
	$2\times 2\times\left(\frac{30.00}{0.15}+1\right)\times 2.80$						=			2251.2	Rm				
	$2\times 2\times\left(\frac{2.80}{0.15}+1\right)\times 30.00$						=			2360	Rm				
	$2\times\left(\frac{30.00}{0.15}+1\right)\times 5.00$						=			2010	Rm				
	$2\times\left(\frac{5.00}{0.15}+1\right)\times 30.00$						=			2060	Rm				
	$2\times\left(\frac{1.425}{0.15}+1\right)\times 30.00$						=			630	Rm				
	$2\times\left(\frac{30.00}{0.15}+1\right)\times 1.425$						=			572.85	Rm				
	$2\times\left(\frac{10.00}{0.15}+1\right)\times 30.00$						=			4060	Rm				
	$2\times\left(\frac{30.00}{0.15}+1\right)\times 10.00$						=			4020	Rm				
	$22\times\left(\frac{30.00}{0.15}+1\right)\times 0.30$						=			1326.6	Rm				

							=			1980	Rm				
		$2\times\left(\frac{30.00}{0.15}+1\right)\times 2.50$					=			1005	Rm				
		$2\times\left(\frac{2.50}{0.15}+1\right)\times 30.00$					=			1060	Rm				
								Total	=	24358.05					
			, @	0.62	Kg/m							15101.99	Kg	60.44	912,764.34
6/ 5.08	Centering and shuttering including strutting, propping, etc. and removal of form works in -														
	(a)Foundation footings, bases etc.														
				2	x	2	x	30.00	x	2.50	=	300.00			
						2	x	4.00	x	0.30	=	2.40			
						2	x	9.00	x	0.20	=	3.60			
						2	x	0.50	x	1.23	=	1.23			
								30.00	x	0.56	=	16.80			
								30.00	x	1.23	=	36.75			
						2	x	2.00	x	0.30	=	1.20			
										Total	=	361.98	m^2	163.82	59,298.74
7/ LS	Water diversion and dewatering														500,000.00
8/ LS	Carriage of materials……														75,000.00
												Total	=	Rs	3,619,732.43
												Say	=	Rs	3,619,732.00

CHAPTER – II

RCC INTAKE JACK-WELL CUM RAW WATER PUMP HOUSE

Detailed Estimate for the Construction of Jackwell at Tuichang under Khawzawl Pumping Scheme

1/2.06

Earthwork in excavation over areas (exeeding 30cm in depth, 1.5m in whidth as well as 10 sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.

a) Hard rock (blasting work)

0.5x3.50x3.00x5.00 = 26.25 m^3

@ Rs. 432.38/m^3 Rs.11350.00

2/2.07

Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.

f) Hard Rock (blasting prohibited)

$0.5x\pi x1.75^2x3.50$ = 16.83 m^3

$\pi x1.75^2x2.50$ = 24.05 m^3

40.88 m^3

@ Rs. 658.48/m^3 Rs. 26919.00

3/4.02 Providing and laying cement concrete 1:2:4 (1 cement :2 coarse sand:4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering in-

a) All work upto foundation & plinth level :

$\pi x1.75^2x0.10$ = 0.96 m^3

@ Rs. 5805.14/m^3 Rs.5573.00

4/5.43 Providing and laying in position machine batched, machine mixed and machine vibrated design mix M-25 grade reinforced cement concrete excluding cost of centering and shuttering and reinforcement in

a) Foundation base

$\pi x1.75^2x0.30$= 2.88 m^3

@ Rs. 6847.68/m^3 Rs. 19721.00

b) Walls,
2xπx1.45x0.20x6.00 = 10.93 m³
@ Rs. 6781.86/m³ Rs. 74126.00

5/5.01

providing and laying reinforced cement concrete 1:2:4 (1 cement :2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering and reinforcement in

c) Floor
0.50xπx1.55²x0.125 = 0.47m³
3.95x3.10x0.125 = 1.53 m³

Beam
0.50x2xπx1.55x0.20x0.15 = 0.146m³
2x3.95x0.20x0.15 = 0.237m³

Roof :
0.50xπx1.55²x0.10 = 0.377m³
3.95x3.10x0.10 = 1.22 m³
3.98 m³
@ Rs. 6231.65/m³ Rs. 24802.00

b) Column, posts
7x0.15x0.15x2.74 =0.43 m³
@ Rs. 6106.48/m³ Rs. 2625.00

6/5.07

HYSD bars like TATA/SAIL (ISI/ISO certified) or equivalent reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete

12mmØ 150 mm c/c

Base slab

Lo		= 2.90
L1	= 2x√1.45²- 0.15²)	= 2.88
L2	= 2x√1.45²- 0.30²)	= 2.83
L3	= 2x√1.45²- 0.45²)	= 2.75
L4	= 2x√1.45²- 0.6²)	= 2.64
L5	= 2x√1.45²- 0.75²)	= 2.48
L6	= 2x√1.45²- 0.9²)	= 2.27
L7	= 2x√1.45²- 1.05²)	= 2.00
L8	= 2x√1.45²- 1.2²)	= 1.63
		22.38 Rm

For both sides 44.76
For both ways 89.52
For two layers 179.04 Rm
Post : 7x4x3.00 = 84.00 Rm
Beam : 4x 7.00 = 28.00 Rm
291.00 Rm
@ 0.89 Kg/Rm 259 Kgs
Add 10% wastage 25.9
285 Kgs

10 mm Ø
Wall :
Vertical :
$2(\pi x \frac{1.35^2}{0.15} + 1)\ 6.00 = 470.00$ Rm

Horizontal
$2(\frac{6.00}{0.10} + 1)\ \pi x\ 1.35^2 = 698.00$ Rm

Floor (main reinforcement)
Lo = 2.90
L1 $= 2x\sqrt{1.45^2 - 0.15^2}$ = 2.88
L2 $= 2x\sqrt{1.45^2 - 0.30^2}$ = 2.83
L3 $= 2x\sqrt{1.45^2 - 0.45^2}$ = 2.75
L4 $= 2x\sqrt{1.45^2 - 0.60^2}$ = 2.64
L5 $= 2x\sqrt{1.45^2 - 0.75^2}$ = 2.48
L6 $= 2x\sqrt{1.45^2 - 0.9^2}$ = 2.27
L7 $= 2x\sqrt{1.45^2 - 1.05^2}$ = 2.00
L8 $= 2x\sqrt{1.45^2 - 1.2^2}$ = 1.63
22.38 Rm
For both sides 44.76
For two layers 89.52

$(\frac{3.75}{0.10} + 1)\ 2.70$ = 103.95 Rm
$(\frac{2.70}{0.10} + 1)\ 3.75$ = 105.00 Rm
298.47 Rm

Distribution bars :
70% from main reinforcement = 208.93 Rm
596.92 Rm

Roof :

Qnty same as floor = 596.92 Rm

TOTAL = 2361.84 Rm

@ 0.62 Kg/Rm 1464 kgs

Add 10% for wastage 146 Kgs

1610 Kgs

TOTAL : 285 + 1991 = 1895 Kgs

@ Rs. 66.43/Kgs Rs. 125885.00

7/5.08 Centering and shuttering including strutting, propping, etc and removal of form works in

b) walls

$2x\pi x1.45^2x6.00= 79.26\ m^2$

@ Rs. 252.40/m^2 Rs. 20005.00

c) Post

$6x4x0.15x2.74 = 9.864\ m^2$

@ Rs. 295.59/m^2 Rs. 2916.00

d) Beam

2x11.30x0.20 = 4.52

11.30 x 0.10 = 1.13

5.65 m^2

@ Rs. 225.36/m^2 Rs. 1273.00

e) Floor & Roof :

$2x0.5x\pi x\ 1.45^2 = 6.6\ m^2$

$2x3.75x2.70 = 20.25\ m^2$

26.85 m^2

@ Rs. 337.68/m^2 Rs. 9067.00

8/Anal. 4" thick LCC Block masonry upto one storey above and below ground level including curring etc. complete.

a) in cement mortar 1:3

11.20 x 2.74 = 30.70 m^2

Deduct :

W = 8x0.90 x 1.20 = 8.64 m^2

V = 8x0.90 x 0.45 = 3.24 m^2

Rolling shutter : 2.50x2.00 = 5 m^2

16.88 m^2

= 30.70 - 16.88 = 13.82 m^2

@ Rs.930.30/m^2 Rs. 12857.00

9/9.06

Providing 1st class local wood dressed in frames of chaukat for doors, windows, clerestory windows fixed in position

Windows : 8x4.20x0.10 = 0.08 = 0.269 m^3

Ventilation : 8x2.70x0.10 = 0.08 = 0.172 m^3

0.441m^3

@ Rs.21150.89/m^3 Rs. 9327.00

10/ 9.13

Providing and fixing 1st class local wood panelled and glazed shutters using 3mm thick plate sheet glass for doors and windows etc. including M.S butt hinges with necessary screws, etc complete.

b) 35 mm thick

Doors : 8x0.90x1.20 = 8.64 m^2

Ventilation : 8x0.90x0.45 = 3.24 m^2

11.88 m^2

@ Rs.1448.99/m^3 Rs. 17214.00

11/10.01

Supplying and fixing steel rolling shutter of approved make, made of required size of M.S laths interlocked together through their entiere length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side quides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary wire spring and M.S top cover.

2.50 x 2.00 = 5 m^2

@ Rs.3600.88/m^2 Rs. 18004.00

12/10.02

Providing and fixing ball bearing for rolling shutters. = 4 nos

@ 383.69 / no Rs. 1535.00

13/21.16 20 mm cement plaster 1:3 (1 cement : 3 fine sqm sand)

Wall : $2x\pi x\ 1.45^2x6.00$ = 79.26 m^2

Floor : $0.50\ x\pi x\ 1.45^2$ = 3.30m^2

4.50 x 2.50 = 10.125 m^2

Roof : Same as floor = 13.425 m^2

Wall (Building):

Qnty of Sl.No. 8/6.05 x 2 =13.82 x 2 = 27.64m^2

133.75 m^2

	@ Rs.258.58/m²	Rs. 34585.00
14/14.51	Providing and fixing alluminium tower bolts (socket bolts) anodised transparent or dyed to required colour or shade with necessary screws etc. complete. b) Window : 200mm = 32 nos. @ Rs.106.32/no	Rs. 3402.00
	d) 100mm = 16 nos. @ Rs.46.74/no	Rs. 748.00
15/14.52	Providing and fixing alluminium handles anodised transparent or dyed to required colour or shade with necessary screws, etc. complete a) 125 mm = 24 nos @ Rs.38.66/no	Rs. 928.00
16/14.57	Providing and fixing M.S hooks and eyes. b) 150mm = 32 nos. @ Rs.19.45/no	Rs. 622.00
17/21.65	Applying one coat of cement primer of approved brand and manufacture on wall surface. Wall : 8.48x4.00 = 33.92 m² Roof : Same as Qnty Sl.No. 13/21.16 = 13.425 m² Wall Building : Qnty Same as Sl.No. 13/21.16 = 27.64 m² **74.985m²** @ Rs.32.30/m²	Rs.2422.00
18/21.89	Finishing walls with water proofing cement paint of approved brand and manufacture and of required shade on new work (three or more coats) to give an even shade. Qnty same as Sl.No 17/21.65 = 74.985m² @ Rs.80.26/m²	Rs. 6018.00
19/10.24	Steel work welded in built up sections/ framed work including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. a) In stringers, treads Main frame : 2x 6 = 12.00 Rm Foot Rest : 24x0.45 = 10.80 Rm	

	Hold fast : 8x0.45 = 3.60 Rm		
	26.40 Rm		
	16 mm Ø MS in grill (1.5 m height, 1.0m width)		
	Vertical member @ 4Cm C/C 26x1.5 = 39.00 Rm		
	Horizontal member @ 15Cm C/C 40x1.5 = 40.00 Rm		
	105.40 Rm		
	@ 1.58 Kg/Rm	166.532 Kgs	
	@ 84.42/ Kg		Rs.14059.00
20/LS	Carriage of materials		Rs. 50000.00
	TOTAL		**Rs. 495983.00**

(Rupees four lakhs ninety five thousand nine hundred eighty three) only

CHAPTER – III

RAW WATER PUMPING MACHINERIES

DESIGN OF RAW WATER PUMPING MACHINERIES.

A. Full capacity of Pumps inclusive of 50% stand by as arrived from Ecodia Software. ---------- 47 KW
B. Full capacity of Pumps without stand by(2/3 of 'A')---------- 32 KW
C. Capacity of pump for first 15 years ---------- 16 KW

Adding 15% transmission loss, capacity of Prime Mover
to drive the above Pump: ---------- 18.4KW
Take commercial capacity of ---------- 20 KW

Proposed Arrangement of Pumping Units:

Initial	+	Ultimate	+	Stand by
1 Unit	+	1 Unit	+	1 Unit

Therefore, Provide 2 nos 20KW Pump sets, one unit for working and the other as Stand by unit at the initial stage. 1 number of same capacity pump set shall be additionally installed in the year 2028 to meet the ultimate design population.

Two numbers Submersible raw water pump (one working and the other as standby unit) shall be installed to lift raw water from River Tuipui to water treatment plant. The level difference of the water treatment plant and river bed is 50m and the discharge capacity of the pump shall be 63.05 m^3/hr. The design of the pump should be such that there shall be sufficient margin between the pump shut off head and the pump duty point. The efficiency of the pump shall not be less than 60%. The pump should be able to operate at +/- 10% of rated voltage.

The Bidder is expected to be aware of latest development of submersible pump manufacturing and is expected to offer the latest model of the pump type.

DIESEL ENGINE GENERATING SET FOR RAW WATER PUMPING

Design of capacity of Diesel Engine Generating set.

Voltage required at full capacity = 32 KW

At 0.4KV incoming voltage, the current shall be $\sqrt{3}$ VI Cosθ

Therefore, $32 = \sqrt{3}$ VI Cosθ

Then, $I = \frac{32}{1.78 \times 0.44 \times 0.8}$

= **51.1 Ampere.**

Starting system shall be Star-Delta whose starting current shall be 2.5 times.

Therefore, starting current shall be = **127.75 Ampere**

Starting Power shall therefore be = **1.78x0.44x127.75x0.8**

= **80 KVA**

SAY = **75 KVA (Nearest commercial size)**

GENERAL SPECIFICATIONS:

The Diesel Engine Generating Set shall be able to produce an output **of** 415V, 3-phase, 4 wire 50 Hz of adequate capacity to drive the clear water pump set including area lighting load.

1. The Diesel Engine Generator is for power source for running the Motor in times of power failure from the Grid line and shall therefore be capable of taking Starting Loads and Normal working loads without getting overload.
2. The engine shall be capable of operating continuously on full load at the site elevation.
3. Priming of the engine oil shall be provided.
4. The fuel oil tank of one day capacity shall be provided.
5. Starting of the engine by means of battery powered DC starter. A battery charger shall be provided and be capable of charging the batteries in position and shall have arrangement for both trickle and boost charging.
6. The engine shall conform to pollution control requirements.
7. The Engine shall be provided with control panel. The panel shall be mounted on a suitable steel frame and installed close to the engine. The control panel shall consist of the followings:
   a) Start/Stop push button for starting the engine.

   b) Visual indication of lubricating oil pressure, water temperature, low oil level, ammeter, voltmeter, lubricating oil temperature, R.P.M. meter.

The general requirement and specification are only the guide for the intending Bidder. The bidder shall only offer the latest model and technology.

CHAPTER – IV

STILLING CHAMBER WITH CASCADE AERATOR AND PARSHALL FLUME

DESIGN OF STILLING CHAMBER

Daily water demand		=	2.90	mld
		=	2900.00	m3/day
Daily pumping hour		=	23.00	hrs
Flow rate		=	126.09	m3/Hr
Detention time		=	0.03	hrs
Capacity of tank required		=	4.20	m3
Selecting Circular tank and		=		
diameter	D	=	1.50	m
Height	H	=	2.38	m
	Say	=	2.40	m
Taking freeboard as		=	0.30	m
Overall height		=	2.70	m
	Say	=	2.70	m
Actual capacity provide		=	4.24	m^3
		=		

DESIGN OF CASCADE AERATOR

Daily water demand	=	2.90	mld
	=	2900.00	m3/day
Daily pumping hour	=	23.00	hrs
Flow rate	=	126.09	m3/Hr
Taking the floor area of cascade aerator as	=	0.03	m2/m3/hr
Area of cascade aerator	=	3.78	m2
Taking the width of chanel as	=	1.50	m
Length of the chanel	=	2.52	m
	=	2.50m	Say

Provide 4 steps along the chanel, 15cm riser, 50cm tread. Semi-circular shaped baffle of radius 10cm may be provisded at the edges of each tread.

STRUCTURAL DESIGN OF STILLING CHAMBER:

Geometrical specifications:

Diameter of the tank, D = **1.50** m

Height of the tank H = **2.40** m

Using: Grades of concrete & steel: M **20** & Fe **415** respectively.

Volume of Cylindrical part of the Tank = 4.2 cum

Permissible stress of steel, σ_{st} = 150 N/mm^2 Modular ratio, m = 13.33

Permissible stress of concret, σc_t = 2.8 N/mm^2

DESIGN OF CYLINDRICAL WALL:

Max. Hoop tension at the base, T = γ_w.D.H / 2 = 17.1 kN

Area of steel required, Ast, req = T / σ_{st} = 118 mm^2 per metre run

Using: **10** mm# HYSD bar, spacing required = 134 ≈ **130** mm c/c in two layers.

Area of steel provided = **524** > 118 mm^2 (OK) **(OK)**

Check for thickness:

Let '**t**' be the thickness. σc_t = T / [1000t + (m-1)Ast,provided]

Wall thickness required, **t** = **0** mm; So, provide wall thickness = **200** mm

Thickness required for uncracked condition = T/1331 = **13** < 200 mm OK **(OK)**

Also, Vertical steel (Minimum steel) = 0.2 % of provided area = 434 mm^2

Using: **10** mm# HYSD bar, spacing required = 236 ≈ **130** mm c/c in two layers.

So, Area of steel provided = **524** > 434 mm^2 OK **(OK)**

DESIGN OF BASE SLAB:

The slab is designed as Slab Spanning in Two Directions at Right Angles, Simply Supported on Four Sides:

Using **200** mm thick slab, D; Longer span, ly = **1.90** m ; Shorter span, lx = **1.90** m

Grade of Concrete & Steel M **20** and F**415** ly / lx = 1.00 < 2. Hence, it is two way slab

e

Limiting Moment of Resistance, = $Q_{u,lim}$ = 2.76

Load Calculation:

Dead Load of Slab = 0.20 x 25 = 5.0 kN/m^2

Dead Load of Water = 2.40 x 9.81 = 23.5 kN/m^2

Live Load, LL = 1.0 kN/m^2

= 29.5 kN/m^2

Total Factored Load = 1.5 x 29.54 = **44.3** kN/m

For all values of ly/lx

From Table 27: Annex D: IS: 456 - 2000 = 1.00

Bending moment coefficients; α_x = 0.062 ; α_y = 0.062

Moments per unit width: Mx = $\alpha_x w l_x^2$ = 0.062 x 3 x 3.6 = 9.94 kNm (-ve)

My = $\alpha_y w l_y^2$ = 0.062 x 3 x 3.6 = 9.94 kNm (+ve)

Check for depth:

Depth required for flexure, $d_{required.}$ = $\sqrt{(Mu / b.Q_{u,lim})}$ = **60** < 200 mm **(OK)**

Using **10** mm# HYSD bar with a clear cover of **25**

Effect. depth for -ve Moment, dxx = 170 mm

Effect. depth for +ve Moment, dyy = 160 mm

Moment steel:

For M_u/bd^2 = 0.34 ; p_t = 0.19 % ; Area of -ve steel required = 165 mm^2

Using **10** mm# bar, spacing required = 476 mm c/c; Provide a spacing = **200** mm c/c

So, Area of steel provided = **393** > 165 mm^2 **(OK)**

For M_u/bd^2 = 0.34 ; p_t = 0.19 % ; Area of +ve steel required = 176 mm^2

Using **10** mm# bar, spacing required = 447 mm c/c; Provide a spacing = **200** mm c/c

So, Area of steel provided = **393** > 176 mm^2 **(OK)**

Minimum steel (Distribution steel):

Minimum -ve steel required = 240 < 393 mm^2 **(OK)**

Minimum +ve steel required = 240 < 393 mm^2 **(OK)**

At discontinuous edges, Provide Steel 50% of Positive Steel, or Minimum steel whichever is greater.

Steel required at each edge = **240** mm^2

Note: Positive Steel are not curtailed if the remaining area is less than A,min

Using **10** mm# bar, spacing required = 327 c/c; Provide a spacing = **200** mm c/c

So, Area of steel provided = **393** > 240 mm^2 **(OK)**

Torsion steel:

Tortion steel reqd at corner = 3/4 x 176 mm^2 = 132 ≈ **240** mm^2

Using **10** mm# bar, spacing required = 327 c/c; Provide a spacing of = **200** mm c/c

So, Area of steel provided = **393** > 240 mm^2 **(OK)**

Check for cracking: (as per cl: 26.3.3; IS:456 - 2000)

For main reinforcement, max. spacing permitted = 510 > 200 mm c/c **(OK)**

For secondary reinforcement, spacing permitted = 480 > 200 mm c/c **(OK)**

Check for Shear:

This is critical along longer span.

At internal point: SF = 44.3 x 0.95 = 42.1 kN

% age = **0.23** %; Design shear stress, τ_c = **0.33** N/mm^2 (Table-19: IS 456-2000)

For a slab thicness 200 mm, coefficient, k = 1.3

Design shear strength = $k.\tau_c$ = 0.43 N/mm^2

Actual shear stress = **0.25** < 0.43 N/mm^2 **(OK)**

At external points: SF = 44.3 x 0.95 = 21.19 kN

% age = 0.25 %; β = (0.8 fck) / (6.89 pt) = 6

Shear strength τ_c = [0.85 √(0.8fck) x {(√(1+ 5β) – 1}] / 6β = 0.36 N/mm^2

Design shear strength = $k.\tau_c$ = 0.46 N/mm^2

Actual shear stress = **0.13** < 0.46 N/mm^2 **(OK)**

Check for development length, Ld:

					S. F.,	Vu	=	21.1	kN				
Critical point is at the external ends,													
Bending moment,	M u	=	0.87 fy Ast {d – (fy Ast)/(b fck)}							=	9.9	kNm (Ld for M2 0 =	56.3 #)
Assuming Lo =	**10**	#	1.3(Mu/Vu) + Lo			≥	Ld						**(OK)**
Which gives,	#	≤	**13**	mm									

Check for deflection:

Basic span ratio	=	20	(Assuming to be simply supported)										
Tension steel %	=	0.1 1 1.8											
Modification factor	=	5											
Permissible span / effective depth ratio =			37										
Actual span / effective depth ratio			=	**12**	<	37							**(OK)**

DETAILED ESTIMATE OF STILLING CHAMBER AND CASCADE AERATOR OF KHAWZAWL WSS

Item No	Description of item	Unit	Rate i/c 22.35% Cl	Diamensions				Quantity	Amount
				No	Length	Width	Thickness		
1/2.07	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.								
	(c) Very Hard Soil (jumper work)								
	Foundation:	*cum*	**371.69**	3.14	6.7		0.15	5.286	0.00
2/4.05	Providing and laying plain cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) excluding cost of centering in -								
	(a) Foundation	*cum*	**4883.72**	3.14	6.7		0.3	10.57	51,628.71
3/Analysis	Providing and laying RCC 1:1.5:3 (1cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size) excluding cost of centering and shuttering etc. in -								
	(a) Floor Slab	*cum*	**6752.70**	3.14	6.7		0.15	5.286	35,693.40
	(b) Haunch portion			3.14	1.8	0.25	0.2	0.141	954.16
	(c) Tank Walls.	*cum*	**6896.30**	3.14	1.8	2.3	0.15	1.950	13,447.37
	(d) Conical wall	*cum*	**6896.30**	3.14	4.25	3.46	0.15	6.926	47,764.15
	(e) 1st Cascades from top	*cum*	**6896.30**	3.14	3.3	0.45	0.45	1.049	7,235.27
	(f) 2nd Cascade from top	*cum*	**6896.30**	3.14	4.2	0.45	0.45	1.335	9,208.53
	(g) 3rd Cascade from top	*cum*	**6896.30**	3.14	5.1	0.45	0.45	1.621	11,181.78
	(h) 4th Cascade from top	*cum*	**6896.30**	3.14	6	0.45	0.45	1.908	13,155.04
	(i) Collecting chanel (Floor)	*cum*	**6896.30**	3.14	7.8	0.75	0.2	1.837	12,667.81
	(j) Collecting chanel (wall)	*cum*	**6896.30**	3.14	7.8	0.45	0.15	0.827	5,700.52
4/20.26	Providing and mixing water proofing chemical (PIDIPROOF POWDER chemical) in plain and	*cum*	**433.60**						

	reinforced cement concrete work 1 : 1.5 : 3 , @ 1.0 % by weight of cement.									
	Floor slab (Qnty as per item 3 above)								5.286	
	Tank wall								1.950	
	Total								7.236	3,137.42
5/5.07	HYSD bars like TATA/SAIL (ISI/ISO certified) or equivalent reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.	*kg*	**66.43**							
	(a) 12mm Steel									
	Wall @ 15cm c/c on one side (Hor)			17	3.14	1.8	96.08			
	Wall @ 15cm c/c on one side (Ver)			38	2.3		87.4			
	Floor slab (spacing @ 15cm c/c)									
	Lo= 1.8				1.80					
	L1= 2xSQR(0.9^2 - .15^2)				1.77					
	L1= 2xSQR(0.9^2 - .30^2)				1.70					
	L1= 2xSQR(0.9^2 - .45$^{2)}$				1.56					
	L1= 2xSQR(0.9^2 - .6$^{2)}$				1.34					
	L1= 2xSQR(0.9^2 - .75$^{2)}$				1.00					
	Total length			4	9.17		36.68			
	Haunches @ 15cm c/c			38	0.25		9.50			
	Conical portion (Hor)			24	3.14	5.05	380.57			
	Conical portion (vert)-Bottom half			164	1.73		283.72			
	Conical portion (vert)-Upper half			82	1.73		141.86			
	@ 0.89 Kg/RM	*kg*	66.43				1035.81		1018	67,625.74
6/5.08	Centering and shuttering including strutting, propping, etc. and removal of form works in -									
	(b) Walls	*sqm*	**252.40**	2	3.14	1.8	2.3		26.00	6,562.20
	(e) Conical portion	*sqm*	**337.68**	1	3.14	4.25	3.46		46.17	15,591.94
	Cacade steps - 1st from top.	*sqm*	**337.68**	1	3.14	3.3	0.45		4.66	1,574.57

	2nd from top	*sqm*	**337.68**	1	3.14	4.2	0.45	5.93	2,004.00
	3rd from top	*sqm*	**337.68**	1	3.14	5.1	0.45	7.21	2,433.42
	4th from top	*sqm*	**337.68**	1	3.14	6	0.45	8.48	2,862.85
	Collecting chanel (Floor)	*sqm*	**337.68**	1	3.14	7.8	0.75	18.37	6,202.84
	Collecting chanel (wall)	*sqm*	**337.68**	2	3.14	7.8	0.45	22.0428	7,443.41
7/21.16	20mm cement plaster 1 : 3 (1 cement : 3 fine sand).								
	Floor			3.14	1.5			1.77	
	Internal tank wall			3.14	1.5	2.3		10.83	
	1st Cascades (vertical)			3.14	3.3	0.45		4.66	
	1st Cascades (Floor)			3.14	3.3	0.45		4.66	
	2nd Cascade (Vert)			3.14	4.2	0.45		5.93	
	2nd Cascade (Hor)			3.14	4.2	0.45		5.93	
	3rd Cascade (Vert)			3.14	5.1	0.45		7.21	
	3rd Cascade (Hor)			3.14	5.1	0.45		7.21	
	4th Cascade (Vert)			3.14	6	0.45		8.48	
	4th Cascade (Hor)			3.14	6	0.45		8.48	
	Collecting Chanel (Floor)			3.14	7.8	0.45	2	22.04	
	Collecting Chanel (Wall)			3.14	7.8	0.45	2	22.04	
		sqm	**258.64**					109.25	28,256.02
8	Providing, fitting and fixing of inlet, outlet and drain pipes, railings, etc complete.								
	(a) Inlet Pipe - 125mm dia	RM	960.31	1	6			6	5,761.86
	(b) Outlet pipe - 125mm dia	RM	960.31	1	6			6	5,761.86
	GI Socket - 125mm dia	Each	850.00	1				1	
	© Drain pipe - 65mm dia	RM	593.46	1	6			6	3,560.76
	(d) Overflow pipe - 125mm dia	RM	960.31	1	2.5			2.5	2,400.78
	GI Bend 90^{o} - 125mm dia	Each	1050.00	1				1	1,050.00
	(e) Railings - 20mm dia	Rm	200.00	4	16			64	12,800.00
9	Providing & fitting steel ladder- 20mm steel @2.48 Kg/m	Kg	66.43	8	0.6		4.8	12	797.16

10	Site development including levelling of ground, etc	LS				5,000.00
11	Carriage of materials like cement, steel, sand, etc. from Champhai.	LS				30,000.00
	TOTAL					**419,463.56**
			Say	=	Rs	421,400.00

CHAPTER – V

HOPPER BOTTOM TYPE VERTICAL FLOW SEDIMENTATION TANK AIDED BY TUBE SETTLER

DESIGN OF SEDIMENTATION UNIT FOR KHAWZAWL WSS.

Discharge (Q)	=	2.9	MLD	
	=	126.087	m3/Hr	
Assume				
Detention time (T)	=	1.5	Hr	
Depth of Tank (D)	=	2.5	m	
Therefore, Surface area required (A)	=	(Q x T)/D		
	=	75.65217	m2	

Surface Loading consideration

Surface Loading	=	Q/A	<	40	m3/m2/day
If, Length (L)	=	8	m		
Breadth (B)	=	10	m		
The Surface loading rate is	=	37.83	m3/m2/day (which is sfe)		

Check for weir loading (Weir loading should be < 300m3/day/m)

Length of weir (L')	=	10	m
Weir loading	=	Q/L'	
	=	290	(Safe)

The performance of Sedimentation tank is proposed to enhance further by incorporating tube settlers.

Performance (P)	=	Vs/Vo(SinQ + lCosQ)	
Where, Vs	=	Settling velocity of partle in downward direction.	
Vo	=	Velocity of flow along the tube settler	
Q	=	Angle of inclination	
l	=	Relative length of settler (l'/d)	
l'	=	Length of tube settler	
d	=	Diameter of tube.	

Assuming circular tube, P should equal or exeed critical value of 1.33

Vs	=	L/T	=	3.33	m/hr
Vo	=	Q/A'	=	5.25	m/hr
Q	=			35^{o}	
d	=			50	mm
Assuming l value	=	10			
Therefore, l'	=			500	mm
or	=			0.5	m

DETAILED ESTIMATE FOR CONSTRUCTION OF SEDIMENTATION TANK AIDDED BY TUBE SETTLER.

SL/No.	DISCRIPTION	Qnty	unit	Rate	Amount
1/2.07	Earthwork in excavation in foundation trenches . Etc.				
	1 x 10.5 0 x 10.75 x 3.70 =	417.64	m^3	151.90	63,439.52
2/5.36	Providing and laying in position machine batched, machine mixed and machine vibrated design mix cement concrete of specified grade for reinforced cement concrete structural elements, etc. M-20 for -				
	Sludge chamber- No-1				
	Bottom 2 x 1.00 x 1.00 x 0.25 =	0.5	m^3		
	Conical wall 6 x 4.00 x 3.00 x 0.25 =	18.00	m^3		
	2 x 2.30 x 3.00 x 0.25 =	3.45	m^3		
	Floor (Slope 1:4)				
	2 x 6.00 x 5.40 x 0.25 =	16.20	m^3		
	Side wall :				
	3 x 1/2 x 1.50 x 5.90 x 0.25 =	3.32	m^3		
	Recrangular wall above above sludge chamber .				
	L/wall: 3 x 10.5 0 x 2.80 x 0.25 =	22.05	m^3		
	S/wall : 2 x 10.5 0 x 2.80 x 0.25 =	14.7	m^3		
	Baffle wall :				
	2 x 5.00 X 2.80 X 0.25 =	7.00	m^3		
	Inlet chamber.				
	Floor : 1 x 10.7 5 x 0.60 x 0.15 =	0.97	m^3		
	L/Wall : 1 x 10.7 5 x 2.80 x 0.15 =	4.515	m^3		
	S/wall: 2 x 0.45 x 2.80 x 0.15 =	0.378	m^3		
	Clear water collection chamber :				
	Floor : 1 x 10.7 5 x 0.60 x 0.15 =	0.97	m^3		
	L/Wall : 1 x 10.7 5 x 0.40 x 0.15 =	0.645	m^3		
	S/wall: 2 x 0.45 x 0.40 x 0.15 =	0.054	m^3		
	Total =	92.752	m^3	6565.50	608,963.26
3/5.07	HYSD Bars reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.				
	Sladge chamber :				
	Hoop reinforcement 10mm # Rod @125mm c/c.				
	mean length of rod :				

$\frac{1.00+5.00}{2}$ = 3.00 m

$\left(\frac{4}{0.125}\right)+1$ = 33 Nos

33 x 3.00 = 99.00 Rm

33 x 0.25 = 8.25 Rm

Distrebution reinforcement 10mm # Rod @ 150mm c/c.

mean length of rod :

$\frac{0.20+4.00}{2}$ = 2.10 m

$\left(\frac{5}{0.15}\right)+1$ = 34.33 3 Nos

Say = 35 Nos.

35 x 2.10 = 73.50 Rm

35 x 0.25 = 8.75 Rm

Hoop reinforcement 10mm # Rod @125mm c/c.

mean length of rod :

$\frac{1.00+5.00}{2}$ = 3.00 m

$\left(\frac{2.30}{0.125}\right)+1$ = 19.4 Nos

Say = 20 Nos

20 x 3.00 = 60.00 Rm

20 x 0.25 = 5.00 Rm

Distrebution reinforcement 10mm # Rod @ 150mm c/c.

mean length of rod :

$\frac{0.115+2.30}{2}$ = 1.21 m

$\left(\frac{5}{0.15}\right)+1$ = 34.33 Nos

Say = 35 Nos.

35 x 1.21 = 42.35 Rm

35 x 0.25 = 8.75 Rm

bottom floor of sladge chamber :

10mm # Rod.

$\left(\frac{1.25}{0.125}\right)+1$ = 11 Nos.

11 x 1.25 = 13.75 Rm

$\left(\frac{1.25}{0.15}\right)+1$ = 9.3333 Nos.

Say = 3 Nos.

Say = 10 Nos.

10 x 1.25 = 12.50 Rm

Total = 331.85

663.70 Rm

For 2(two) layers = 0 Rm

For 2(two) chambers = 1327.40 Rm

Floor (slope 1:4)

10mm # Rod.

$\left(\frac{6.28}{0.125}\right)+1$ = 51.24 Nos.

Say = 52 Nos.

52 x 5.37 = 279.2 Rm

$\left(\frac{5.37}{0.15}\right)+1$ = 36.8 Nos.

Say = 37 Nos.

37 x 6.28 = 232.4 Rm

Total = 511.6 Rm

For 2(two) layers = 1023

For 2(two)floor = 2046.40 Rm

Side wall: 10mm # Rod.

mean length of rod :

$\frac{0.17+1.60}{2}$ = 0.885 m

$\left(\frac{5.75}{0.125}\right)+1$ = 47 Nos.

47 x 0.885 = 41.6 Rm

$\frac{0.454+5.75}{2}$ = 3.102 m

$\left(\frac{1.60}{0.15}\right)+1$ = 11.667

Say = 12 Nos.

12 x 3.102 = 37.22 Rm

Total = 78.82 Rm

For 2(two) layers = 157.6

For 2(two) wall = 315.28 Rm

Above sladge chamber .

L/wall: $\left(\frac{10.625}{0.15}\right)+1$ = 71.833 Nos.

Say = 72 Nos.

72 x 2.80 = 201.60 Rm

$\left(\frac{2.80}{0.15}\right)+1$ = 19.667

Say = 20 Nos.

20 x 10.625 = 212.50 Rm

Total = 414.10 Rm

For 2(two) layers = 828.20

For 2(two) wall = 1656.40 Rm

S/wall : $\left(\frac{10.25}{0.15}\right)+1$ = 69.333 Nos.

Say = 70 Nos.

70 x 2.80 = 196.00 Rm

$\left(\frac{2.80}{0.15}\right)+1$ = 19.667 Nos.

Say = 20 Nos.

						205.00		
		20	x	10.25	=		Rm	
						401.00		
				Total	=		Rm	
	For 2(two) layers				=	802		
	For 3(three) wall				=			2406.00 Rm

Baffle wall :

$$\left(\frac{5.25}{0.15}\right)+1$$

					=	36	Nos.	
						100.80		
		36	x	2.80	=		Rm	

$$\left(\frac{2.80}{0.15}\right)+1$$

						19.667		
					=			
		Say			=	20	Nos.	
						105.00		
		20	x	5.25	=		Rm	
						205.80		
				Total	=		Rm	
	For 2(two) walls				=			411.60 Rm

Partition wall :

$$\left(\frac{10.25}{0.15}\right)+1$$

						69.333		
					=		Nos.	
		Say			=	70	Nos.	
						196.00		
		70	x	2.80	=		Rm	

$$\left(\frac{2.80}{0.15}\right)+1$$

						19.667		
					=			
		Say			=	20	Nos.	
						205.00		
		20	x	10.25	=		Rm	
				Total	=			401.00 Rm

Raw water entrance chamber.

Floor :

$$\left(\frac{10.67}{0.15}\right)+1$$

					=	72.13	Nos.	

				3				
		Say	=	73	Nos.			
	73	x	0.52	=	37.96	Rm		
$\left(\frac{0.52}{0.15}\right)+1$			=	4.466 7				
		Say	=	5	Nos.			
	5	x	10.67	=	53.35	Rm		
			Total	=			91.31	Rm

L/Wall :

$\left(\frac{10.67}{0.15}\right)+1$			=	72.13 3	Nos.			
		Say	=	73	Nos.			
	73	x	2.80	=	204.4 0	Rm		
$\left(\frac{2.80}{0.15}\right)+1$			=	19.66 7				
		Say	=	20	Nos.			
	20	x	10.67	=	213.4 0	Rm		
			Total	=			417.80	Rm

S/wall:

$\left(\frac{0.77}{0.15}\right)+1$			=	6.133 3	Nos.			
		Say	=	7	Nos.			
	7	x	2.80	=	19.60	Rm		
$\left(\frac{2.80}{0.15}\right)+1$			=	19.66 7	Nos.			
		Say	=	20	Nos.			
	20	x	0.77	=	15.40	Rm		
			Total	=	35.00	Rm		
	For 2(two) Wall			=			70.00	Rm

Clear water collection chamber :

Floor : $\left(\frac{10.67}{0.15}\right)+1$

			72.13						
		=	3	Nos.					
	Say	=	73	Nos.					
	73	x	0.52	=	37.96	Rm			
$\left(\frac{0.52}{0.15}\right)+1$									
			4.466						
		=	7						
	Say	=	5	Nos.					
	5	x	10.67	=	53.35	Rm			
			Total	=			91.31	Rm	
L/Wall :									
			72.13						
$\left(\frac{10.67}{0.15}\right)+1$		=	3	Nos.					
	Say	=	73	Nos.					
	73	x	0.461	=	33.65	Rm			
			4.073						
$\left(\frac{0.461}{0.15}\right)+1$		=	3	Nos.					
	Say	=	4	Nos.					
	4	x	10.67	=	42.68	Rm			
			Total	=			76.333	Rm	
S/wall:									
$\left(\frac{0.60}{0.15}\right)+1$		=	5	Nos.					
	5	x	0.461	=	2.305	Rm			
			4.073						
$\left(\frac{0.461}{0.15}\right)+1$		=	3	Nos.					
	Say	=	4	Nos.					
	4	x	0.60	=	2.40	Rm			
			Total	=	4.705	Rm			
For 2 (two) wall				=			9.41	Rm	
				G.TOTAL		=	9320.24	Rm	
								Kg	
Weight of 10mm bar……							5778.5	s	
								Kg	
Add 1% for overlapping & wastages…….							57.785	s	
Total weight of 10mm bar						=	5836.3	Kg	49.40	288,314.88

s

4/5.08 Centering and shuttering including strutting, propping, etc. and removal of form works in -

Sludge chamber :											
Conical wall	6	x	4.00	x	3.00	x	2	=	144.00	m^2	
	2	x	2.30	x	3.00	x	2	=	27.60	m^2	
Side wall :											
3 x	1/2	x	1.50	x	5.90	x	2		26.55	m^2	
Recrangular wall above above sludge chamber .											
L/wall:	3	x	10.50	x	2.80	x	2	=	176.40	m^2	
S/wall :	2	x	10.50	x	2.80	x	2		117.60		
Baffle wall :											
	2	x	5.00	X	2.80	X	2	=	56.00	m^2	
Inlet chamber.											
Floor :	1	x	10.75	x	0.60	x	1	=	6.45	m^2	
L/Wall :	1	x	10.75	x	2.80	x	2	=	60.20	m^2	
S/wall:	2	x	0.45	x	2.80	x	2		5.04		
Clear water collection chamber :											
Floor :	1	x	10.75	x	0.60	x	1	=	6.45	m^2	
L/Wall :	1	x	10.75	x	0.40	x	2		8.60		
S/wall:	2	x	0.45	x	0.40	x	2	=	0.72	m^2	
Above sladge chamber .											
L/wall:	2	x	2	x	10.50	x	2.80	=	117.6	m^2	
S/wall :	1	x	2	x	10.25	x	2.80	=	57.40	m^2	
	1	x	2	x	10.25	x	2.50	=	51.25	m^2	
Baffle wall :											
	2	x	2	x	5.00	X	2.80	=	56.00	m^2	
	1	x	1	x	5.00	x	0.15	=	0.75	m^2	
									918.61	m^2	206.3	189,509.24

5/21.16 20mm cement plaster 1 : 3.

Sludge chamber :											
Bottom floor											
	1	x	1	x	1	x	2	=	2	m^2	
Conical	6	x	4.00	x	3.00	x	2	=	144.00	m^2	

	l wall												
		2	x	2.30	x	3.00	x	2	=	27.60	m^2		
	Side wall :												
	3 x	1/2	x	1.50	x	5.90	x	2		26.55	m^2		
	Recrangular wall above above sludge chamber .										m^2		
	L/wall:	3	x	10.50	x	2.80	x	2	=	176.40			
	S/wall :	2	x	10.50	x	2.80	x	2		117.60	m^2		
	Baffle wall :										m^2		
		2	x	5.00	X	2.80	X	2	=	56.00			
	Inlet chamber.												
	Floor :	1	x	10.75	x	0.60	x	1	=	6.45	m^2		
	L/Wall :	1	x	10.75	x	2.80	x	2	=	60.20	m^2		
	S/wall:	2	x	0.45	x	2.80	x	2		5.04	m^2		
	Clear water collection chamber :										m^2		
	Floor :	1	x	10.75	x	0.60	x	1	=	6.45			
	L/Wall :	1	x	10.75	x	0.40	x	2		8.60			
	S/wall:	2	x	0.45	x	0.40	x	2	=	0.72	m^2		
	Above sladge chamber .												
	L/wall:	2	x	2	x	10.50	x	2.80	=	117.6	m^2		
	S/wall :	1	x	2	x	10.25	x	2.80	=	57.40	m^2		
		1	x	2	x	10.25	x	2.50	=	51.25			
	Baffle wall :										m^2		
		2	x	2	x	5.00	X	2.80	=	56.00	m^2		
		1	x	1	x	5.00	x	0.15	=	0.75	m^2		
								Total	=	920.61	m^2	211.40	194,616.95
6/LS	Providing pollythene sheetbarrier between earth and concrete												500.00
7	Arrangement of tube settlers												
	Area occupied by tube settlers									5E+05	Sq. Cm		
	Square area occupied by 40mm dia tubes									16	Sq. Cm		
										3375			
	No. of tubes									0	Nos.		
	No. of 0.5m cut length in 6m long pipe									12	Nos.		
	No. of 6m long pipes required									2813	Nos.	350	984,550.00
	Add 5% for cutting charge												49,227.50

Agle Iron requirement												
Floor	11	x	2	x	5.7		125.4					
	12	x	2	x	5		120					
Top	11	x	2	x	5.7		125.4					
	12	x	2	x	5		120					
Brackets @ 1.5m c/c both direction												
	5	x	5	x	0.5		12.5					
							503.3					
Added 5% for wastage in cutting, etc.							528.5					
@ 1.8Kg per meter							951.2				72	68,489.06
												2,447,610.42
Add 22.35% cost index												547,040.93
										TOTAL	=	2,994,651.34
										SAY	=	2,994,651.00

DESIGN OF HOPPER BOTTOM WALL

The slab is designed as Slab Spaning in Two Directions at Right Angles, Simply Supported on Four Sides:

Using **250** mm thick slab, D; Longer span, ly = **5.00** m ; Shorter span, lx = **4.12** m

Grade of Concrete & Steel M **25** and Fe **415** ly / lx = 1.22 / 2 < 2. Hence, it is two-way slab

Limiting Moment of Resistance, $Q_{u,lim}$ = 3.45

Load Calculation:

Dead Load of Slab, DL	=	0.25	x	25	=	6.25	kN/m^2	
water pressure					=	9.81	kN/m^2	
					=	16.06	kN/m^2	
Total Factored Load	=	1.5	x	16.06	=	24.1	kN/m	

From Table 27: Annex D: IS: 456 - 2000 For all values of ly/lx = 1.22

Bending moment coefficients; α_x = 0.086 ; α_y = 0.059

Moments per unit width:

Mx	=	$\alpha_x w$	=	0.086	x	24.1	x	16.9	=	34.9	kNm (-ve)
My	=	$\alpha_y w$	=	0.059	x	24.1	x	25.0	=	35.4	kNm (+ve)

Check for depth:

Depth required for flexure, $d_{required.}$ = $\sqrt{(Mu / b.Q_{u,lim})}$ = **10 1** < 250 mm **(OK)**

Using **10** mm# HYSD bar with a clear cover of **25**

Effect. depth for -ve Moment, dxx = 220 mm

Effect. depth for +ve Moment, dyy = 210 mm

Moment steel:

For $M_u/b / d^2$ = 0.7 21 ; p_t = 0.2 1 % ;

Area of -ve steel required = 455 mm^2

Using **10** mm# bar, spacing required = 173 mm c/c;

Provide a spacing = **150** mm c/c

So, Area of steel provided = **524** > 455 mm^2 **(OK)**

For $M_u/b / d^2$ = 0.8 02 ; p_t = 0.2 3 % ;

Area of +ve steel required = 485 mm^2

Using **10** mm# bar, spacing required = 162 mm c/c;

Provide a spacing = **125** mm c/c

So, Area of steel provided = **628** > 485 mm^2 **(OK)**

Minimum steel (Distribution steel):

Minimum -ve steel required = 300 < 524 mm^2 **(OK)**

Minimum +ve steel required = 300 < 628 mm^2 **(OK)**

At discontinuous edges, Provide Steel 50% of Positive Steel, or Minimum steel whichever is greater.

Steel required at each edge = **300** mm^2

Note: Positive Steel are not curtailed if the remaining area is less than A,min

Using **10** mm# bar, spacing required = 262 mm c/c;

Provide a spacing = **220** mm c/c

So, Area of steel provided = **357** > 300 mm^2 **(OK)**

Torsion steel:

Tortion steel reqd at corner = 3/4 x 485 mm^2 = 364 ≈ **364** mm^2

Using **10** mm# bar, spacing required = 216 mm c/c;

Provide a spacing of = **125** mm c/c

So, Area of steel provided = **628** > 364 mm^2 **(OK)**

Check for cracking: (as per cl: 26.3.3; IS:456 - 2000)

For main reinforcement, max. spacing permitted = 660 > 150 mm c/c **(OK)**

For secondary reinforcement, spacing permitted = 630 > 125 mm c/c **(OK)**

Check for Shear:

This is critical along longer span.

At internal point: SF = 24.1 x 2.06 = 49.6 kN

% age = **0.24** % ; Design shear stress, τc = **0.35** N/mm^2 (Table-19: IS 456-2000)

For a slab thicness 250 mm, coefficient, k = 1.1

Design shear strength = k. τc = 0.39 N/mm^2

Actual shear stress = **0.23** < 0.39 N/mm^2 **(OK)**

At external points: SF = 1 x 24.6 = 24.8 kN

% age = 0.30 % ; β = (0.8 fck) / (6.89 pt) = 9.70

Shear strength τc = [0.85 √(0.8fck) x {(√(1+ 5β) – 1}] / 6β = 0.39 N/mm^2

Design shear strength = k. τc = 0.43 N/mm^2

Actual shear stress = **0.12** < 0.43 N/mm^2 **(OK)**

Check for development length, Ld:

Critical point is at the external ends, S.F., Vu = 24.8 kN

Bending moment, Mu = 0.87 fy Ast {d – (fy Ast)/(b fck)} = 35.4 kNm

Assuming Lo = **10** # 1.3(Mu/Vu) + Lo ≥ Ld (Ld for M25 = 56.3 #) **(OK)**

Which gives, # ≤ **40** mm **(OK)**

Check for deflection:

Basic span ratio = 20 (Assuming to be simply supported)

Tension steel % = 0.23

Modification factor = 1.65

Permissible span / effective depth ratio = 33

Actual span / effective depth ratio = **24** < 33 **(OK)**

Anchorage of bar required = Areq/Apvd x Ø σs / 4 τ_{bd} (as per cl. 26.2 of IS:456-2000)

= 27.2 #

= 27 ≈ **400** mm (provided) **(OK)**

CHAPTER – VI

RAPID SAND FILTRATION PLANT WITH ATTACHED CHEMICAL HOUSE

DESIGN OF RAPID SAND FILTER AT GREATER KHAWZAWL WSS

Flow Rate	=	2.7	mld	
	=	1960	lpm	
Design for Filter Bed area				
Desireable filtration rate	=	80	lpm/m2	
Therefore, Area of Filter Bed required	=	24.5	m2	
Usual Length/width ratio	=	1.25		
Provide	L	3.25	m	
	B	2.60	m	
Area of 1 unit		8.45		
Provide 4 beds, 3 units working and 1 unit as a stanby				
Actual area provided		25.35	> 24.5 thus OK	
Depth requirment:				
Under drainage	=	0.15	m	0.6
Desireable gravel depth	=	0.45	m	
Sand depth	=	0.70	m	
Standing depth of water over filter media	=	1.00	m	
Free Board	=	0.50	m	
Total depth required	=	2.80	m	
Under Drainage System				
Desireable ratio of total area of perforation to Filter area	=	0.3	%	
Therefore, total area of perforation	=	253.5	cm2	
Providing 10mm dia perforation, nos of perforations required	=	322.93	Nos	
Desireable ratio of length to Dia of lateral	=	60		
Length	=	2400	mm	
Therefore, Diameter of Lateral pipe	=	40	mm	
Providing 2 rows of perforations @ 15cm c/c				
Nos of perforations in one lateral	=	32	Nos	

Nos of laterals required	=	10.09	Nos	Say	10	Nos.
Spacing of laterals	=	240	mm c/c			
Cross sectional area of central manifold	=	1.5	times of total area of laterals			
Total C/S area of laterals	=	12560	mm2			
C/S area of central manifold	=	18840	mm2			
Providing 150 mm dia manifold pipe, actual C/S area of manifold		17662.5	mm2			
Backwash System	=					
To cause sand expansion of 130-150% of undisturbed sand volume, the desireable flow as per Manual	=	600	lpm/m2			
Total flow rate required	=	5070	lpm	0.0845	m3/sec	
Desireable time of backwash	=	10	min			
Capacity of backwash tank required	=	50700		Say	50,000	lits.
If B and H are width and height of backwash gutter, drain off rate is given by		$1.376BH^{1.5}$	m3/sec			
The drain off rate is same as backwash flow	=	0.0845	m3/sec			
Assuming H value	=	0.35	m			
Therefore, width of trough	=	0.30	m			
Desireable pressure at under drainage	=	6-8	m			

DESIGN OF RECTANGULAR REINFORCED CONCRETE TANK:

Design criteria:

Grade of Concrete:	M	20.0
Grade of Steel:	Fe	415.0

Geometrical specification of the tank:

Length of the tank, L	=	4.60	m			
Breadth of the tank, B	=	3.55	m			
Height of the tank, H	=	1.80	m, including Freeboard of		300	mm
Capacity of the tank, V	=	29.4	cum			
	=	29.4	x 10^3	litres		

Summary of the design:

The design is based on approximate method.

Final moment of long wall	=	-7.1	kNm
Final moment of short wall	=	7.1	kNm

BM at centre of long span	=	5.8	kNm			
BM at centre of short span	=	0.6	kNm			
Direct tension in long wall	=	8.7	kN			
Direct tension in short wall	=	11.3	kN			
Thickness of wall required	=	78.0	mm	≈	**200**	mm (provided)

Long wall:

Main horizontal reinforcement steel:

Remote face	=	10	mm #	@	200	mm c/c
Liquid face	=	10	mm #	@	300	mm c/c
Vertical steel	=	10	mm #	@	250	mm c/c
Distribution bar	=	10	mm #	@	300	mm c/c on both face

Short wall:

Main horizontal reinforcement steel:

Remote face	=	10	mm #	@	300	mm c/c
Liquid face	=	10	mm #	@	180	mm c/c
Vertical steel	=	10	mm #	@	250	mm c/c
Distribution bar	=	10	mm #	@	300	mm c/c on both face

AB: longer span;

AD: shorter span;

D fix	I =	1 / 3.55	m	A	I =	1 / 4.60	m	B	hinge	
D fix	I =	1 / 3.55	m	A	I =	1 / 4.60	m	B	fix	
Fix: AD			=	Iad/Lad	=	1	/ 4	=	0.282	
Fix: AB			=	Iab/Lab	=	1	/ 5	=	0.217	
Total =	0.4991						Dist. Factor for AD	=	0.564	
							Dist. Factor for AB	=	0.436	

Distribution factor:

Fix: AD		=	Iad/Lad	=	1	/	4	=	0.282	
Hinge: AB		=	3Iab/4Lab	=	3	/	18	=	0.163	
Total =	0.4447						Dist. Factor for AD	=	0.633	
							Dist. Factor for AB	=	0.367	

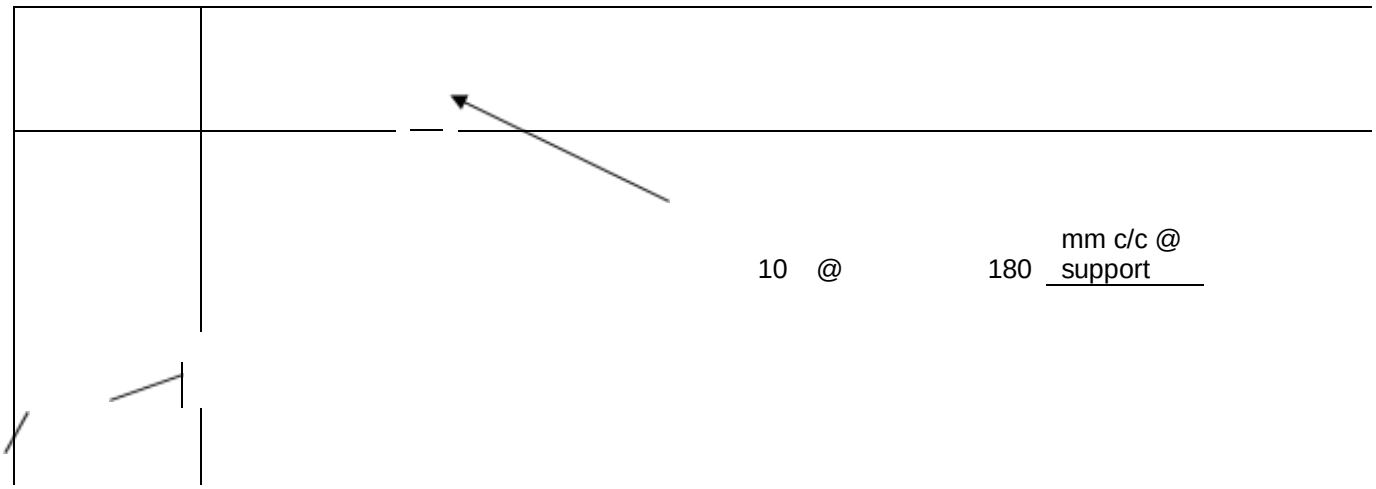
σ_{st}	=	150	N/mm2 for t < 225mm
	=	190	N/mm2 for t > 225mm
j	=	0.875	Lever arm constant for t < 225mm
	=	0.89	Lever arm constant for t > 225mm
Q	=	1.17	MR for t < 225mm
	=	1.03	MR for t > 225mm

Note; Daily water demand = 135 lpcd, lpcd - litre per capita per day

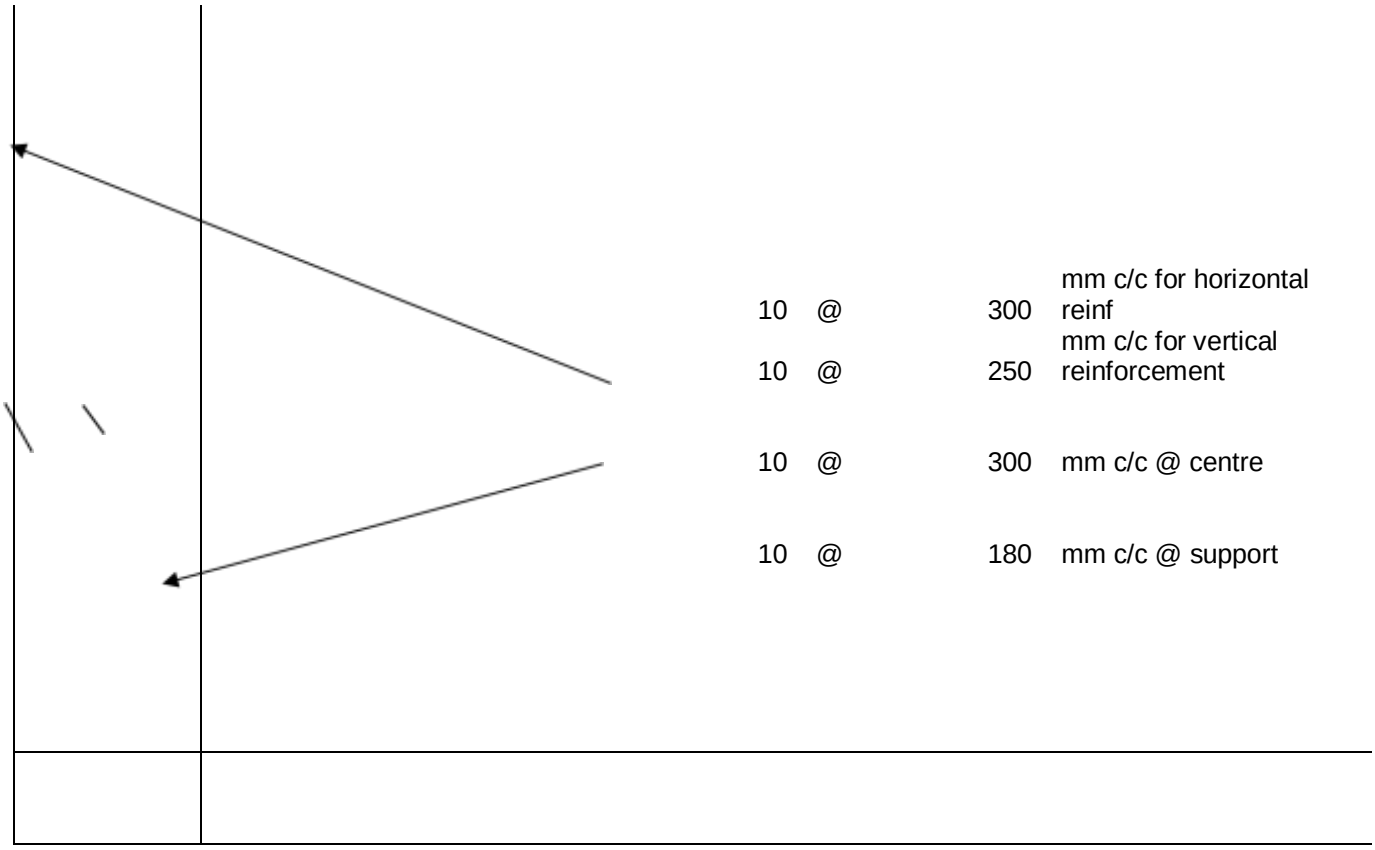
Minium grade is M20

		10	@	200	mm c/c for vertical reinf
400		10	@	300	mm c/c for hori. Reinf.
600					
800		10	@	200	mm c/c @ centre
1000					
1200	1400 1600				

A



10	@	180	mm c/c @ support	



D

Minimum reinforcement for Water retaining structures:

t, mm	% of reinf. MS	HYSD
100	0.300	0.240
150	0.286	0.229
200	0.271	0.217
250	0.257	0.206
300	0.243	0.194
350	0.229	0.183
400	0.214	0.171
450 or more	0.200	0.160

= 200 0.217

	250	0.206
S		
o	**250**	***0.206***

DESIGN OF SLAB IN FILTER HOUSE

The slab is designed as Slab Spaning in Two Directions at Right Angles, Simply Supported on Four Sides:

Using **120** mm thick slab, D; Longer span, ly = **4.60** m ; Shorter span, lx = **3.55** m

Grade of Concrete & Steel M **20** and Fe **415** ly / lx = 1.30 < 2. Hence, it is two-way slab

Limiting Moment of Resistance, = $Q_{u,lim}$ = 2.76

Load Calculation:

Dead Load of Slab, DL	=	0.12	x	25	=	3.00	kN/m^2						
Live load					=	3.00	kN/m^2						
					=	6.00	kN/m^2						
Total Factored Load	=	1.5	x	6.00	=	9.0	kN/m						

From Table 27: Annex D: IS: 456 - 2000 For all values of ly/lx = 1.30

Bending moment coefficients; α_x = 0.094 ; α_y = 0.057

Moments per unit width: Mx = $\alpha_x w l_x^2$ = 0.094 x 9.0 x 12.6 = 10.6 kNm (-ve)

My = $\alpha_y w l_y^2$ = 0.057 x 9.0 x 21.2 = 10.9 kNm (+ve)

Check for depth:

Depth required for flexure, $d_{required.}$ = $\sqrt{(Mu / b.Q_{u,lim})}$ = **63** < 120 mm **(OK)**

Using **10** mm# HYSD bar with a clear cover of **15**

Effect. depth for -ve Moment, dxx = 100 mm

Effect. depth for +ve Moment, dyy = 90 mm

Moment steel:

For M_u/bd^2 = 1.03 ; p_t = 0.31 % ; Area of -ve steel required = 315 mm^2

Using **10** mm# bar, spacing required = 250 mm c/c; Provide a spacing = **150** mm c/c

So, Area of steel provided = **524** > 515 mm^2 **(OK)**

For M_u/bd^2 = 1.03 ; p_t = 0.41 % ; Area of +ve steel = 366 mm^2

required

Using 10 mm# bar, spacing required = 215 mm c/c; Provide a spacing = 150 mm c/c

So, Area of steel provided = 524 > 436 mm^2 **(OK)**

Minimum steel (Distribution steel):

Minimum -ve steel required = 144 < 524 mm^2 **(OK)**

Minimum +ve steel required = 144 < 524 mm^2 **(OK)**

At discontinuous edges, Provide Steel 50% of Positive Steel, or Minimum steel whichever is greater.

Steel required at each edge = 183 mm^2

Note: Positive Steel are not curtailed if the remaining area is less than A,min

Using 10 mm# bar, spacing required = 430 mm c/c; Provide a spacing = 200 mm c/c

So, Area of steel provided = 393 > 183 mm^2 **(OK)**

Torsion steel:

Tortion steel reqd at corner = 3/4 x 366 mm^2 = 274 ≈ **274** mm^2

Using 10 mm# bar, spacing required = 280 mm c/c; Provide a spacing of = 200 mm c/c

So, Area of steel provided = 393 > 274 mm^2 **(OK)**

Check for cracking: (as per cl: 26.3.3; IS:456 - 2000)

For main reinforcement, max. spacing permitted = 300 > 150 mm c/c **(OK)**

For secondary reinforcement, spacing permitted = 270 > 150 mm c/c **(OK)**

Check for Shear:

This is critical along longer span.

At internal point: S_F = 9.0 x 1.78 = 16.0 kN

%age = **0.52** %; Design shear stress, τc = **0.49** N/mm^2 (Table-19: IS 456-2000)

For a slab thicness 120 mm, coefficient, $k_{\tau c}$ = 1.3

Design shear strength = τc = 0.64 N/mm^2

Actual shear stress = **0.16** < 0.64 N/mm^2 **(OK)**

At external points: S_F = 9.0 x 1.78 = 8.03 kN

%age = 0.58 %; β = (0.8 fck) / (6.89 pt) = 3.99

Shear strength τc = [0.85 √(0.8fck) x {(√(1+ 5β) – 1}] / 6β = 0.51 N/mm^2

Design shear strength = $\tau_c k_{\tau c}$ = 0.66 N/mm^2

Actual shear stress = **0.09** < 0.66 N/mm^2 **(OK)**

Check for development length, Ld:

Critical point is at the external ends, S.F., Vu = 8.0 kN

Bending moment, Mu = 0.87 fy Ast {d – (fy Ast)/(b fck)} = 10.9 kNm

Assuming Lo = **10** # 1.3(Mu/Vu) + Lo ≥ Ld (Ld for M20 = 56.3 #) **(OK)**

Which gives, # ≤ **38** mm

Check for deflection:

Basic span ratio = 20 (Assuming to be simply supported)

Tension steel % = 0.41

Modification factor = 1.34

Permissible span / effective depth ratio = 27

Actual span / effective depth ratio = **51** < 27 **(NOT OK)**

Anchorage of bar required = Areq/Apvd x Ø σs / 4 τ_{bd} (as per cl. 26.2 of IS:456-2000)

= 32.8 #

= 32 **40** **(OK)**

= 8 ≈ **0** mm (provided)

DESIGN OF BACKWASH SLAB IN FILTER HOUSE

The slab is designed as Slab Spaning in Two Directions at Right Angles, Simply Supported on Four Sides:

Using **200** mm thick slab, D; Longer span, ly = **4.60** m ; Shorter span, lx = **3.5** m

Grade of Concrete & Steel M **20** and Fe **415** ly / lx = 1.30 < 2. Hence, it is two-way slab

Limiting Moment of Resistance, $Q_{u,lim}$ = 2.76

Load Calculation:

Dead Load of Slab, DL = 0.20 x 25 = 5.00 kN/m^2

Water weight = 9.81 kN/m^2

= 14.81 kN/m^2

Total Factored Load = 1.5 x 14.81 = 22.2 kN/m

						For all values of ly/lx								
From Table 27: Annex D: IS: 456 - 2000					=					1.30				
						0.0								
Bending moment coefficients;			α_x	=	94	;	α_y	=	0.057					
			$\alpha_x w$		0.0		22.					26.	kNm (-	
Moments per unit width:	Mx	=	l_x^2	=	94	x	2	x	12.6	=		2	ve)	
			$\alpha_y w$		0.0		22.					26.	kNm	
	My	=	l_y^2	=	57	x	2	x	21.2	=		8	(+ve)	

Check for depth:

														(O
Depth required for flexure, $d_{required.}$			=	$\sqrt{(Mu / b.Q_{u,lim})}$	=	**99**	<	200	mm					**K)**
Usin	**1**					**2**								
g	**0**	mm# HYSD bar with a clear cover of				**0**								
Effect. depth for -ve Moment,		dxx	=	175	mm									
Effect. depth for +ve Moment,		dyy	=	165	mm									

Moment steel:

			M_u/b		0.8			0.2			Area of -ve steel		43		
For			d^2	=	55	;	p_t	=	5	% ;	required	=	8	mm^2	
Usin	**1**	mm# bar, spacing									Provide a		**12**		
g:	**0**	required					=	180	mm c/c;		spacing	=	**5**	mm c/c	
					62										**(O**
So, Area of steel provided			=		**8**	>	438	mm^2							**K)**
			M_u/b		0.9			0.2			Area of +ve steel		48		
For			d^2	=	86	;	p_t	=	9	% ;	required	=	0	mm^2	
Usin	**1**	mm# bar, spacing									Provide a		**12**		
g:	**0**	required					=	164	mm c/c;		spacing	=	**5**	mm c/c	
					62										**(O**
So, Area of steel provided			=		**8**	>	480	mm^2							**K)**

Minimum steel (Distribution steel):

					24										**(O**
Minimum -ve steel required			=		0	<	628	mm^2							**K)**
Minimum +ve steel					24										**(O**
required			=		0	<	628	mm^2							**K)**

At discontinuous edges, Provide Steel 50% of Positive Steel, or Minimum steel whichever is greater.

Steel required at each		**24**				
edge	=	**0**	mm^2			

Note: Positive Steel are not curtailed if the remaining area is less than A,min

Usin	**1**	mm# bar, spacing								Provide a		**20**		
g:	**0**	required	=	327	mm c/c;					spacing	=	**0**	mm c/c	
				39										**(O**
So, Area of steel provided			=	**3**	>	240	mm^2							**K)**

Torsion steel:

								36						
Tortion steel reqd at corner	=	3/4	x	480	mm^2	=	0	≈	**250**	mm^2				
Usin	**1**	mm# bar, spacing							Provide a		**20**		
g:	**0**	required	=	314	mm c/c;				spacing of	=	**0**	mm c/c	
				39									**(O**
So, Area of steel provided	=			**3**	>	250	mm^2						**K)**

Check for cracking: (as per cl: 26.3.3; IS:456 - 2000)

For main reinforcement, max. spacing permitted	=	525	>	12	mm c/c			**(O**

								5			**K)**
								12			**(O**
For secondary reinforcement, spacing permitted			=	495	>	5	mm c/c				**K)**

Check for Shear:

This is critical along longer span.

				22.		1.7		39.			
At internal point:	SF	=	2	x	8	=	4	kN			
% age = **0.36** ;	Design shear stress, τc	=	**0.34**	N/mm^2	(Table-19: IS 456-2000)						
For a slab thicness 200 mm, coefficient, k	=	1.1									
			k.	0.37							
Design shear strength	=	τc	=	7	N/mm^2						
			0.2	0.37							**(O**
Actual shear stress	=	**3**	<	7	N/mm^2						**K)**
			22.		1.7			19.			
At external points:	SF	=	2	x	8		=	7	kN		
% age = 0.38 ;	β	=	(0.8 fck) / (6.89 pt)				=	6.10			
Shear strength	τc	=	[0.85 √(0.8fck) x {(√(1+ 5β) – 1}] / 6β					=	0.43	N/mm^2	
			k.	0.40							
Design shear strength	=	τc	=	7	N/mm^2						
			0.1	0.40							**(O**
Actual shear stress	=	**2**	<	7	N/mm^2						**K)**

Check for development length, Ld:

				S.F.		19.					
Critical point is at the external ends,				, Vu	=	7	kN				
Bending moment,	Mu	=	0.87 fy Ast {d – (fy Ast)/(b fck)}				=	26.8	kNm		
									(Ld for M20	56.	
Assuming Lo =	**10**	#	1.3(Mu/Vu) + Lo		≥	Ld			=	3	#)
											(O
Which gives,	#	≤	**38**	mm							**K)**

Check for deflection:

Basic span ratio	=	20	(Assuming to be simply supported)		
		0.2			
Tension steel %	=	9			
		1.3			
Modification factor	=	4			
Permissible span / effective depth ratio	=	27			
					(N
					OT
					OK
Actual span / effective depth ratio	=	**28**	<	27	**)**

Anchorage of bar required = Areq/Apvd x Ø σs / 4 τ_{bd} (as per cl. 26.2 of IS:456-2000)

= 29.9 #

= 299 ≈ **400** mm (provided) **(OK)**

DESIGN OF FOOTING RSF:

Total axial load from Column, Pu = 1 x **600** = 600 KN

Size of Column: b x D = **450** x **450**

Using M **20** grade of concrete; and Fe **415** grade of steel; xu,max/d = **0.48**

Taking Safe bearing capacity of Soil, SBC = **250** kN/m^2

Size of footing:

Factored axial load on column, Pu = 600 kN

Dead load of footing (10% of Pu) = 60 kN

Total load = **660** kN

Area of footing required = P/SBC = 2.64 m^2

If b is width of footing, Then, b(b + 0.5) = 2.64 m^2

$b^2 + 0.5b$ = 2.64 m^2

Therefore, the required width of footing = 1.39 m

So, Provide a rectangular footing of size = **1.70** **X** **1.70** (b x l)

Area provided, A1 **=** **2.89** m^2 **(OK)**

Design of the section:

Factored axial load on column, Pu = 900 kN

Net upward pressure, nup = Pu/A = 1 = 311 kN/m^2

Net cantilever on *xx* or *yy*, nc = 0.63 m or nc = 0.63 m

Limiting moment of resistance, Mu,x = x = 0.20 x 1.70 x 311 = 103 kNm

The resisting section has a width = 450 + **200** = 650 mm

Depth required for flexure: for Mu,x = x = 240 mm

Limiting moment of resistance, Mu,y & y = 0.20 x 1.70 x 311 = 103 kNm

The resisting section has a width = 450 + 200 = 650 mm

Depth required for flexure: for Mu,y = y = 240 mm

So, provide overall depth, **D** = **350** > 240 mm **(OK)**

Moment steel:

Providing **12** mm# HYSD bar, with a clear cover of **50** mm; Total cover = 68 mm

Effect. depth for second layer = 276 mm

Effective depths: dxx = 350 - 50 - 6 = 294 mm

dyy = 294 - 12 = 282 mm

Providing a depth at the edge of footing = **150** mm

											Mu,xx /bd^2	=	1.84			
	For Mu,xx	% of steel, pt	=	0.58	%											
											Mu,xx /bd^2	=	2.00			
	For Mu,yy	% of steel, pt	=	0.64	%											
	Area of steel required for Mu,xx		=	110 8	mm^2											
	Providing	**1** no. **1** **2** of **2** mm# HYSD bar	≈	**124 4**	>	110 8	mm^2									**(OK)**
	Area of steel required for Mu,yy		=	117 1	mm^2											
	Providing	**1** no. **1** **2** of **2** mm# HYSD bar	≈	**135 7**	>	117 1	mm^2									**(OK)**
Check for cracking:																
	Clear distance between bars:		=	170 (0 - 100 - 12	) / 10 - 12											
			=	**147**	<	180	mm									**(OK)**
Check for reinf. parallel to shorter dir., β			=	1.70	/	1.7	=	1.00								
			2 / (1 + β)	=	1.00											
	Reinforcement on central band of		**1.70**	m width	=	117 1	mm^2									
	Remaining steel	=	117 1	-	1171	=	0	mm^2								
	This remaining steel is to be distributed in:			1.70	-	1.70	=	0.00	m width.							
	For a central band, steel required/metre		=	117 1	/	1.70	=	689	mm^2							
	Providing	**1** **2** mm# bar, spacing required	=	164	mm c/c											
	For total length of footing, no. of bar reqd		=	1.70	/	164	=	10	≈	**12**	nos.					
	Provide	**1** no. **1** **2** of **2** mm diameter equally spaced HYSD bar.														
	Clear distance between bars:		=	170 (0 - 100 - 12	) / 11 - 12											
			=	**132**	<	180	mm									**(OK)**
Development length:																
	Development length reqd, Ld	=	56.3	x	12	=	676	mm								
	Anchorage available	=	625	-	50	=	**575**	>	676	mm						**(NOT OK)**
Check for one-way shear:																
	Depth at the edge of footing	=	**150**	mm												
	About x-axis: At d	=	282	mm from the face of Column.												
	S.F. at this critical section	=	0.34	x	1.70	x	311	=	181.6	kN						
	Width at this critical section	=	450	+	2	x	282	=	1014	mm						
	Depth at this critical section	=	88	+ (	343	/	625	) x	200	=	198	mm				
	Actual shear stress at this critical section,			τv	=	**0.91**	<	2.10	N/mm^2							**(OK)**

Check for two-way shear:

Two-way shear is checked at a distance d/2 from the face of column.

Area at the critical section	=	732	x	732	=	0.54	mm^2				
S.F. at this critical section	=	2.89	-	0.54	x	311.4	=	733	kN		
Width at this critical section	=	2	x (	732	+	732	) =	2928	mm		
Depth at this critical section	=	88	+ (	484	/	625	) x	200	=	243	mm

Actual shear stress at this critical section, τ_v = 1.03 N/mm^2

But, permissible shear stress = $k_s \tau_c$;

Where, ks = $(0.5 + \beta_c)$ = 1.50 ~ **1** ; βc = b / D = **1.00**

τ_c = $0.25\sqrt{fck}$ = 1.12 N/mm^2

So, Permissible shear stress = $k_s \tau_c$ = **1.12** > 1.03 N/mm^2 **(OK)**

Typical geometrical diagram:

The detail section of the footing is shown below:

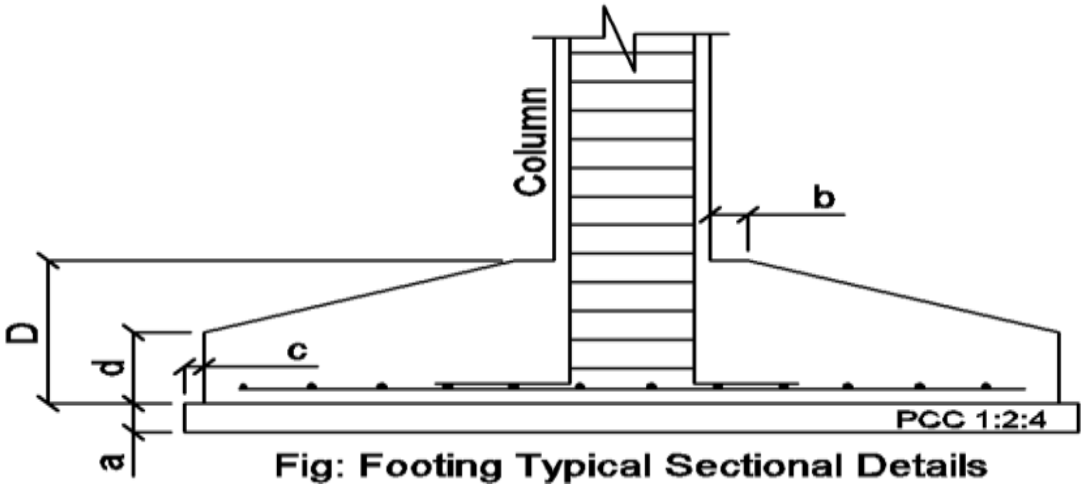


Fig: Footing Typical Sectional Details

Detail of the section:

D	=	350	mm
d	=	150	mm
c	=	50	mm
b	=	100	mm
a	=	100	mm

No. of steel required along short direction	=	**11.00**	x	1.70	x	0.89	=	0.17	**Qtl**
No. of steel required along short direction	=	**12.00**	x	1.70	x	0.89	=	0.18	**Qtl**
						Total	=	**0.35**	**Qtl**

RCC DESIGN OF RAPID SAND FILTER HOUSE

Live Load = 3 KN/m^2

Dead Load = 0.12x25 = 3.0 KN/m^3

Load due to finishing = 1 KN/m^3

Total Load	=	7.0 KN/m²
Self cut of beam	=	0.27x0.45x25
	=	3.0375 KN/m
Load from wall	=	0.10x3x25
	=	7.50 KN/m

Beam (a)

Area responsible	=	5.023m²
Total load transmitted through slab	=	5.023x7.0
	=	35.16 KN
Total load per M length	=	7.64 KN/m
Total UDL	=	18.178 KN/m

Beam (b)

Area responsible	=	3.15 m²
Total load transmitted the slab	=	3.15x7 = 22.05 KN
Total load per M length	=	6.211 KN/m
Total UDL	=	16.75 KN/m

Top roof (Tanky Portion)

Water Load	=	9.81 KN/m²
Dead weight of slab	=	0.20x25 = 5.0 KN/m²
Load due to finish	=	1 KN/m²
Total Load	=	15.81 KN/m²
Self weight of beam	=	0.3x0.45x25
	=	3.0375 KN/m
Load from wall	=	0.20x 1.8x25

= 9.0 KN/m

Beam (a)

Area responsible (5.023+4.194) = 9.217 m^2

Total Load transmitted through Slab = 9.217x15.81 KN/m^2

= 145.72 KN

Total load per M length = 31.68 KN/m

Total UDL per M = 43.72 KN/m

Beam (b)

Area responsible = 3.15 m^2

Total Load transmitted through slab = 3.15x15.81

= 49.80 KN

Total load per metre length = 14.02 KN/m

Total UDL per M = 26.057 KN/m

Beam (c)

Area responsible = 4.194 m^2

Total Load transmitted through slab = 4.194x15.81

= 86.31 KN

Total load per metre length = 14.41 KN/m

Total UDL per M = 26.4475 KN/m

Beam (d)

Area responsible = 1.56 m^2

Total Load transmitted through slab = 1.56x15.81

= 24.66 KN

Total load per metre length = 9.86 KN/m

Total UDL per M = 21.897 KN/m

Design of T Beam

Effective beam = 4.60+0.415

(ℓ) = 5.015 m

ℓo = 0.7x5.015 = 3.51 m

Over all depth = 450 mm

Breadth of web = 270 mm

Effective depth = $\frac{450-20-25}{2}$ = 415 mm

Maximum moment = $\frac{43.72x4.6^2}{12}$ = 77.09 KNm

= 770,92,933.00 Nmm

Factor moment = 770,92,933.00 x 1.5
Mu max

= 11,56,39,400.00 N mm

Effective width of flange bf = ℓo/6 +bw+6d

= $\frac{5015}{6}$+270+6x200

= 835.83+270+1200

= 2305.83 mm

Let us assume NA lies in flange

Mu limit = $0.36xfck \times \frac{xu}{d} \times (1-0.42 \times \frac{xu}{d}) bd^2$

= 0.36 x 20x0.48 (1-0.42x0.48) 2305.83 x 415^2

= 3.456 (0.798) 397121571.80

= 1095216817.00 Nmm

Mu max < Mu limit
Hence the section is under reinforced

Mu max = $0.87xfy\ Ast \times 415 \{1 - \frac{415}{Fck} \times \frac{Ast}{bxd}\}$

$$115639400.00 = 0.87 \times 415 \times Ast \times 415 \left\{1 - \frac{415}{20} \times \frac{Ast}{2335.83 \times 415}\right\}$$

$$= 149835.75\ Ast\ (1 - 0.00002168\ Ast)$$

$$= 149835.75\ Ast - 3.249\ Ast^2$$

$$Ast = \frac{149835.75 \pm \sqrt{(149835.75)^2 - (4 \times 3.249 \times 115639400)}}{2 \times 3.249}$$

$$= \frac{149835.75 \pm 144733.902}{2 \times 3.249} = \frac{5101.85}{6.498}$$

$$= 785.141\ mm^2$$

Provide 20 mm ø ... of 8 nos. = 314.16 x 8 = 2513.28 mm^2

Shear reinforcement

Shear force due to UDL = $\frac{WL}{2} = \frac{43.72 \times 5.015}{2}$

= 109.63 KN

Shear force due to moment = $(m_2 - m_1)/\ell = 0$

Total shear force V = 109.63 KN

Factor shear force Vv = 1.50 x 109.63 = 164.445 KN

% of steel = (785.141 x 100)/ 270 x 415

tc = 0.7007 N/mm^2

Nominal shear stress

tv = 164.445 x 10^3/ 270 x 415

= 1.4676 N/mm^2

Net shear = Vs = (tv –tc) bd

= (1.4676 – 0.7007) x 270 x 415

= 85931.56 N

Provide 8mm 2 legged stirrups Asv = $2 \times \frac{\pi}{4} \times 8^2 = 100.53\ mm^2$

Spacing of stirrups Sv = $\frac{0.87 \times 100.53 \times 415 \times 415}{85931.56\ N} = 175.29$ mm

So provide 8 mm ø 2 legged stirrups at 100 mm c/c

Load capacity of column

Column Size = 450 x 450 mm

D = 450 mm

Hence 0.05 D = 0.05 x 450 mm = 22.5 mm, thus the minimum eccentricity of 20 mm is less than 0.050 (22.5 mm)

Equation : Pu = 0.4 fck Ac + 0.67 fy

A = 450 x 450 = 202500 mm^2

Ast = $2 \times \frac{\pi}{4} \times 20^2 = 3769.91 mm^2$

Ac = A - Ast

= 202500 – 3769.91 = 198730.09 mm^2

Pu = 0.40 x 20x198730.09 +0.67 x 415 x 3769.91

= 1589840.00 + 1048223.47

= 2638063.47

Allowable service load = $\frac{Pu}{1.5} = \frac{2638.06}{1.5}$

= 1758.70 KN

The actual load carried by the column is less than the allowable ser vice load, hence safe

DETAILED WORKING ESTIMATE FOR CONSTRUCTION OF RSF & CHEMICAL HOUSE AT PUMPING STATION OF GREATER KHAWZAWL WSS

Item No	Description of Item	Unit	Rate	No	L	B	H	Qnty	Amount
1	2	3	4	5	6	7	8	9	10
1/LS	Site preparation and levelling								15,000.00
2/2.07	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.								
	(b) Hard Soil (pick work)								
	i) column foundation for Filter Block			6	1.2	1.2	1.5	**12.960**	
	ii) Column foundation for Chem house block			8	1.5	1.5	1.5	**27.000**	
		cum	**Rs. 278.71**					**39.960**	**11,137.25**
3/4.02	Providing and laying plain cement concrete 1:2:4 (1 cement :2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering in -								
	(a) All work upto foundation & plinth level :								
	i) column foundation for Filter Block			6	1.2	1.2	0.15	**1.296**	
	ii) Column foundation for Chem house block			8	1.5	1.5	0.15	**2.700**	
	iii) Foundation for Filter			1	9.5	6.35	0.3	**18.098**	
		cum	**Rs. 5,805.14**					**22.094**	**128,255.86**
4/5.01	Providing and laying reinforced cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering and reinforcement in -								
	(a) All work upto foundation & plinth level :								
	i) column foundation for Filter Block			6	1.2	1.2	0.35	**3.024**	
	ii) Column foundation for Chem house block			8	1.5	1.5	0.35	**6.300**	
	iii) Filter floor			1	9.5	6.35	0.25	**15.081**	
	iv) Filter walls (Long)			6	3.25	2.8	0.25	**13.650**	
	iv) Filter walls (short)			4	2.8	2.8	0.25	**7.840**	
	Net Quantity	*cum*	**Rs. 5,945.47**					**45.895**	**272,868.83**

(b)	Columns, pillers, posts, piers, etc. upto floor two level or floor two below from the ground floor (as indicated in the drawing).									
	i) columns at Filter Block				6	0.3	0.3	7.2	**3.888**	
	ii) Columns at Chem house block				8	0.45	0.45	12.5	**20.250**	
	iii) Column for railing at filter floor				16	0.15	0.15	0.75	**0.270**	
	iv) Column for railing at top of stair case				2	0.15	0.15	0.75	**0.034**	
	TOTAL	*cum*	**Rs. 6,106.49**						**24.442**	**149,253.30**
(c)	Beams, suspended floors, balconies, shelves, chajjas, lintels, cantilevers upto floor two level or floor two below from the ground floor (as indicated in the drawing).									
	Groung Floor:	i. Tie Beams			2	9.5	0.3	0.35	1.995	
					4	4.6	0.3	0.35	1.932	
		ii. Lintel Beam			2	9.5	0.2	0.2	0.760	
					4	4.6	0.2	0.2	0.736	
	First Floor:	i. Beams			2	9.5	0.3	0.35	1.995	
					4	4.6	0.3	0.35	1.932	
		ii) Lintels			2	9.5	0.2	0.2	0.760	
					4	4.6	0.2	0.2	0.736	
	Second Floor:	i. Beams			2	9.5	0.3	0.35	1.995	
					4	4.6	0.3	0.35	1.932	
		ii) Lintels			2	9.5	0.2	0.2	0.760	
					4	4.6	0.2	0.2	0.736	
	Third Floor:	i. Beams			2	9.5	0.3	0.45	2.565	
					4	4.6	0.3	0.45	2.484	
	Backwash water tank:	Floor slab			1	9.5	4.6	0.25	10.925	
		Wall (Short)			2	4.6	1.5	0.25	3.450	
		Wall (Long)			2	9.5	1.5	0.25	7.125	
		i. Rain Gutter			2	9.95	1.1	0.12	2.627	
	Filter Block:	Top beam (short)			2	6.35	0.3	0.3	1.143	
		Top beam (long)			2	9.5	0.3	0.3	1.710	
		Truss			2	10.8	0.3	0.3	1.944	

			Backwash gutter			4	3.25	1.25	0.15	2.438	
				cum	**Rs. 6,587.67**					**52.679**	**347,033.84**
5/5.06	HYSD bars reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.										
	16mm Dia										
		Ground floor:	I. Tie Beams			2	4	9.5	76		
						4	4	4.6	73.6		
			ii. Lintels			2	4	9.5	76		
						4	4	4.6	73.6		
		First floor:	i. Beams			2	9.5	6	114		
						4	4.6	6	110.4		
			ii. Lintels			2	9.5	6	114		
						4	4.6	6	110.4		
		Second Floor:	i. Beams			2	9.5	6	114		
						4	4.6	6	110.4		
			ii) Lintels			2	9.5	4	76		
						4	4.6	4	73.6		
		Third Floor:	i. Beams			2	9.5	8	152		
						4	4.6	8	147.2		
			i) columns at Filter Block			6	7.2	6	259.2		
			ii) Columns at Chem house block			8	12.5	8	800		
		Filter Block:	Top beam (short)			2	6.35	6	76.2		
			Top beam (long)			2	9.5	6	114		
			Truss			2	10.8	6	129.6		
		Filter Block:	wall (short)@ 12cm c/c			4	3.05	24	292.8		
			wall (long)			4	3.5	24	336		
			Floor			4	3.05	30	366		
						4	3.5	26	364		
		Backwash water tank:	Floor @ 12cm c/c			1	9.5	39	370.5		
						1	4.6	80	368		
			wall (short)			1	1.5	39	58.5		
						1	4.6	13	59.8		

wall (long)			1	1.5	80	120		
			1	9.5	13	123.5		
						5259.3		
@ **1.58Kg/m**	*kg*	**Rs. 60.44**					**8309.694**	502,237.91
10mm Dia								
i. Foundation base (10cm c/c, both ways)			5	1.2	24	144		
			8	1.5	32	384		
ii. Rain Gutter (15cm c/c, 1.3cm)			2	1.3	43	111.8		
			2	6.35	9	114.3		
ii. Floor Slab (12cm c/c, both ways)						0		
Inspection gallery of RSF			1	2	53	106		
			1	6.35	17	107.95		
			2	1	53	106		
			2	6.35	9	114.3		
			2	9.5	9	171		
			2	1	80	160		
Foyer			3	2.4	21	151.2		
			3	2.5	21	157.5		
Floor slab of chemical house : Ground floor @ 20cm c/c			1	9.5	23	218.5		
			1	4.6	48	220.8		
1St & 2nd floor slab @ 12cm c/c			2	9.5	39	741		
			2	4.6	80	736		
Stair case			6	3.6	11	237.6		
			6	1.2	30	216		
Backwash gutter			1	3.25	13	42.25		
@ 0.62Kg/Rm	*kg*	**Rs. 60.44**				4240.2	2628.924	158,892.17
6mm Dia								
Stirrups for long Columns (15cm c/c)			8	1.7	30	408		
Stirrups for short Columns (15cm c/c)			4	1.5	20	120		
Stirrups for Tie Beams			4	1.3	70	364		
			3	1.3	74	288.6		

	Stirrups for Beams			4	1.5	74	444		
				2	1.5	70	210		
				1	1.5	20	30		
	Stirrups for lintel Beams			3	0.7	74	155.4		
				4	0.7	70	196		
				1	0.7	20	14		
	Stirrupts for backwash gutter			1	1.25	22	27.5		
	@ 0.39Kg/Rm	*kg*	**Rs. 60.44**				2257.5	880.425	53,212.89
6/5.08	Centering and shuttering including strutting, propping, etc. and removal of form works in -								
	(c) Columns, pillars, piers, abutments, posts and struts.								
	i) columns at Filter Block			6	1	1.2	7.2	**51.840**	
	ii) Columns at Chem house block			8	1	1.8	12.5	**180.000**	
	iii) Column for railing at filter floor			16	1	0.6	0.75	**7.200**	
	iv) Column for railing at top of stair case			2	1	0.6	0.75	**0.900**	
	TOTAL	*sqm*	**Rs. 295.59**					**239.940**	**70,923.86**
	(d) Lintels, beams, plinth beams, girders, bressumers and cantilevers, etc.								
	Groung Floor: i. Tie Beams			2	9.5	1.3	1	24.700	
				4	4.6	1.3	1	23.920	
	ii. Lintel Beam			2	9.5	0.8	1	15.200	
				4	4.6	0.8	1	14.720	
	First Floor: i. Beams			2	9.5	1.3	1	24.700	
				4	4.6	1.3	1	23.920	
	ii) Lintels			2	9.5	0.8	1	15.200	
				4	4.6	0.8	1	14.720	
	Second Floor: i. Beams			2	9.5	1.3	1	24.700	
				4	4.6	1.3	1	23.920	
	ii) Lintels			2	9.5	0.8	1	15.200	
				4	4.6	0.8	1	14.720	
	Third Floor: i. Beams			2	9.5	1.5	1	28.500	
				4	4.6	1.5	1	27.600	

		Backwash water tank:	Floor slab			1	9.5	4.6	0.25	10.925	
			Wall (Short)			2	4.6	1.5	0.25	3.450	
			Wall (Long)			2	9.5	1.5	0.25	7.125	
		Filter Block:	Top beam (short)			2	6.35	1.2	1	15.240	
			Top beam (long)			2	9.5	1.2	1	22.800	
			Roof truss			2	10.8	1.2	1	25.920	
			Total	sqm	**Rs. 225.37**					377.180	85,005.06
	(e)	Suspended floors, roofs, landings, shelves and their support, balconies and chajjaj,etc.									
		Backwash water tank:	Floor slab			1	9.5	4.6	1	43.700	
			Wall (Short)			2	4.6	1.5	2	27.600	
			Wall (Long)			2	9.5	1.5	2	57.000	
			i. Rain Gutter			2	9.95	1.1	1	21.890	
			Backwash gutter			2	3.25	1.25	1	8.125	
				sqm	**Rs. 337.68**					**158.315**	53,459.81
7/Anal	4" thick LCC Block masonry upto one storey above and below ground level including curing, etc. complete.										
	a)	in cement moratar 1:3 (1 cement : 3 fine sand)									
		External Wall									
		Filter Block:	Short wall			2	6.35	2.8		35.560	
			Long wall			1	9.5	2.8		26.600	
		Chemical House Block:									
			Groung floor:			2	5.65	3		33.900	
						3	4.6	3		41.400	
			First floor			2	9.5	3		57.000	
						4	4.6	3		55.200	
			Second floor			2	9.5	3		57.000	
						4	4.6	3		55.200	
		Deductions								361.860	
		windows & ventilations at Filter block				4	1.8	0.9		6.480	

	Chemical house block:	Ground Floor								
		Door(rolling shutter)			1	2.4	2.5		6.000	
		Door(entrance)			1	1.8	0.9		1.620	
		Ventilation (stair case)			1	0.4	0.9		0.360	
		First Floor							0.000	
		Doors			2	1.8	0.9		3.240	
		windows & ventilations			4	1.8	0.9		6.480	
		Ventilation (stair case)			1	0.4	0.9		0.360	
		Second floor: Doors			2	1.8	0.9		3.240	
		windows & ventilations			6	1.8	0.9		9.720	
		Ventilation (stair case)			1	0.4	0.9		0.360	
		Total deductions							37.860	
		Net Quantity	*sqm*	**Rs. 930.30**					**324.000**	**301,417.20**
8/9.06	Providing Ist class local wood dressed in frames of chaukat for doors, windows, clerestory windows fixed in position.									
		Door D1			5	5.4	0.08	0.1	0.216	
		Windows /ventilation			10	6.3	0.08	0.1	0.504	
		ventilation			3	4.8	0.08	0.1	0.115	
		Total	*cum*	**Rs.21,150.88**					0.835	17,665.21
9/9.11	Providing and fixing 1st class local wood panelled shutters for doors etc. including M.S. butt hinges with necessary screws, etc. complete. (a) 40 mm thick.									
		Door D1	*sqm*	**Rs.1,451.56**	5	0.9	1.8		8.100	11,757.64
10/9.13	Providing and fixing 1st class local wood panelled and glazed shutters using 3mm thick plate sheet glass for doors and windows etc. including M.S. butt hinges with necessary screws, etc. complete. (b) 35 mm thick.									
		Windows W1			10	0.9	1.8		16.200	
		ventilation			3	0.4	0.9		1.080	

		TOTAL	*sqm*	**Rs.1,449.00**				17.280	25,038.72
10.13	Providing and fixing M.S tubular section in built up section of truss welded in position including cutting, hoisting, fixing in position and applying priming coat with approved steel primer etc. complete.								
	i.	Rafter: 40mm dia tube (medium class)			2	10.8	3.59	77.544	
	ii.	Bottom Chord: 50mm dia tube (medium class)			2	9.6	5.07	97.344	
	iii.	Braces: 32mm dia tube (medium class)			2	1.65	3.11	10.263	
					2	0.77	3.11	4.789	
					2	1.5	3.11	9.330	
								199.270	
		For two trusses						398.541	
	iv.	Purlins: 50mm dia tube.			8	5.4	5.07	219.024	
			kg	**Rs.109.38**				617.565	67,549.24
12/16.01	Providing corrugated G.S. sheet roofing fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (upto a pitch of 60 degrees) excluding the cost of purlins, rafters and trusses.								
	(e)	0.63mm thick with zinc coating not less than 275gm/m²							
		Filter block	*sqm*	**Rs. 391.39**	1	10.5	7	73.500	28,767.17
15/12.05	40mm thick red oxide flooring under layer of 30mm thick cement concrete 1:2:4 (1 cement : 2 sand : 4 well graded stone aggregate 12.5mm size) and top layer 10mm thick								

	plaster of cement red oxide mix using 3.5 kg of red oxide of iron per 50kg of cement in mortar 1:3 (1 cement : 3 sand) finished with a floating coat of neat cement red oxide mix of same proportion including cement slurry etc. complete but excluding the cost of nosing of steps etc.							
	Inspection gallery at RSF			1	2	6.35	12.700	
				2	1	6.35	12.700	
				2	1	9.5	19.000	
	Laboratory & Clorinator room			2	3.25	4.6	29.900	
	Alum solution room and rest house			2	3.25	4.6	29.900	
	varendah			1	3.25	4.6	14.950	
	Foyers			3	2	2.5	15.000	
	Stairs: Tread			48	1.2	0.3	17.280	
	Risers			54	1.2	0.17	11.016	
	TOTAL	*sqm*	**Rs. 646.37**				162.446	105,000.22
16/21.01	Pointing on brick works with cement mortar 1:3 (1 cement : 3 fine sand). (b) Ruled pointing.							
	Outer face of exterior wall (Qnty asper item 7)	*sqm*	**Rs. 81.11**				324.000	26,279.64
17/21.65	Applying one coat of cement primer of approved brand and manufacture on wall surface.							
	i. Both sides of exterior walls (twice the Qnty as per item 7-a)	*sqm*	**Rs. 32.30**	2	323		646.000	20,865.80
18/21.78	Painting with oil type wood preservative of approved brand and manufacture on new work (two or more coats) .							
	Doors: Qnty twice of item 9	*sqm*	**Rs. 17.49**	6	1.62		9.720	170.00
	Windows & Ventilations: Qnty twice of item 10			10	20.79		207.900	3,636.17
19/21.97	Wall painting with water and weather proof paint (Latex Emulsion base) on cement works of approved brand and manufacture (ISI/ISO certified) of required shade on new work (two or more coats) to give an even shade .							
	Brick walls:(Qnty twice of item No 7).	*sqm*	**Rs. 89.43**	2	323		646.000	57,771.78
20/14.07	Providing and fixing M.S. Tower bolts (socket bolts) bright finished with necessary screws etc. complete. Doors:							
	(b) 250 mm	*No*	**Rs. 90.04**	5	2		10.000	900.40

	Windows:								
	(c) 200 mm	*No*	**Rs. 75.61**	10	2			20.000	1,512.20
	Ventilations:								
	(e) 100 mm	*No*	**Rs. 46.12**	13	2			26.000	1,199.12
21/14.09	Providing and fixing M.S. door latch bright finished with necessary screws etc. complete.								
	Doors: D1								
	(b) 250 x 20 x 6 mm	*No*	**Rs. 54.69**	5	1			5.000	273.45
22/14.52	Providing and fixing alluminium handles anodised transparent or dyed to required colour or shade with necessary screws, etc. complete								
	(a) 125 mm								
	Doors:			5	2			10.000	
	Windows:			10	2			20.000	
	Ventilations:			13	1			13.000	
	TOTAL	*No*	**Rs. 38.66**					43.000	1,662.38
23/14.57	Providing and fixing M.S. hooks and eyes.								
	Windows:								
	(a) 200 mm	*No*	**Rs. 30.95**	10	2			20.000	619.00
	Ventilations:								
	(b) 150mm	*No*	**Rs. 19.45**	13	1			13.000	252.85
24/10.01	Supplying and fixing steel rolling shutter of approved make, made of required size of M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing nescessary wire spring and M.S. top cover.								
	Main door (D)	*sqm*	**Rs.3,600.88**			2.5	2.4	6.000	21,605.28
25/10.02	Providing and fixing ball bearing for rolling shutters.	*No.*	**Rs.383.68**					2.000	767.36

26/	Providing, jointing and fixing piping system and apurtenances in under drainage system, inlet system, outlet system, etc..								
	a) Under drainage system								
	i. Manifold- 150mm dia GI pipe (Medium)			4	1	4.5		18.000	
	ii. Discharge pipe - 150mm dia GI Pipe(M)			2	1	6		12.000	
	iii. Backwash pipe - 150mm dia GI Pipe (M)			2	1	15		30.000	
		RM	**Rs.1,751.50**					60.000	105,090.00
	iv. Laterals - 40mm dia GI Pipe (Medium)	*Rm*	**Rs.320.12**	4	14	2.4		134.400	43,024.13
	v. 150mm dia CS Sluice valve - ASA Class 150.	*No.*	**Rs.56,000.00**					16.000	896,000.00
	Railing in inpection gallery - 20mm dia GI Pipe	*RM*	**Rs.145.05**	4	5	11.7		234.000	33,941.70
27.00	Supply of Filter media of approved quality.								
	i. Supply of Filter media (Fine sand) of approved quality.	*m3*	**Rs.6,000.00**	4	3.25	2.6	0.7	23.660	141,960.00
	ii. Coarse sand	*m3*	**Rs.2,000.00**	4	3.25	2.6	0.6	20.280	40,560.00
28.00	Providing and fixing chain pulley system for lifting chemical, like Alum, Salt, etc	*Each*	**Rs.35,000.00**	1					35,000.00
								Total	3,837,567.44
								Carriage of materials	150,000.00
								GRAND TOTAL	3,987,567.44
								SAY	**3,987,567.00**

CHAPTER – VII

CLEAR WATER SUMP

Estimate for RCC Reservoir for Clear Water Sump at Khawzawl(WSS)

Sl. No.	SOR No.	Particulars	No	L	B	H	Quantity	Unit	Rate `	Amount `
		Preparatory Works								
1	1.01	Clearing grass and removal of rubbish upto a distance of 50 metres outside the periphery of the area cleared.								
		By manual means .								
			1	8.00	8.00		64.000	sqm	0.80	51.20
		Earth Works								
2	2.01	Surface dressing of ground including removing vegetation and inequalities not exceeding 15cm deep and disposal of rubbish,lead upto 50 m and lift upto 1.5m .								
	(a)	All kinds of soil								
			1	6.00	6.00		36.000	sqm	18.80	676.80
3	2.07	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.								
	(b)	Hard Soil (pick work)								
		$\frac{22}{7}$ x4.25x4.25x.5					28.384	cum	227.80	6465.88
				1.50	1.50	1.50	3.375	cum	227.80	768.83
		Stone Works								
5	7.06	Coursed rubble masonry with rectangular sized hard stone in foundation upto one storey above and below ground level including curing, etc. complete.								
	(a)	in cement mortar 1 : 3 (1cement : 3fine sand)								
			1	2.00	1.50	2.00	6.000			
						Total				
						=	**6.000**	cum	4513.80	27082.80
6	7.11	Stone pitching in cement mortar 1:3 (1 cement : 3 sand) in slopes of roads, in slopes of embankments etc. including supply of stone and preparing surface, etc. complete.								

		22/7 x4.25x4.25x0.150			8.52	cum	3447.30	29371.00
		Plain Cement Concrete Works						
7	4.04	Providing and laying cement concrete 1:2:4(1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering in -						
	(a)	All work upto foundation & plinth level :						
		22/7 x4.25x4.25x0.15			8.52	cum	4582.20	39040.34
		Masonry foundation:						
		2.00	1.50	0.10	0.30	cum	4582.20	1374.66
		Reinforced Cement Concrete Works						
8	5.43	Providing and laying in position machine batched, machine mixed and machine vibrated design mix M-25 grade reinforced cement concrete excluding cost of centering and shuttering and reinforcement in -						
	(a)	All work upto foundation and plinth.						
		22/7 x4.25x4.25x0.2			11.35	cum	5596.80	63523.68
		1.50	1.50	2.00	4.5	cum	5596.80	25185.60
	(b)	Walls, columns, pillars, posts and struts upto floor two level or floor two below from the ground floor (as indicated in the drawing).						
		22/7 x((3.95x3.95)-(3.7x3.7))x3.3			19.84	cum	5543.00	109973.12
		4.80	0.30	0.30	0.432	cum	5543.00	2394.58
	(c)	Beams, plinth beams, girders, bressumers, cantilevers, suspended floors, lintels, roofs, staircases, spiral staircases, shelves, etc.						
		Slab						
		22/7 x(3.95x3.95)x0.1			4.9	cum	5617.30	27524.77
9	5.07	HYSD bars like TATA/SAIL (ISI/ISO certified) or equivalent reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.						
		Foundation=100kg/cum		100	15.9	1585.00	kg	

		Wall=150kg/cum	150	20	3040.80	kg		
		Cover slab=100kg/cum	100	4.90	490.00	kg		
				TOTAL	5115.80	kg	54.30	277787.94
		Centering and Shuttering Works						
10	5.08	Centering and shuttering including strutting, propping, etc. and removal of form works in -						
	(a)	Foundations, footings, bases of columns etc. for mass concrete.						
		2x 22/7 x 4.25x 0.20			5.343	sqm	133.90	715.43
	(b)	Walls including attached pillasters, buttresses, string courses, etc.						
		1x2x 22/7 x 3.7x 3.3			76.749	sqm		
		1x2x 22/7 x 3.95 x 3.3			81.934	sqm		
		3.30 1.20			3.960	sqm		
				Total =	162.643	sqm	206.30	33553.25
	(e)	Suspended floors, roofs, landings, shelves and their support, balconies and chajjaj,etc.						
		22/7 x(3.95x3.95)			49.04	sqm	276.00	13535.04
		Plastering						
11	20.08	Plastering with 12mm thick cement mortar 1 : 3 (1 cement : 3 fine sand) on all internal and external of walls and floor.						
		Floor :			43.026	sqm		
		Walls :			162.643	sqm		
		slab			98.080	sqm		
				Total =	303.749	sqm	144.20	43800.61
		Flooring						
12	12.01	Cement concrete flooring 25mm thick with cement concrete 1:2:4 (1 cement : 2 sand : 4 well graded stone aggregate 12.5mm size) finished with a floating coat neat cement including cement slurry etc. complete but excluding the cost of nosing of steps etc.						
		22/7 x 3.7x3.7			43.026	sqm	195.90	8428.79
		Water						

		Proofing				
13	20.08	Providing and laying four courses water proofing treatment with bitumen felt over roofs consisting of first and third courses of blown bitumen 85/25 or 90/15 conforming to IS : 702 applied hot @ 1.45 Kg per square metre of area for each course, second course of roofing felt type 3 grade-I (hessian based self finished bitumen felt) manufactured by Bengal Bitumen, STP Ltd, Arcus Ltd etc., and fourth and final course of stone grit 6mm and down size or pea-sized gravel spread at 6 cubic diameter per square metre including preparation of surface but excluding grading complete with :				
	(a)	Bitumen felt (hessian base)type 3 grade I conforming to IS : 1322.				
		$\frac{22}{7}$ x4.25x4.25	56.768	sqm	184.60	10479.37
14	20.26	Providing and mixing water proofing chemical (PIDIPROOF POWDER chemical) in plain and reinforced cement concrete work 1 : 1.5 : 3 , @ 1.0 % by weight of cement.				
		Qtty as Sl.No.8/SOR No.5.43 (a), (b) & (c)	36.090	cum	354.40	12790.30
15	20.31	Applying double coated Dr. Fixit PIDIFIN-2K on the surface of cement concrete for prevention of water infiltration and dampness in water tanks, basement, terraces, etc.) @1.85kg per sqm.				
		Qtty as Sl.No.10/SOR No. 5.08 (a), (b) & 2x(e)	266.066	sqm	272.50	72502.99
16	LS	Providing and fixing bend pipes of size 100mm dia on walls for overflow at top and drainage at bottom of reservoir				
		3	3.000	nos	3400.00	10200.00
					Cost of One RCC Reservoir	**817175.78**
					Add cost index of 22.35% over MPWD SOR 2007	182638.79
					Total Cost of One RCC Reservoir	999814.57
					Say	999815.00

CHAPTER – VIII

CLEAR WATER PUMP HOUSE

DETAILED WORKING ESTIMATE FOR CONSTRUCTION OF PUMP HOUSE BUILDING AT PUMPING STATION OF KHAWZAWL WSS

Item No	Description of Item	Unit	Rate (SOR+22.35%)	No	L	B	H	Qnty	Amount
1	2	3	4	5	6	7	8	9	10
1/2.06	Earth work in excavation over areas (exceeding 30cm in depth. 1.5m in width as well as 10 sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.								
	(a) 2.6.1 - All kinds of soil	*cum*	**Rs. 182.30**	0.5	30	13.78	1.8	372.06	67,826.54
2/7.01	Regular coursed rubble masonry with hard stone in foundation upto one storey above and below ground level including curing, etc. complete.								
	a) in cement mortar 1 : 3	*cum*	**Rs. 4,816.55**						
	i) Retaining wall for compound wall			1	60	0.6	0.75	27	130,046.85
	ii) At split level			2	10.36	0.3	0.45	2.80	13,472.85
				2	3.05	0.3	0.45	0.82	3,966.43
2/2.07	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres. -								

	Column foundation									
	(b)	Hard Soil (pick work)	*cum*	**Rs. 278.71**	12	1.2	1.2	1.5	**25.92**	**7,224.16**
4.05	Providing and laying cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20mm nominal size) excluding cost of centering in -									
	(a)	All work upto foundation & plinth level :	*cum*	**Rs. 4,883.72**	12	1.2	1.2	0.15	**2.592**	**12,658.60**
3/4.02	Providing and laying plain cement concrete 1:2:4 (1 cement :2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering in -									
	(a)	All work upto foundation & plinth level :	*cum*	**Rs. 5,805.14**	12	1.2	1.2	0.15	**2.592**	**15,046.92**
4/5.01	Providing and laying reinforced cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering and reinforcement in -									
	(a)	All work upto foundation & plinth level :								
		i. Foundation base			12	1.2	1.2	0.35	6.048	
		ii. Pumphouse floor			1	10.36	10.36	0.12	12.880	
		iii. Control panel floor			1	10.36	3.05	0.12	3.792	
									22.719	
		Deductions for pump foundation			2	4.5	1.5	0.12	1.620	
		Net Quantity	*cum*	**Rs. 5,945.47**					**21.099**	**125,445.33**
	(b)	Columns, pillers, posts, piers, etc. upto floor two level or floor two below from the ground floor (as indicated in the drawing).								
		i. Long Column			8	0.45	0.3	5.8	6.264	
		ii. Short column			4	0.3	0.3	4.2	1.512	
		TOTAL	*cum*	**Rs. 6,106.48**					**7.776**	**47,483.99**

	(c)	Beams, suspended floors, balconies, shelves, chajjas, lintels, cantilevers upto floor two level or floor two below from the ground floor (as indicated in the drawing).								
		i. Tie Beams			3	10.36	0.25	0.3	2.33	
					3	10.36	0.25	0.3	2.33	
					1	3.05	0.25	0.3	0.23	
		ii. Lintel Beam			3	10.36	0.2	0.2	1.24	
					4	10.36	0.15	0.2	1.24	
		iii. Beams (for Girder)			2	10.36	0.75	0.4	6.22	
		iii. Beams (Top)			2	10.36	0.25	0.4	2.07	
					2	10.36	0.25	0.4	2.07	
					1	3	0.25	0.4	0.30	
		iii. Rain Gutter			3	10.36	1.1	0.12	4.10	
			cum	**Rs. 6,231.65**					**22.14**	**137,966.92**
5/5.06	HYSD bars reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.									
		16mm Dia								
		I. Tie Beams			3	4	10.36	124.32		
					3	4	10.36	124.32		
					1	4	3.05	12.2		
		ii. Beams(Girder)			2	10	10.36	207.2		
		iii. Beams (Top)			2	5	10.36	103.6		
					2	5	10.36	103.6		
					1	5	3	15		
		iii. Columns			8	6	5.8	278.4		
					4	4	4.2	67.2		
								1035.84		
		@ 1.58Kg/m	*kg*	**Rs. 60.44**					**1636.627**	98,917.75
		10mm Dia								
		i. Foundation base (10cm c/c, both ways)			24	1.2	12	345.6		

		ii. Rain Gutter (15cm c/c, 1.3cm)			3	1.3	73	284.7		
					3	11.6	6	208.8		
		ii. Floor Slab (20cm c/c, both ways)			46	10.97	1	504.62		
					56	10.36	1	580.16		
		lintel. Beams			3	5	10.36	155.4		
					4	5	10.36	207.2		
					1	5	3	15		
		@ 0.62Kg/Rm	*kg*	**Rs. 60.44**				2301.48	1426.918	86,242.90
		6mm Dia								
		Stirrups for long Columns (15cm c/c)			8	1.7	30	408		
		Stirrups for short Columns (15cm c/c)			4	1.5	20	120		
		Stirrups for Tie Beams			4	1.3	70	364		
					3	1.3	74	288.6		
		Stirrups for Beams			4	1.5	74	444		
					2	1.5	70	210		
					1	1.5	20	30		
		Stirrups for lintel Beams			3	0.7	74	155.4		
					4	0.7	70	196		
					1	0.7	20	14		
		@ 0.39Kg/Rm	*kg*	**Rs. 60.44**				2230	869.7	52,564.67
6/5.08	Centering and shuttering including strutting, propping, etc. and removal of form works in -									
	(c)	Columns, pillars, piers, abutments,	*sqm*	**Rs. 295.59**	8	1.5	5.8	1	69.6	20,573.06
		posts and struts.		**Rs. 295.59**	4	1.2	4.2	1	20.16	5,959.09
	(d)	Lintels, beams, plinth beams, girders, bressumers and cantilevers, etc.								
		Tie Beams			3	1.1	10.97	1	36.201	
					4	1.1	10.36	1	45.584	
		Beams			3	1.3	10.97	1	42.783	
					2	1.3	10.36	1	26.936	
					1	1.3	3	1	3.9	

		Lintel			3	1	10.97	1	32.91	
					4	1	6	1	24	
		Total	*sqm*	**Rs. 225.36**					212.314	47,847.08
	(e)	Suspended floors, roofs, landings, shelves and their support, balconies and chajjaj,etc.								
		Gutter	*sqm*	**Rs. 337.68**	3	1.1	11		36.3	12,257.78
7/Anal	4" thick LCC Block masonry upto one storey above and below ground level including curing, etc. complete.									
	a)	in cement moratar 1:3 (1 cement : 3 fine sand)								
		External Wall			1	10.36	4.5		46.62	
					2	10.36	4.5		93.24	
					2	3	3		18.00	
					1	10.97	3		32.91	
					1	10.97	1		10.97	
		Internal wall for duty room			1	3	3		9.00	
					1	3.5	3		10.50	
									221.24	
		Deductions for openings								
		Door 'D'			1	3	2.4		7.20	
		Windows and Ventilation: W1			12	0.9	1.8		19.44	
		Door 'D1'			1	0.9	1.8		1.62	
		Glass windows at duty room W2			2	0.9	1.5		2.7	
									30.96	
		Net Quantity	*sqm*	**Rs. 930.30**					**190.28**	**177,017.48**
8/9.06	Providing Ist class local wood dressed in frames of chaukat for doors, windows, clerestory windows fixed in position.									
		Door D1	*cum*	**Rs.21,150.88**	1	5.4	0.08	0.1	0.0432	913.72

9/9.11	Providing and fixing 1st class local wood panelled shutters for doors etc. including M.S. butt hinges with necessary screws, etc. complete. (a) 40 mm thick.								
	Door D1	*sqm*	**Rs.1,451.56**	1	0.9	1.8		1.62	2,351.53
11.01	Providing and fixing anodised aluminium work for windows and ventilators with extruded built up standard sections of approved make conforming to IS : 733 and IS : 1285 fixed with rawl plugs and screws or with fixing clips or with expansion hold fasteners including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC/ neoprene gaskets etc.Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically whenever required including cleat angle, aluminium snap beading for glazing /panelling, CP brass /stainless steel screws all complete including fixing of glasses but excluding cost of glasses.								
	(c) 4 - track sliding windows/ventilators. (Profile of size 120x30x1.5mm should be used as frames. Profile of size 40x20x1.5mm should be used as shutters.Profile of size 40x30x1.5 should be used as interlocking hook for sliding shutters. Movement of shutters should be on projected rails.)								
	Windows W1			12	0.9	1.8		19.44	
	Windows W2			2	0.9	1.5		2.7	
	TOTAL	*sqm*	**Rs.6,543.64**					22.14	144,876.19
11/9.08	Providing 1st class local wood in trusses etc. including hoisting fixing in position supplying necessary fittings such as spikes bolts and nuts, nails etc and applying wood preservative for unexposed surface etc. complete.								

	i.	Control panel roof								
		Rafter			13	3.5	0.1	0.1	0.455	
		Purlin			8	12	0.075	0.05	0.36	
	ii.	Ceiling frame			6	12	0.075	0.05	0.27	
		Total	*cum*	**Rs.16,614.88**					1.085	18,027.14
10.13	Providing and fixing M.S tubular section in built up section of truss welded in position including cutting, hoisting, fixing in position and applying priming coat with approved steel primer etc. complete.									
		Rafter-40mmdia (M)			2	3.3	3.59	23.694		
		Bottom Chord - 40mm dia(M)			1	6.3	3.59	22.617		
		Ties - 32mm dia (M)			2	1.35	3.11	8.397		
					2	0.42	3.11	2.612		
								57.320		
		For 5nos. Of Trusses						286.602		
		Purlin - 40mm dia (M)			6	10.96	3.59	236.078		
		Total	*Kg*	**Rs.109.38**				522.680		57,170.78
12/16.01	Providing corrugated G.S. sheet roofing fixed with polymer coated J or L hooks, bolts and nuts 8 mm diameter with bitumen and G.I. limpet washers or with G.I. limpet washers filled with white lead and including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (upto a pitch of 60 degrees) excluding									

	the cost of purlins, rafters and trusses.								
	(e) 0.63mm thick with zinc coating not less than 275gm/m²								
	Pump House block				2	12	5	120	
	Control panel & duty room				1	12	3.3	39.6	
	Total	*sqm*	**Rs. 391.39**					159.6	62,465.84
13/15.07	Supplying, fitting and fixing 4mm thick plain asbestos cement sheet ceiling with nescessary nails complete excluding frame work of base and beading.								
	Duty room				1	3	3	9	
	Total	*sqm*	**Rs. 305.50**					9	2,749.50
14/15.01	Providing and fixing plain, chamfered edged 1st class local wood beading with screws or nails for walls, ceiling, etc. complete.								
	(a) 50mm x 12mm Duty room				8	3		24	
					8	3		24	
	Total	*Rm*	**Rs. 128.71**					48	6,178.08
15/12.05	40mm thick red oxide flooring under layer of 30mm thick cement concrete 1:2:4 (1 cement : 2 sand : 4 well graded stone aggregate 12.5mm size) and top layer 10mm thick plaster of cement red oxide mix using 3.5 kg of red oxide of iron per 50kg of cement in mortar 1:3 (1 cement : 3 sand) finished with a floating coat of neat cement red oxide mix of same proportion including cement slurry etc. complete but excluding the cost of nosing of steps etc.								
	Pump House Floor				1	6	11	66.00	
	Control Panel & Duty room				1	3	11	33.00	

	TOTAL	*sqm*	**Rs. 646.37**				99.000	63,990.63
16/21.01	Pointing on brick works with cement mortar 1:3 (1 cement : 3 fine sand). (b) Ruled pointing.							
	Outer face of exterior wall (Qnty asper item 7)	*sqm*	**Rs. 81.11**				153.19	12,425.24
17/21.65	Applying one coat of cement primer of approved brand and manufacture on wall surface.							
	i. Both sides of exterior walls (twice the Qnty as per item 7-a)	*sqm*	**Rs. 32.30**	2	153.19		306.38	9,896.07
18/21.78	Painting with oil type wood preservative of approved brand and manufacture on new work (two or more coats) .							
	Doors: Qnty twice of item 9	*sqm*	**Rs. 17.49**	2	1.62		3.24	56.67
	Windows & Ventilations: Qnty twice of item 10			2	20.79		41.58	727.23
19/21.97	Wall painting with water and weather proof paint (Latex Emulsion base) on cement works of approved brand and manufacture (ISI/ISO certified) of required shade on new work (two or more coats) to give an even shade .							
	Brick walls:(Qnty twice of item No 7).	*sqm*	**Rs. 89.43**	2	153.19		306.38	27,399.56
20/14.07	Providing and fixing M.S. Tower bolts (socket bolts) bright finished with necessary screws etc. complete. Doors:							
	(b) 250 mm	*No*	**Rs. 90.04**	1	2		2	180.08
21/14.09	Providing and fixing M.S. door latch bright finished with necessary screws etc. complete.							
	Doors: D1							
	(b) 250 x 20 x 6 mm	*No*	**Rs. 54.69**	1	1		1	54.69
22/14.52	Providing and fixing alluminium handles anodised transparent or dyed to required colour or shade with necessary screws, etc. complete (a) 125 mm							
	Doors:			1	2		2	
	TOTAL	*No*	**Rs. 38.66**				2	77.32
24/10.01	Supplying and fixing steel rolling shutter of							

	approved make, made of required size of M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing nescessary wire spring and M.S. top cover.								
	Main door (D)	*sqm*	**Rs.3,600.88**			3	2.4	7.2	25,926.34
25/10.02	Providing and fixing ball bearing for rolling shutters.	*No.*	**Rs.383.68**					2	767.36
Trenches for Cables and Pipes									
26/2.07	Earthwork in excavation in foundation trenches or drains etc. (not exceeding 1.5m in width or 10sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5m including getting out excavated soil and disposal of surplus excavated soil as directed within a lead of 50 metres.								
	(b) Hard Soil (pick work)	*cum*	**Rs. 278.71**	1	25	0.65	0.5	**8.125**	**2,264.52**
27/5.01	Providing and laying reinforced cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) excluding cost of centering and shuttering and reinforcement in -								
	(a) All work upto foundation & plinth level :	*cum*	**Rs. 5,945.47**		25	1.65	0.1	4.125	24,525.06
28/5.06	6mm dia HYSD bars reinforcement for RCC work including straighthening, cutting, bending, placing in position and binding all complete.			17 250	25 1.65		425 412.5 837.5		
	@ 0.62Kg/Rm	*kg*	**Rs. 60.44**					519.25	31,383.47
29/5.08	Centering and shuttering including strutting,								

	propping, etc. and removal of form works in -							
	(a) Foundations, footings, bases of columns etc. for mass concrete.	*sqm*	**Rs. 163.82**	1	25	1.65	41.25	6,757.58
30/LS	Providing and fixing chequered MS Plates for trench covers.	*sqm*	**Rs. 4,500.00**	1	25	0.65	16.25	73,125.00
	Carriage of materials							90,000.00
	TOTAL							**1,726,808.03**
	Add 20% for electrification							345,361.61
	Add 5% for site development							86,340.40
	GRAND TOTAL							2,158,510.04
	SAY							**2,158,510.00**

CHAPTER – XI

CLEAR WATER PUMPING MACHINERIES

DESIGN OF CLEAR WATER PUMPING MACHINERIES.

A.	Full capacity of Pumps with 50% stand by as arrived from Ecodia Software. ----------	646 KW
B.	Full capacity of Pumps without stand by(2/3 of 'A')----------	430.66 KW
C.	Capacity of pump for first 15 years ----------	215.33 KW

Adding 10% for transmission loss, capacity of Prime Mover to drive the above Pump: ---------- 247.63 KW
Taking nearest commercial size ---------- 250 KW

Proposed Arrangement of Pumping Units:

Initial	+	Ultimate	+	Standby
1unit	+	1unit	+	1unit

Provide 2 nos of 250 KW pump sets initially, where 1 set shall be working while 1 set shall be stand by. Additional 1(one) pump set of same capacity shall be installed in the year 2028 to meet the ultimate requirement.

Two numbers of similar capacity electrically driven Clear Water Pump sets having discharge capacity of 58.7 m3/hr against the total head of 867.12m are to be installed such that when one pump is in working the other shall be a standby unit. The design of pump shall be such that there shall be sufficient margin between the pump shut off head and pump duty head. The margin should not be less than 50m. Air-vent with valve shall be provided to each stage of pump. Necessary pipe connection shall be provided for saving over flown water from delivery balance valve to the suction flange of the pump. The pump nozzles should be side suction and side delivery. The efficiency of the pump should not be less than 60%. Provision may also be made for the suction and delivery pressure gauge in the pump with bearing oil level indicator.

Suitable flow meter of sufficient capacity and accuracy shall also be installed as to enable the pump operator monitoring the water flow at all times. The dial type indicator should be easily visible and the reading should be displayed in m3/hr.

General specification for Pump:

The pump should be horizontal multi-stage centrifugal pump for developing required head and discharge. The general specifications are highlighted below as a guide for the contractor. However, this is not the ruling factor but the contractor has to see the latest development in the pump manufacture and shall therefore made an offer for the latest model of the pump.

Casing:

i. The casing should with stand 1.5 times of the shut off head pressure.

ii. The casing will be of barrel type in which individual disc of each stage are assembled and tied together with tie bar.
iii. The casing should be made of cast steel and robust in construction.
iv. Provision for connecting over flown pipe from the balance valve to the suction flange.
v. Air cooks should be provided on each stage/chamber for releasing air.

Impeller:

The impeller shall be closed type impeller. The impellers shall be properly balance on proper balancing equipment so as not to cause any vibration during operation. Impellers should be made of bronze. The impeller should be securely keyed to the shaft. Mean shall be provided to prevent loosening during operation including rotation in reverse direction. Impeller fastened nuts if provided shall be of cap type and shall be tightened in the direction of rotation.

Wearing Ring:

i) Renewable wearing rings shall be provided.
ii) The wearing ring should be abrasion resistant and should have close clearance.
iii) The wearing rings should either be flat or L-shape and fixed with screw for locking.

Shaft:

i) Shaft should be proportioned to take the stress set up when the pump starts quickly i.e. the situation, when the motor is directly on the line.
ii) The impeller, coupling/pulley and shaft sleeve shall firmly be secured by key/nut.
iii) Shaft should be protected against wear and tear by shaft sleeves which are renewable.
iv) The shaft should be made of steel (EN24 or equivalent category)with proper sealing.

Stuffing Box:

Stuffing box shall be designed in such a way as to accommodate mechanical seal and suitable cooling arrangement. It shall be so designed that standard packing can be removed and replaced by mechanical seal or vice versa when desired. The lantern ring shall be sandwiched between rows of packing and shall be easily removable. The lantern ring should split type.

Bearings:

The bearings shall be able to hold good for axial and radial thrust. The bearings shall be so designed so as to take up necessary radial load as well as the net hydraulic axial thrust. The bearings shall be easily accessible without disturbing the alignment. Proper lubricating and cooling system has to be provided along with the drainage. The bearings should be designed for minimum life of 40,000 hours.

Coupling: Flexible coupling

Connections:

Suction and delivery connection shall be made of face flanges and grooves. The connection shall be on the sides of the pump. Suitable rated flexible joint of appropriate size is to be provided between suction flange of the pump and suction pipe.

Sealing: Mechanical seal/ Gland Seal is to be provided.

Balance Flow: Balance over flown pipe connected to the suction flange be provided with transparent tube.

THE INDUCTION MOTOR:

The prime mover shall be capable of driving the pump to discharge water at full design capacity and at design head without throttling the delivery gate valve. The general specification of the induction motor shall be as follows. However, this is not the ruling factor but the contractor has to see the latest development in the pump manufacture and shall therefore made an offer for the latest model of the pump.

i) Insulation/Protection class F.

ii) Permissible limit of voltage fluctuation i.e. tolerance should be $\pm$ 10%.

iii) Winding temperature be within permissible limit.

iv) Frequency tolerance should be $\pm$ 5%.

v) Continuous operating condition.

vi) The starting system of the motor shall be star delta.

vii) A capacitor bank of required capacity to increase the power factor of the motor.

viii) Proper air cooling system shall be provided.

ix) Space heaters of adequate rating suitable for the station low tension AC voltage shall be provided to keep the stator windings warm when the motor is not in service.

x) The bearings shall be equipped with all accessories devices for lubricating the bearings while the motor is in service. Suitable bearing temperature detector probes with contacts shall also be provided.

xi) All safety protections such as over current, over voltage, earth fault and thermal, etc., shall be provided.

The pump and prime mover should be mounted in a common base frame. The construction/fabrication of base frame should be robust and strong enough. The pad of the base plate where pump and prime mover legs will be rested shall be fine smooth machine finished, so that resting pump-set may not face any problems.

DIESEL ENGINE GENERATING SET FOR CLEAR WATER PUMPING

Design of capacity of Diesel Engine Generating set.

Voltage required at full capacity = 500 KW

At 3.3KV incoming voltage, the current shall be $\sqrt{3}$ VI Cosθ

Therefore, $500 = \sqrt{3}$ VI Cosθ

Then, $I = \frac{500}{1.78 \times 3.3 \times 0.8}$

= **106.4 Ampere.**

Starting system shall be Star-Delta whose starting current shall be 2.5 times.

Therefore, starting current shall be = 266 Ampere

Starting Power shall therefore be = 1.78x3.3x266x0.9

= **1406.2 KVA**

Lighting loads (assume) = 75 KVA

TOTAL POWER REQUIREMENT = 1482 KVA

SAY = 1.5 MVA

The Diesel Engine Generating Set shall be able to produce an output **of** 415V, 3-phase, 4 wire 50 Hz of adequate capacity to drive the clear water pump set including area lighting load.

8. The Diesel Engine Generator is for power source for running the Motor in times of power failure from the Grid line and shall therefore be capable of taking Starting Loads and Normal working loads without getting overload.
9. The engine shall be capable of operating continuously on full load at the site elevation.
10. Priming of the engine oil shall be provided.
11. The fuel oil tank of one day capacity shall be provided.
12. Starting of the engine by means of battery powered DC starter. A battery charger shall be provided and be capable of charging the batteries in position and shall have arrangement for both trickle and boost charging.
13. The engine shall conform to pollution control requirements.
14. The Engine shall be provided with control panel. The panel shall be mounted on a suitable steel frame and installed close to the engine. The control panel shall consist of the followings:
    a) Start/Stop push button for starting the engine.

b) Visual indication of lubricating oil pressure, water temperature, low oil level, ammeter, voltmeter, lubricating oil temperature, R.P.M. meter.

The general requirement and specification are only the guide for the intending Bidder. The bidder shall only offer the latest model and technology.

CHAPTER – X

ERECTION AND COMMISSIONING

The Contractor shall properly install all the equipments required for the project at the appropriate location as per good engineering practices and as directed by the Engineer-in-charge. On completion of the installation work, the contractor shall carry out site-testing and pre-commissioning checks before any of the equipments can be started for the first time. All the pre-commissioning checks results are to be approved by the Engineer-in-charge. On receipt of approval of the pre-commissioning checks, individual equipment may be started for trial test. After the trial test of the individual equipment, the entire plant can be given a trial test for continuous operation on full load for a period of 72 (seventy two) hours. The 72 (seventy two) hours continuous trial test shall be free from any operational problem or malfunction of any nature. On successful completion of 72 (seventy two) hours trial test with available load/full load of individual pumping system, the plant may deem to be commissioned. If any defect found during trial run/test of individual equipment the same shall be rectified by the contractor at his own cost. Consumables like, fuel, lubricant and power required for trial testing shall be arranged and borne by the PHE Department. After successful commissioning, the contractor shall withdraw all their site staff (except the staff required for training of the officials of the department for operation and maintenance for one month) and the insurance cover of the project will cease immediately. The tested equipments will be deemed to be taken over by the PHE Department.

CHAPTER - XI

RAW AND CLEAR WATER PUMPING MAIN

A. RATE ANALYSIS FOR LAYING, WELDED JOINTING OF GI HIGH PRESSURE PIPE FOR RAW WATER PUMPING MAIN

Considering 100m length for analysis purpose, average length of each pipe as 6m, Nos. of joints is 20 (100/6 + 20% allowance for hilly nature).

Sl. No	Description	Unit	Qnty	Rate (Rs)	Amount (Rs)
	Providing and laying GI High Pressure pipe including cutting, grinding, jointing by welding, painting the joints with red oxide paint and laying to a minimum depth of 1.2m below ground including trenching, refilling, etc all complete as directed by Engineer in-charge.				
A.	**MATERIALS**				
i.	GI High Pressure Pipe, 200 MM nominal diameter	Rm	100	2,649.00	264,900.00
	Add 10% for wastage				26,490.00
	Add 10% for local handling				26,490.00
ii.	3.15mm Welding electrodes for cutting	Each	80	17.30	1,384.00
iii.	3.15mm Welding electrodes for jointing.	Each	300	17.30	5,190.00
iv	4.0mm Welding electrode for jointing	Each	250	24.80	6,200.00
v.	5.0mm Welding electrode for jointing	Each	100	41.50	4,150.00
vi.	Steel brush	Each	5	45.00	225.00
vii.	Fuel HSD	Liter	80	45.00	3,600.00
viii	Grinding disc	Each	10	2,500.00	25,000.00
ix	Hire charge of welding machine	days	4	2,500.00	10,000.00
x	Paints, brush, etc				500.00
xi	T & P like Chain pulley, etc				1,500.00
	TOTAL				**375,629.00**
	Add 5% due to bends				**18,781.45**
	TOTAL o f 'A'				**394,410.45**
B.	**MAN POWER**				
i.	Welder	Man-day	6	350	2,100.00
ii.	Plumber	Man-day	6	300	1,800.00
ii	Grinder	Man-day	6	300	1,800.00
iii.	Electrician/Mechanic	Man-day	6	300	1,800.00
iv.	Helper	Man-day	50	250	12,500.00

		TOTAL OF 'B'				**8,428.00**
C.		**TRENCHING & REFILLING**				
	I/08	Earthwork in excvation in foundation trenches, etc., all complete.				
		1x 1.0 x1.2x100	cum	120	163.6	19,632.00
	ii/18	Filling excavated in trenches, etc all complete. (Quantity - 80% of excavated earth)	cum	96	46.7	4,483.20
						24,115.20
		Add 19.6% cost index on 'C'				4,726.58
		TOTAL OF "C"				28,841.78
		TOTAL OF A,B & C				**431,680.23**
		Add 10% Contractor's Profit				43,168.02
		Sundries @ 1.5%				6,475.20
		Overhead charges @ 3%				12,950.41
		Laying cost of 100RM				494,273.86
		Laying cost per RM				**4,942.74**
		For total length of 550m				**2,718,506.00**

(Rupees twenty seven lakh eighteen thousand five hundred and six) only

B. RATE ANALYSIS FOR LAYING, WELDED JOINTING OF CARBON STEEL SEAMLESS PIPE FOR CLEAR WATER PUMPING MAIN

Consider100m length,Nos. of joints is 20 (100/6 + 20% allowance for hilly nature).

Sl. No	Description	Unit	Qnty	Rate (Rs)	Amount (Rs)
Providing and laying CS pipe i/c cutting, grinding, jointing by welding, painting the joints with red oxide paint and laying to a minimum depth of 1.2m below ground including trenching, refilling, etc all complete as directed by Engineer in-charge.					
A.	**MATERIALS**				
i.	Seamless Pipe, 219.10mm OD	Rm	100	3,866.00	
	Exise duty @ 16.25%			628.23	
				4,494.23	
	Add 4% CST			179.77	
	Add 12.5% VAT			561.78	
	Add 2% packing and forwarding			89.88	
	Add freight charge @ 15%			674.13	
	Add 1% for inspection charge			44.94	
	Cost of Pipe			6,044.73	604,473.26

		Add 10% for wastage				60,447.33
		Add 10% for local handling				60,447.33
	ii.	3.15mm Welding electrodes for cutting	Each	80	17.3	1,384.00
	iii.	3.15mm Welding electrodes for jointing.	Each	400	17.3	6,920.00
	iv	4.0mm Welding electrode for jointing	Each	250	24.8	6,200.00
	v.	5.0mm Welding electrode for jointing	Each	80	41.5	3,320.00
	vi.	Steel brush	Each	5	45	225.00
	vii.	Fuel HSD	Liter	80	45	3,600.00
	viii	Grinding disc	Each	10	2,500.00	25,000.00
	ix	Hire charge of welding machine	Days	4	2,500.00	10,000.00
	x	Paints, brush, etc				500.00
	xi	T & P like Chain pulley, etc				1,500.00
		TOTAL				**784,016.92**
		Add 5% due to bends				**39,200.85**
		TOTAL o f 'A'				**823,217.76**
B.	**MAN POWER**					
	i.	Welder	Man-day	6	350	2,100.00
	ii.	Plumber	Man-day	6	300	1,800.00
	ii	Grinder	Man-day	6	300	1,800.00
	iii.	Electrician/Mechanic	Man-day	6	300	1,800.00
	iv.	Helper	Man-day	50	250	12,500.00
		TOTAL OF 'B'				**20,000.00**
C.	**TRENCHING & REFILLING**					
	I/08	Earthwork in excvation in trenches.				
		1x 1.0 x1.2x100	Cum	120	163.6	19,632.00
	ii/18	Filling trenches, etc all complete.	Cum	96	46.7	4,483.20
						24,115.20
		Add 19.6% cost index on 'C'				4,726.58
		TOTAL OF 'C'				**28,841.78**
		Total of A,B & C				872,059.54
		Add 10% Contractor's Profit				87,205.95
		Sundries @ 1.5%				13,080.89
		Overhead charges @ 3%				26,161.79
		Laying cost of 100RM				998,508.17
		Laying cost per RM				**9,985.08**
		For total length of 4500 RM				44,932,868.00

(Rupees four crore fortynine lakhthirty two thousand eight hundred sixty eight) only

CHAPTER – XII

APPROACH ROAD

(1) Approach Road from clear water pumping station to raw water pumping station:

Clearing and grubbing road land including uprooting wild vegetation, grass, bushes, shrubs, saplings and trees of girth upto 300mm, removal of stumps of such trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, upto a lead of 1000m including removal and disposal of top organic soil not exceeding 150mm thickness as per Technical specification.

By manual means in area of non theory jungle :-

550.00 x 5.00 = 2500.00m^2 = 0.275 hectares.

@ Rs.22,771/hectare …….. Rs.6262.00

3.5(ii) Excavation for roadway in soil by mechanical means including cutting and pushing the earth to site of embankment upto a distance of 100m, including trimming bottom and side slopes in accordance with requirements of lines, grades and cross sections.

$550.00 \times \frac{1}{2} \times 3.75 \times 3.2 = 3300.00 m^3$

@ Rs.62.00/m^3 …….. Rs.2,04,600.00

19.32 Construction of unlined surface drains of average Cross-sectional area 0.40sqm in soil to specified line, grades, levels and dimensions. Excavated material to be used in embankment with a lift upto 3m and lead of 50m (average lead 25m).

By manual means :-

550.00m @ Rs.30/m = Rs.16,500.00

Total = Rs.2,27,363.00

Added 22.35% = Rs. 2,78.179.00

Construction of footpath for transportation of the Rising main pipes and movement of Welding Machine along the pipeline:-

Clearing and grubbing road land including uprooting wild vegetation, grass, bushes, shrubs, saplings and trees of girth upto 300mm, removal of stumps of such trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, upto a lead of 1000m including removal and disposal of top organic soil not exceeding 150mm thickness as per Technical specification.

(ii) By manual means in area of non thorny jungle :-

4500 x 5.00 = 2.7 hectares

@ **Rs.22,771/hectares…….. Rs. 61,482.00**

Excavation for roadway in soil using manual means for carrying of cut earth to embankment site with a lift upto 1.5m and lead upto 50m as per Technical specification.

$4500 \times \frac{1}{2} \times 3.00 \times 3.1 = 20{,}925\ m^3$

@ Rs.56/m^3 …….. Rs. 11,71,800.00

TOTAL Rs. 12,33,282.00

Added 22.35% Rs. 15,08,920.00

Analysis of RCC Culverts:

1/2.07. Earthwork in excavation in foundation trenches or drains including getting out of excavated soils etc. complete

Hard Soil (Pick work)

1x7.50x1.33+1.60x1.80 = 19.77m^3

@ Rs.227.80/m^3 ..... Rs. 4,504.00

2/7.01. Regular coursed rubble masonry with hard stone in foundation including curing etc. complete.

In cement Mortar 1:4

Base : 1x7.50x1.33x0.30 = 2.99m^3

2x7.50x1.50x0.30 = 6.75m^3

Total = 9.74m^3

@ **Rs.3610.20/m^3 ..... Rs.35,163.00**

3/5.01. Providing and laying R.C.C. 1:2:4 excluding cost of centering, shuttering and reinforcement-

(c) Slab: 1x7.50x1.75x0.20 = 2.625m^3

@ Rs.5105.80/m^3 ..... Rs.13,403.00

4/5.06 HYSD bars reinforcement for RCC works including straightening, cutting, bending, placing in position and binding all complete.

12mm dia T/S = 100mm c/c

$\frac{(7.50 + 1)x1.75}{0.10}$ = 133.00 Rm

$\frac{(1.75 + 1)x7.50}{0.10}$ = 138.75 Rm

Total = 271.75 Rm

For double layer = 271.75x2 = 543.50 Rm

@ 0.89 kg/Rm = 483.71 Kgs

@ Rs.49.40/kg Rs.23,895.00

5/5.08. Centering and shuttering including strutting, propping etc and removalof form works

(e) Slab: 1x7.50x1.00 = 7.50m^2

2x7.50x0.20 = 3.00m^2

2x1.75x0.20 = 0.70m^2

Total = 11.20m^2

@ Rs.276.00/m^2 ..... Rs. 3 091.00

Total = Rs. 80,056.00

For 2 Nos. of Culverts = Rs. 1,60,000.00

CHAPTER – XV

DETAILED ESTIMATE FOR 33/3.3KV SUB-STATION

A. MAIN EQUIPMENT FOR 33/3.3Kv SUB-STATION

Main Equipments for 33/3.3kV Sub-Station)		Unit	Qnty	Rate (Rs)	Amount (Rs)
1	1MVA, 33/3.3KV Power Transformer complete with all accessories	No	1	30,00,000.00	30,00,000.00
2	33kV Circuit Breakers (3nos in one set) complete with mounting structures, marshalling box etc.	Set	1	4,88,790.00	4,88,790.00
3	33kV Isolators with E/S (3nos in one set) complete with mounting structures and all other accessories etc.	Set	2	98,000.00	196,000.00
4	33kV Lightning Arrestors complete with mounting structures and all other accessories.	No	6	72,900.00	437,400.00
5	33kV Current Transformers complete with mounting structures and all other accessories etc. 50-100/1-1A	No	3	1,64,298.00	4,92,894.00
6	33kV Potential Transformers complete with mounting structures and all /other accessories.	No	3	1,26,312.00	3,78,936.00
8	33kVControl & Relay Panels - a) Transformer	No	1	7,41,990.00	7,41,990.00
9	Power & Control Cables	Set	1	6,40,000.00	6,40,000.00
10	Sub-Station Steel Structures (Tower Type) complete etc	Set	1	5,00,000.00	5,00,000.00
11	Disc Insulators 90KN	No	18	624.00	11,232.00
12	Hardware Strain fittings	Set	15	660.00	9,900.00
13	ACSR 'Racoon' (for Bus)	Km	0.2	45,000.00	9,000.00
14	3.3 kV Indoor type Switchgear -				-
	a) Incoming Panels	No	1	12,30,000.00	12,30,000.00
	b) Outgoing Panels	No	2	12,30,000.00	24,60,000.00

15	3.3 kV Lightning Arrestor 9kV 10 kA	No	3	12,500.00	37,500.00
16	3.3 kV Isolator with mounting structure and other accessories completed	Set	1	68,250.00	68,250.00
17	Cable Jointing kits (3.3kV)	Set	4	11,590.00	46,360.00
Total 'A'					1,07,48,252.00
	Add 5% Cost index of UCD 2008-2009 from 'A'				5,37,412.60
	Add Transportation to site 8%, Insurance 1%, Vat 4%, Erection 8%	21.00%			22,57,132.92
GRAND TOTAL A:					135,42,797.52
B.	Auxiliary Equipments	Unit	Qnty	Rate	Amount
1	Battery Bank and Battery Charger	Set	1	10,30,004.00	10,30,004.00
2	LTAC	No	1	5,000.00	75,000.00
3	DC Distribution Board	No	1	5,000.00	75,000.00
4	Station Transformer 250KVA, 33/0.415kV	No	1	8,06,473.00	8,06,473.00
5	Switchyard Lighting HPSV Lamp 250W	Set	8	8,800.00	0,400.00
6	Rubber matting	No	8	8,000.00	64,000.00
Total B					21,20,877.00
	Add Transportation to site 8%, Insurance 1%, Vat 4%, Erection 8%	21.00%			4,87,384.17
GRAND TOTAL 'B'					26,08,261.00
GRAND TOTAL OF 'A' & 'B'					1,61,51,059.00