BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

ORIGINAL APPLICATION No. 751 of 2024

IN THE MATTER OF:

Abhisht Kusum Gupta & Anr **.... Applicant**

Versus

State of Uttrakhand & Ors. **... Respondent**

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THROUGH

DATE: 02.09.2025

PLACE: NEW DELHI

Gigi.C.George,Advocate
Advocate for Respondent
Ch No. 457, Lawyers Block-1
Delhi High Court, New Delhi

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BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

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AFFIDAVIT ON BEHALF OF NATIONAL MISSION FOR CLEAN GANGA i.e. R-5

MOST RESPECTFULLY SHEWETH:

I, Anup Kumar Sirvastava, aged about 58 years, presently working as Executive Director (Technical) in the National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Government of India, New Delhi do hereby solemnly affirm and state as under:

1. That I am working as Executive Director (Technical) in the National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Government of India, New Delhi. I am duly authorized for and on behalf of the Respondent No. 5 to swear to the present affidavit. I am fully conversant with the facts and circumstances of the present case from the records.

2. That I am the Authorized Representative of the Respondent No. 5 in the captioned matter. I am fully conversant with the facts of the case and am thus competent to depose the present affidavit.

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3. That at the outset it is submitted that NMCG is one of the authorities constituted in accordance with the provisions of sub-section 3 of Section 3 of the Environment (Protection) Act, 1986 vide notification no. S.O. No. 3187(E) dated 07.10.2016, published in the gazette of India. NMCG has been mandated with for the implementation of programs for protection, prevention and rejuvenation of river Ganga and its tributaries christened as the Namami Gange Programme (NGP) of the Central Government. The NGP focuses on effective abatement of pollution and rejuvenation, protection and management of the river Ganga and its tributaries through interventions like taking up sewerage infrastructure projects for interception, diversion and treatment of waste water discharge from open drains into the river through construction of new STPs and/or rehabilitation and augmentation of existing STPs, laying of sewage pipelines etc.

4. That the present Original Application No. 751 of 2024 has been filed by the applicant raising grievance concerning environmental pollution in River Mandakini, a tributary of River Alaknanda, which originates from Chaorabari Glacier and runs approximately 81 km between Rudraprayag and Sonprayag, merging with River Songanga at Sonprayag and further flowing past the Hindu temple Madhyamaheshwar at Ukhimath. The applicant's grievance is primarily that there is no Sewage Treatment Plant (STP) at Shri Kedarnath Dham and untreated sewage is being discharged into River Mandakini, and further that there is absence of proper solid waste management system at Kedarnath Dham, thereby aggravating pollution in the river.

5. That it is respectfully submitted that no sewerage infrastructure project at Shri Kedarnath Dham has been taken up by NMCG, nor is any such project presently pending with NMCG. The responsibility for development of sewerage infrastructure at Kedarnath rests with the

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State Government, which is undertaking the work as per its approved master plan. However, in compliance with the directions of the Hon'ble Tribunal in O.A. No. 751/2024, the matter was taken up with the State Government in the meeting convened on 11.11.2024. Copy of the Record of Discussion dated 11.11.2024 has been marked and annexed herewith as **'Annexure A'**.

6. That in the aforesaid meeting, the State Government was advised to carry out a comprehensive assessment of the solid and liquid waste generated in and around Shri Kedarnath Dham and to confirm whether the facilities proposed under the approved master plan, being executed by PWD Uttarakhand, would be sufficient to effectively address the issue of pollution in the area.

7. That it is further submitted that vide letter dated 13.11.2024, NMCG shared the Record of Discussion of the meeting held on 11.11.2024 with the State Government and simultaneously instructed the District Magistrate, Rudraprayag, as well as the Tourism Department, Urban Development Department, and Environment Department of the State to furnish a detailed report outlining the measures taken to address the environmental challenges at Shri Kedarnath Dham, together with other initiatives undertaken for management of such issues.. A copy of the letter dated 13.11.2024 marked to State has been marked and annexed herewith as **'Annexure B'.**

8. That it is submitted that NMCG has received a detailed report from the State Government wherein it has been informed that a committee was constituted for site inspection. The said report records that discussions were held with a Professor from IIT Roorkee following the site inspection carried out on 20.12.2024, and further provides an elaborate account of the

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measures implemented to address the environmental challenges in the region. A copy of the detailed report from the state has been marked and annexed herewith as **'Annexure C'.**

The summary of the key measures indicated in the said report is reproduced hereinbelow for ready reference.

a) *The construction of 600 KLD STP is 80-85% complete. The remaining works like roof work, flooring work and internal installations which was due by December 2024, have been hampered, due to extreme cold temperature, snowfall, ineffectiveness of welding in extreme cold climatic conditions, cement setting issues and low availability of skilled labours along with other causes. Despite this, efforts are being made & work is in progress in prevailing harsh climate conditions for timely completion of STP so as to complete the STP.*

b) *The liquid waste management was designed for a population of 5000 residential and 20,000 floating population at Dham and regarding the higher numbers of pilgrims reported in the joint committee report dated August, 2024, it is to be clarified that higher numbers of pilgrims mentioned was effectively the number of pilgrims moving from Sonprayag to Kedarnath area and not more than the designed population stays at Kedarnath Dham in a given day. Further STPs (4 in number totalling 222 KLD) along with sewerage network and I&D of drains are under construction along the Kedarnath yatra trek/route at Gaurikund.*

c) *Currently, for pilgrims staying in the camps, 155 nos. of fixed toilets are in place based on soak pit systems. The joint committee highlighted seepage at few locations, however these have been rectified. Professor A.A. Kazmi has advised for installation of*

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Major Dhyanchand National Stadium First Floor New Delhi National Mission for Clean Ganga

Johkasou System for management of sewage in such locations, in continuation of which proposal will be submitted for sanction/approval.

9. That, the answering respondent herein craves leave of the Hon'ble Tribunal to file additional reply, in future, if required.

10. In light of the above submission, it is respectfully submitted that this Answering Respondent DoWR, RD & GR, shall abide by any order(s) or direction(s) passed by this Hon'ble tribunal in this Application.

DEPONENT

VERIFICATION

I, the deponent above named do hereby verify that the contents of the aforesaid affidavit are true and correct to my knowledge and belief and nothing material has been concealed therefrom. Verified at New Delhi on this ____ day of ____ 2024.

DEPONENT

Date: 02.09.2025

Place: New Delhi

ATTESTED
NOTARY PUBLIC
02 SEP 2025

'Annexure - A' 6

Record of Discussion (RoD) held on 11.11.2024 at 11.00 AM under the Chairmanship of DG, NMCG

A meeting was held with the officials of Uttarakhand on 11.11.2024 at 11.00 AM under the Chairmanship of Director General NMCG for discussion regarding the Hon'ble NGT Matter OA No. 751/2024 - Abhishit Kusum Gupta vs. State of Uttarakhand. The list of participants present in the meeting is at ***Annexure I.***

Actionable points discussed in the meeting are as follows: -

1. **Sewage management:**
   a) A detailed assessment of wastewater generation at Kedarnath Island area is required, especially during peak season, to determine whether the 600 KLD STP under construction is adequate especially in view of the number (peak) quoted by joint committee before NGT. The same may also be corroborated by Tourism Department of Uttarakhand.
   b) The report may include the liquid waste management for Tent area (outside Kedarnath Island) also.

[Action: DM, Rudraprayag/ Tourism Dept. UK]

2. **Solid Waste Management:** Similarly, the report should also include solid waste generation at Kedarnath Island area & along trekking route and waste management options being adopted by the State Government including relevant details of the waste management facilities.

[Action: DM, Rudraprayag/ Urban Development Dept. UK]

3. It was decided in the meeting that there is need to deal the solid waste management issue in a more comprehensive manner and hence state may engage the experts from NIUA (National Institute of Urban Affairs) and IIT Roorkee to assess and prepare the comprehensive waste management plan. NMCG may facilitate the joint meeting of state officials, NIUA and IIT Roorkee.

[Action: NMCG]

4. **Construction and Demolition (C&D) Waste:** Details regarding the quantity of C&D waste generated & disposed-off and time lines/agency responsible for disposing remaining debris in Kedarnath should be included in the report to be submitted to the NMCG.

[Action: DM, Rudraprayag/ UKPCB]

5. **Report Submission:** The detailed report may be submitted to NMCG by 2nd December 2024. The State's report may also include other initiatives taken by the State in managing the environmental challenges in Kedarnath.

[Action: DM, Rudraprayag/ Tourism Dept./Urban Development Dept./Environment Dept.]

The meeting ended with thanks to the Chair.

****

Annexure 1

List of Attendees

From NMCG;

S. No.	Name	Designation
1.	Shri Rajeev Kumar Mital	Director General
2.	Shri. Brijendra Swaroop	Executive Director (Projects)
3.	Shri. Anup Kumar Srivastava	Executive Director (Technical)
4.	Dr. Pravin Kumar	Director (Technical)
5.	Shri Narender Kumar Madan	Senior Monitoring Expert
6.	Shri Mahender Singh	Monitoring Expert
7.	Shri Ishwer Singh	Consultant Legal
8.	Shri Vishal Garg	Institutional Associate

From Uttrakhand:

S. No.	Name	Designation
1.	Shri Shailesh Bagauli	Secretary, DW & Sanitation
2.	Shri Nitesh Kumar Jha	Secretary UD
3.	Shri R.K. Sudhanshu	Principal Secretary, Env.& Forest
4.	Shri Sachin Kurve	Secretary, Tourism
5.	Shri Ranvir Singh Chauhan	PD SPMG UK
6.	Dr. Saurabh Gahaewar	DM Rudraprayag
7.	Dr. Parag Madhukar	MS, UKPCB
8.	Shri Deepak Yadav	Engineer in chief, PWD

'ANNEXURE - B' 9

No. Pr-12011/17/2017 - O/o Dir (T-III) NMCG
भारत सरकार
जल शक्ति मंत्रालय
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
राष्ट्रीय स्वच्छ गंगा मिशन
****

पहली मंजिल, मेजर ध्यान चंद नेशनल स्टेडियम,
निकट इंडिया गेट, नई दिल्ली – 110002,

दिनांक: 13.11. 2024

Subject: Record of Discussion (RoD) to discuss the response to the Hon'ble NGT order dated 04.10.2024 in OA No. 751/2024 Abhisht Kusum Gupta V/s State of Uttarakhand held on 11.11.2024 at 11.00 AM on Hybrid mode.

A copy of Record of Discussion (RoD) of the meeting dated 11th November 2024 under the Chairmanship of Director General, NMCG in the Hon'ble NGT matter OA No. 751/2024 - Abhisht Kusum Gupta V/s State of Uttarakhand, is forwarded herewith for information / necessary actions.

2. This issues with the approval of Competent Authority, NMCG.

भवदीय,

Encl: As above

13/11/24
(डॉ. प्रवीण कुमार)
निदेशक (तकनीकी), एनएमसीजी

To,

I. Secretary, Drinking Water Department, Govt of Uttarakhand, New Building, 4th Floor, Uttarakhand Secretariat, 4, Subhash Rd, Dehradun-248001. (secy-dw-ua@nic.in)
II. Secretary, Urban Development Directorate, 31/62, Rajpur Rd, Indra Market, Dehradun, Uttarakhand 248001 (secynkjha@gmail.com)
III. Principal Secretary, Environment & Forest, Govt of Uttarakhand, New Building, 4th Floor, Uttarakhand Secretariat, 4, Subhash Rd, Dehradun-248001. (secy-env-ua@nic.in)
IV. Secretary, Uttarakhand Tourism Development Board. Pt. Deendayal Upadhyay Paryatan Bhawan, Near ONGC Helipad Garhi Cantt, Dehradun-248001(secyoffice.uk2003@gmail.com)
V. Program Director, SPMG Uttarakhand, – 117 Indira Nagar, Dehradun -248001. (spmgngrba.utk01@gmail.com)

VI. District Magistrate Rudraprayag, 8242+8QQ, Chopta Pokhari Road, Rudraprayag, Uttarakhand 246171 (dmrudraprayag@gmail.com)

VII. Member Secretary, Uttarakhand Pollution Control Board (UKPCB) Gaura Devi Paryavaran Bhawan,46 B IT Park, Sehstradhara Road,Dehradun -248001. (msukpcb@yahoo.com)

VIII. Engineer in Chief, Public Works Department, 29, Yamuna Colony Road Yamuna Colony, Yamuna Colony Road, Yamuna Colony, Khurbura Mohalla, Dehradun – 248001 (einc.ukpwd@gmail.com, cepwdua@gmail.com)

For Internal Distribution:

PS to DG/ ED (P)/ED(T), NMCG

Compliance report in O.A. No. 751/2024 in Abhisht Kusum Gupta Vs State of Uttarakhand

This is in reference to the Hon'ble National Green Tribunal (NGT) order dated 04.10.2024 in O.A. No. 751/2024 Abhisht Kusum Gupta Vs State of Uttarakhand, read with National Mission for Clean Ganga letter No. Er- 12011/17/2017- Office o/dir (T-III) NMCG dt. 13.11.2024, where in detail report was asked from District Magistrate, Rudraprayag, Tourism department, Urban development department and Environment Department. In continuation of the above directions, a committee was constituted for site inspection and discussions with Professor of IIT, Roorkee.

The following committee members inspected the site on dated 20.12.2024 and discussions were held with Proff. Kazmi, IIT Roorkee.

- ACEO, KDA, Rudraprayag.
- Executive Engineer, PWD, Guptkashi
- Environment specialist, SMCG, Dehradun.
- Executive officer, Nagar Panchayat, Kedarnath
- Solid waste management consultant, Urban Development Directorate, Dehradun.
- Assistant engineer, Urban Development Directorate, Dehradun.
- District tourism development officer, Rudraprayag.
- Project manager, Jal Nigam, Srinagar.

A. Hon'ble Tribunal in order dt. 04.10.2024 has stated that

a. **Para 08:** - *The above report clearly indicates that there is no STP in Kedarnath to treat the sewage. One STP of 600 KLD is under construction and annexure C to the report states that 60% of work is over and construction of STP will be completed by December 2024. No timeline has been provided for household connection to the STP. It also needs to be ascertained that 600 KLD of STP is adequate.*

Response: -

i. Under Shri Kedarnath Dham Master plan, 84 buildings (total 862 modules) are being constructed or to be constructed in the temple island area. 04 persons per module cumulates to **3448** Residential/Permanent population. For STP design calculation, Residential/Permanent population was taken as 5000 along with 20,000 floating population. Per capita Water usage/sewage generation was taken as per National Building Code, Part-9 & Central Public Health & Environmental Engineering Organization Manual 1999. Due consideration was also given to cold climatic conditions at the Dham. Sewerage system with STP and DPR was vetted by Jamia Milia Islamia University, Delhi and CSIR-CBRI Roorkee. Copy of the vetted process design is enclosed as **Annexure-*1***

ii. In the design plan, there are branching sewerage channels in 3 major regions, along Saraswati edge, Mandakini edge and in the central street area. Out of these, as the buildings to be constructed in the Master plan are completed or are in near completion along the Mandakini edge, the sewerage channel along this edge measuring 400 meters in length has been installed. As sewerage channel laying work is possible only after

development /finalisation of surroundings and plinth level around the buildings, and the building construction works as per Master plan is ongoing on Saraswati edge and in the central street area, therefore the installation work of the sewerage channel is ongoing in these two regions. Post confluence of the sewerage channels from the three regions measuring 575 meters length is near completion (80%). Due to the ineffectiveness of welding in extreme cold climatic condition, cement setting issues and low availability of skilled labours, work progress in the month of December was hampered, however efforts are being made to complete the work in due time.

iii. The construction of 600 KLD STP is 80-85% complete. The remaining works like roof work, flooring work and internal installations which was due by December 2024, have been hampered, due to extreme cold temperature, snowfall, ineffectiveness of welding in extreme cold climatic conditions, cement setting issues and low availability of skilled labours along with other causes. Despite this, efforts are being made & work is in progress in prevailing harsh climate conditions for timely completion of STP so as to complete the STP. ***Annexure-2- Photographs of the site.***

iv. The liquid waste management was designed for a population of 5000 residential and 20,000 floating population at Dham and regarding the higher numbers of pilgrims reported in the joint committee report dated August, 2024, it is to be clarified that higher numbers of pilgrims mentioned was effectively the number of pilgrims moving from Sonprayag to Kedarnath area and not more than the designed population stays at Kedarnath Dham in a given day. Further STPs (4 in number totalling 222 KLD) along with sewerage network and I&D of drains are under construction along the Kedarnath yatra trek/route at Gaurikund.

v. Currently, for pilgrims staying in the camps, 155 nos. of fixed toilets are in place based on soak pit systems. The joint committee highlighted seepage at few locations, however these have been rectified. Professor A.A. Kazmi has advised for installation of Johkasou System for management of sewage in such locations, in continuation of which proposal will be submitted for sanction/approval.

B. Para 09: - *In respect of solid waste management, the committee has found that there is no waste processing plant established in Kedarnath for the management of solid and plastic waste which is estimated to be 1.667 TPD during the season.*
(Read with)

Para 10: - *The observations of the committee is that waste management facilities needs to be enhanced.*

Response

i. Currently the total solid waste generation was estimated to be 1.667 TPD and this is being managed with following resource.

1. Status of Human Resource

a.	Total number of Paryavaran Mitra	-	190
b.	Environment Supervisor	-	07

2. Status of SWM/PWM

a. Solid Waste Collection Vehicle - 01 (mini tractor with trolley)

b. Processing Facility - 01 MRF and 01 (for segregation of dry waste) Bailing machine (Photograph attached -01)

3. Deposit Refund System (DRS) – New Initiative

a. Under this system all the plastic bottles of water or soft drinks are labelled with QR code. Every bottle is charged Rs. 10.00 extra on MRP. Post use the customer can deposit these bottles at multiple kiosks along the track and can get their Rs. 10.00 refunded.

b. The initiative has engaged the local community and has promoted responsible waste disposal practices and environmental awareness.

c. DRS Progress Status –

i. Total QR provided on plastic bottle/tetra pack is 1,72,100.

ii. Out of above, 1,39,838 Bottles/Tetra Pack (81%) with QR have been returned by the customers for recycling. (Photograph attached-02)

ii. Prospective Solid Waste Management Action Plan -

1. Solid Waste Management Action Plan/Detail Project Report costing Rs. 309.46 Lacs has been prepared and submitted to urban development (***Annexure-3)*** that includes: -

a. For Dry Waste, Executive Officer Nagar Panchayat appraised that 01 TPD capacity Material Recovery Facility centre will be established in collaboration with the Heal Himalaya Foundation with equipments like Plastic Compactor, Shredder, Ballistic Separators, etc.

b. For Wet waste management an Organic Waste Composter of 500 Kg per day capacity is proposed at the MRF and additional 8 Organic Waste Composters with capacity of 50 kg per day are to be established at 08 different locations for processing of Wet Waste generated in outer periphery/tent colony. Contour map of Dham area and the plan is annexed in ***Annexure-4***

c. As per suggestions of Dr./Prof. Kazmi, IIT Roorkee verification of the performance of above proposed organic waste composter was needed with reference to low temperature areas and in continuation satisfactory performance reports issued by agencies, where these have been established have been received. ***Annexure-5***

C. Para 11: - *The joint committee during the visit found a lot of construction and demolition waste materials like iron rods/pipes and cemented broken bricks etc., lying in many places due to ongoing construction activities.*

Response: –

i. As mentioned in the 1st para, buildings and other structures are being constructed as per the Master plan in Dham area. Demolition waste materials like Iron rods, pipes and cement blocks and excavated soil are being used for back filling/foundation filling of under construction buildings and also to construct approach.

ii. In the year 2023-24, 10 old buildings were demolished, generating approximately 2400 cum of waste material, which was completely used in backfilling of Sangam Ghat, Arrival plaza and also in the foundation filling of under construction buildings.

iii. The plan of Construction agency (PWD) is to utilise all the demolition waste for backfilling in low lying areas and also to strengthen such locations. As soon as the construction will be completed, the entire C&D waste will be utilised in such locations. ***Annexure-6.***

(Nerraj Kumar)
Executive Officer
Nagar Panchayat,
Kedarnath

(Vinay Jhinkwan)
Executive Engineer
PWD Guptkashi

(Akshay Kumar)
Environment Specialist,
SMCG, Dehradun

(Ravinder Singh)
Project Manager
Jal Nigam
Srinagar

(Digvijay Semwal)
SWM Consultant,
Urban Development
Directorate, Dehradun

(Bharat Singh Rawat)
Assistant Engineer
Urban Development
Directorate, Dehradun

(Rahul Chaubey)
DTDO
Rudraprayag

(Shyam Singh Rana)
ACEO, KDA
Rudraprayag

KEDARNATH RESTORATION AND REDEVELOPMENT
BASIC ENGINEERING PROCESS
of
SEWAGE TREATMENT PLANT (600 KLD)

CLIENT

GOVT. OF UTTRAKHAND

उत्तराखण्ड राज्य

PROJECT MANAGEMENT CONSULTANT:

INI DESIGN STUDIO

INI DESIGN STUDIO

CONTRACTOR

GAWAR CONSTRUCTIONS LTD.

STP VENDOR

AV ENGINEERING

Dr. Abid Ali Khan
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamia
New Delhi - 110025

VETTED BY

DR. ABID ALI KHAN
DEPARTMENT OF CIVIL ENGINEERING
JAMIA MILLIA ISLAMIA (A CENTRAL UNIVERSITY)
NEW DELHI INDIA - 110025

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Abbreviations

- CPHEEO - Central Public Health & Environmental Engineering Organization.
- FB – Free Board.
- H – Height.
- HFL – High Flood Level.
- HR - Hours
- KLD – Kilo Liters Per Day.
- L – Length.
- LD - Liquid Depth.
- W- Width.

SECTION I

DESIGN CHARACTERISTICS

Dr. Ahir
Princi
Dep
Jo
New Delhi - 110025

Raw Sewage and Treated Sewage Characteristics of 600 KLD Sewage Treatment Plant at Kedarnath Dham, UK

- **Treatment Capacity:**

  The Sewage treatment plant is designed to treat 6,00,000 Litre per day of sewage generated from the site. The treated sewage can be used for agriculture, horticulture or can be discharged to public drain.

- **Characteristics of Raw & Treated Sewage:**

The Sewage characteristics considered for the design purpose of the plant are as mentioned below:-

S. No.	Parameters	Raw Sewage	Treated Sewage	Treated Sewage for Discharge into Inland surface water as per CPHEEO Manual (Table 5.3)
1.	Daily average flow	600 KLD	600 KLD	-
2.	Design temperature	15-25°C	15 -25°C	-
3.	pH	6.5 – 8.5	6.5 – 8.5	5.5 to 9.0
4.	Total suspended solids (TSS)	400 -450 mg/L	< 10 mg/L	10 mg/L
5.	Conductivity	50 µS	-	-
6.	Total BOD	250 – 300 mg/L	< 10 mg/L	10 mg/L
7.	Total COD	400 – 450 mg/L	< 50mg/L	50 mg/L
8.	Oil and grease	<10 mg/Ltr	Nil	NIL
9.	Total ammoniacal nitrogen	<25 mg/L	<5 mg/L	5.0 mg/L
10.	Total Nitrogen	<10 mg/L	<5 mg/L	10 mg/L
11.	Total Phosphorous	5 – 12 mg/L	<2 mg/L	-
12.	Total coliform count	$1x10^6$ MPN/100ml	<100 MPN/100ml	<100 MPN/100ml

- **Design & Peak Flow:**
  - Design Flow : 600 KLD = **30Cum/hr.**
  - Working Hours: **20.**
  - Peak Load Factor: **2**
  - Peak Flow: 30 Cum/hr X 2 = **60Cum/hr.**
- **The Design** of various units are as per CPHEEO manual on Sewerage and Sewage Treatment Systems except Electrocoagulation reactors.

Gawar Construction Ltd. Dehradun

M/S DESIGN STUDIO PVT. LTD. AHMEDABAD

Verified

Dr. Abid Ali Khan
Principal Investigator
Deptt. of Civil Engineering
Jamia Millia Islamia
New Delhi - 110025

SECTION II

PROCESS DESCRIPTION

Gawar Construction Limited Dehradun

INI DESIGN STUDIO PVT. LTD. AHMEDABAD

Verified

Dr. Abid Ali
Principal Inv.
Deptt. of Civil Engineering
Jamia Millia Islamia
New Delhi - 110025

ELECTROCOAGULATION (EC) PROCESS DESCRIPTION

- Water is one of human being's most fundamental needs.
- **Globalization**, uncontrolled growth, and other causes are causing a lack of fresh water, and many countries are concerned about the problem. As a result, it's critical to consider water purifying processes that are both effective and affordable, as well as reusability.

- People are presently aware of a wide range of wastewater treatment options. With recent technological advancements in the **electrochemical** area, a new technique known as electrocoagulation has been introduced into the business.

The Process of Electrocoagulation in Sewage Treatment Plants

Ref. Science journal - Science Direct, Jan 26th 2021

- Here major goal is to focus on **electrocoagulation** process technique and applications!

Introduction of the process

- Filtration, air stripping, ion exchange, chemical precipitation, chemical oxidation, carbon adsorption, ultrafiltration, reverse osmosis, electrodialysis, volatilization, and gas stripping are the traditional physico-chemical treatment techniques utilized for wastewater treatment.
- Oxidation of Biological mass by aeration technique is widely used in treatment of sewage water. Aeration of the sewage generates aerobic bacteria which in turn destroys the disease-causing bacteria in the liquor. But this process is viable at ambient temperature because the growth of aerobic bacteria can only occur at the RT.

- The **electrocoagulation** process is the viable option for such conditions.
- The **electrocoagulation** process is a sophisticated electrochemical technology-based procedure. **Electrocoagulation** (EC), which involves sending an electric current through water to remove pollutants, has shown to be quite successful. Anode and cathode geometries such as plates, balls, fluidized bed spheres, wire mesh, rods, and tubes have been used in electrocoagulation systems for many years.
- Water containing foodstuff wastes, oil wastes, dyes, suspended particles, chemical and mechanical polishing waste, organic matter from landfill leachates, de-fluorination of water, synthetic detergent

Dehr
AHMEDABAD

effluents, mine wastes, and heavy metal-containing solution have all been treated with it in recent decades. By decreasing electricity usage and miniaturizing the required power supply, EC has become one of the most cost-effective

- wastewater treatment systems in the world.

Parameters removed by EC

- **EC removes** metals, colloidal solids and particles, and soluble inorganic contaminants.
- EC treats a wide spectrum of waste streams comprising heavy metals, virus, bacteria, pesticides, arsenic, MTBE, cyanide, Biochemical oxygen demand (**BOD**), Total dissolved solids (**TDS**), and Total suspended solids (**TSS**) using a specialized treatment chamber and electricity. It is used to treat wastewater from municipal, industrial, and commercial sources.

Methodology involved

- For breaking stable emulsions and suspensions, EC is a viable alternative to metal salts, polymers, and polyelectrolyte addition.
- An electrolytic cell with one anode and one cathode makes up an EC reactor. The EC system is made up of two parallel pairs of conductive metal plates that operate as monopolar electrodes.

- The criteria for using EC are as follows:
  - A power source that uses direct current
  - Box of Resistance
  - Multimeter

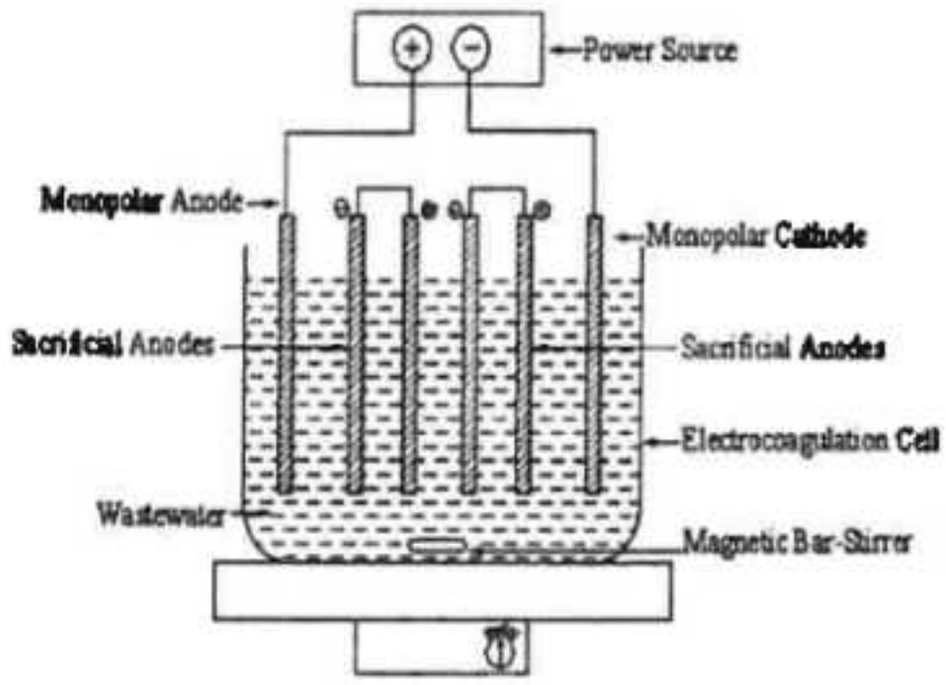

Fig 1: Bench-scale EC reactor with monopolar electrodes in series connection

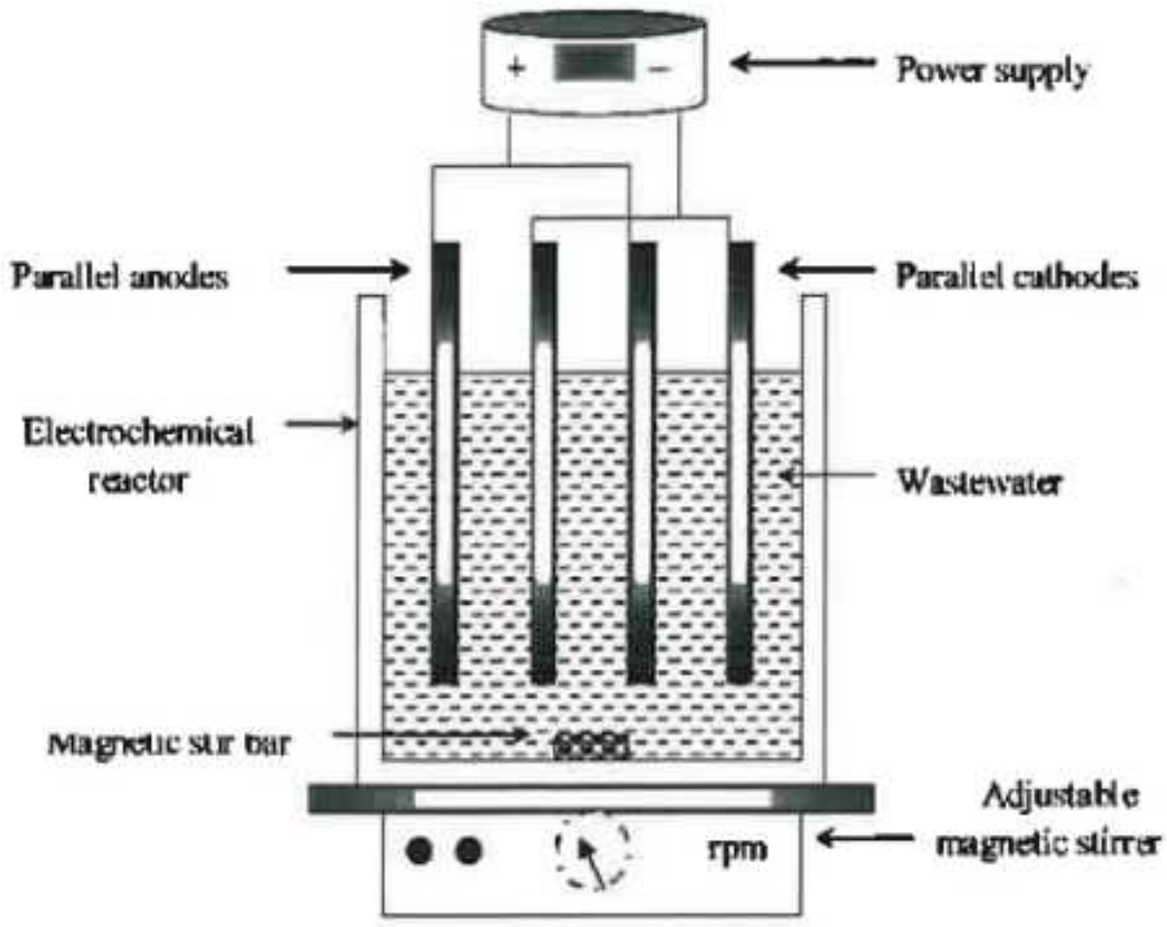

Fig 2: Bench-scale EC reactor with monopolar electrodes in parellel connection

1. "Sacrificial electrodes" is a term used to describe the conductive metal plates. The sacrificial anode decreases the anode's dissolving potential and reduces the cathode's passivation. The materials used for the sacrificial anodes and cathodes might be the same or different.

2. The cells can be connected to monopolar electrodes in a series. or in parallel.
   The cells connected in series have higher resistance, so bigger potential difference is required for a given current to flow in a series cell configuration. The cells connected in parallel have lower resistance, so lesser potential difference is required for a given current to flow in a series cell configuration.

   During electrolysis, anodic reactions occur on the positive side, whereas cathodic reactions occur on the negative side. The coagulation process will begin with released ions neutralizing the charges of the particles.

3. The released ions eliminate undesired impurities by forcing colloidal materials to agglomerate, which can then be removed by flotation. When water containing colloidal particles, oils, or other pollutants passes through an electric field, ionization, electrolysis, hydrolysis, and the generation of free radicals can occur, altering the physical and chemical characteristics of the water and contaminants. Contaminants are liberated from the water and destroyed or rendered less soluble due to the reactive and excited condition.

   Reactions in an EC cell

   At Anode
   $2Al - 6e = 2AL^{3+}$

   At Cathode
   $6H_20 + 6e = 6OH^- + H_2$

   Within the Cell
   $2Al^{3+} + 6OH^- = 2Al(OH)_3$

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Conclusion

- **Electrocoagulation** is capable of treating wide range of wastewaters. It is the technique of using a little amount of electrical current to destabilize suspended, emulsified, or dissolved pollutants in an aqueous media. As a result, the process's extra expenses are reduced.

- When it comes to the advantages, the EC method aids in the elimination of TSS by 95-99%, BOD by 50-99%, and bacteria by 95-99%. This shows that the technology is successful and dependable for a wide range of future uses, providing hope for everyone to have access to clean water.

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SECTION III

UNIT SIZING AND TECHNICAL DESCRIPTION OF VARIOUS UNITS

3.1 Inlet Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	1.6M3
HRT at normal flow	3 minutes
HRT at peak flow	1 minute, 30 seconds
Dimensions in mm	900(L)X1800(W)X1500(LD)+300(FB)
Use	Holding heavy material such as pebbles, metal lids etc

3.2 Coarse Bar Screen Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	2.3M3
Dimensions in mm	2900(L)X800(W)X1500(LD)+450(FB)
Use	Fixing of Coarse Screen

3.3 Fine Bar Screen Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	2.3M3
Dimensions in mm	2900(L)X800(W)X1500(LD)+600(FB)
Use	Fixing of Fine Screen

3.4 Coarse Screen

Quantity	1 working + 1 standby
MOC	SS 304
Dimensions in mm	800 x 2000
Slit or pore size of screen	10 mm approx.
Angle of Inclination	55° to 60°
Head Loss	150mm
Use	Screening of large particulate from raw sewage

3.5 Fine Screen

Quantity	1 working + 1 standby
MOC	SS 304
Dimensions in mm	800 x 2000
Pore Size of screen	6mm approx.
Angle of Inclination	55° to 60°
Head Loss	150mm
Use	Screening of fine particulate from raw sewage

3.6 Grit Chamber

Quantity	1 No.
MOC	Civil
Effective Volume	1.1M3
HRT at normal flow	120 seconds
HRT at peak flow	60 seconds
Dimensions in mm	900 x 900 x 1500
Use	Collection of particle that skips the fine screen (sand etc)

3.7 Oil & Grease Chamber

Quantity	1 No. (divided into two parts)
MOC	Civil

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	Effective Volume	7.5M3
	HRT at normal flow	15 minutes
	HRT at peak flow	7 minutes 30 seconds
	Dimensions in mm	2900 x 1800 x 1500
	Use	Separation of oil and aqueous phase
3.8	**Oil Skimmer**	
	Quantity	1 No.
	MOC	Standard
	Capacity	Capable of extracting 50 lph of oil
	Motor capacity	0.37KW, 3P, Geared motor
	Belt size	1200 mm length and 15 mm width, MOC PP
	Use	Extraction of remaining oil from O & G trap
3.9	**Collection/Equalization Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	250M3
	HRT for normal flow	8 Hrs and 30 minutes (Aerated thru Blowers)
	HRT with peak load	7 Hrs
	Dimensions in mm	9500 x 6030 x 4350 + 500mm FB
	Use	Collection and equalization of influent raw sewage
3.10	**Twin Lobe Air Blower**	
	Quantity	2 working + 1 standby
	MOC	Standard
	Capacity	110M3/Hr at 0.6 bar pressure
	Motor capacity	5.5KW, 3P
	Make	Everest, Model No. M44 or equiv.
	Use	Complete with MS base, antivibration pads, V belt, pulleys, NRV, pressure gauge, filling oil etc Providing air to collection tank to maintain aseptic conditions, EC reactors, flash mixers, sludge holding tank etc. for agitation
3.11	**Air Grid in Collection Tank**	
	Quantity	1 set
	Pipe MOC	GI and CPVC of varied sizes as required for headers, manifolds and connections to diffusers Coarse diffusers 150 mm dia, EPDM disc type diffusers
	Quantity of diffusers	1 set
3.12	**Raw Sewage Transfer Pumps**	
	Quantity	2 working + 1 standby
	MOC	Standard, submersible cutter pumps
	Capacity	30M3/Hr, 15 M head, with low & high level sensors
	Motor capacity	5.5KW, 3P
	Make	KBL, Model Eterna 5500CW or equiv
	Use	Complete with MS lowering & lifting frame, NRV, pressure gauge, valves etc. Lifting of raw sewage from collection tank to EC reactors at desired flow and height
3.13	**Acid/Alkali Dosing system**	
	Dosing Pumps	

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	Quantity	1 working + 1 standby
	MOC	Standard, Electronic dosing pumps
	Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
	Motor capacity	80 W, 1P
	Make	Milton Roy (Asia LMI)
		Complete with PU flexible pipe, inlet & outlet NRV's Dosing
	Tanks	
	Quantity	1 No
	MOC	HDPE
	Capacity	100 Ltr
	Make	Sintex
	Mixing	Agitation by air
	Use	The dosing system will be used to dose acid or alkali to the sewage to adjust pH to almost neutral if required
3.14	**Electrolyte (NaCl) Dosing system**	
	Dosing Pumps	
	Quantity	1 working + 1 standby
	MOC	Standard, Electronic dosing pumps
	Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
	Motor capacity	80 W, 1P
	Make	Milton Roy (Asia LMI)
		Complete with PU flexible pipe, inlet & outlet NRV's
	Dosing Tanks	
	Quantity	1 No.
	MOC	HDPE
	Capacity	100 Ltr
	Make	Sintex
	Mixing	Agitation by air
	Use	The dosing system will be used to dose electrolyte to the sewage to adjust conductivity to approx. 100uS if reqd.
3.15	**Electrocoagulation Reactors**	
	Quantity	6 Nos, all working
	Effective volume	3.6 M3
	Dimensions in mm	3000 x 1000 x 1200 + 300 mm weir with EC treated water collection tank, complete with outlet weirs, valves etc
	MOC of tanks	MS FRP coated from inside and epoxy coated for outside
	HRT for each EC unit	30 minutes minimum
	Number of Anodes	26 Nos
	MOC of Anodes	Aluminium
	Size of Anodes in mm	800 x 700
	Number of Cathodes	26 Nos
	MOC of Cathodes	Iron
	Size of Cathodes in mm	800 x 700
	Voltage applied	12 V, DC
	Current density at each Electrode	2 mA/cm2
	Electrode configuration	Parallel
	AC Step down transformer & DC Rectifier	AC Transformer 240 V AC to 12 V AC Rectifier 12V AC to 12V DC, 12 A, 3.5 KW
3.16	**Flash Mixers**	
	Quantity	3 Nos.

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MOC	MS EP
Effective Volume	4.0M3
HRT	20 minutes (Wastewater Engg, Metcalf & Eddy)
Dimensions in mm	1000 x 2000 x 2000
Mixing	Agitation by air
Use	Mixing of Poly electrolyte for coagulation process

3.17 **Poly Electrolyte Dosing System**

Dosing Pumps	
Quantity	3 working + 3 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's
Dosing Tanks	
Quantity	1 No.
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air
Use	The dosing system will be used to dose polyelectrolyte to the EC treated sewage for floc formation of the sludge toe ease the settling process

3.18 **Tube Settlers**

Quantity	3 Nos.
MOC	MS EP
Length of settler	2062 mm
Width of settler	1300 mm
Total Height of settler	3100 mm
Height of legs	500 mm
Qty of tube deck media(TDM)	2M3
Surface area available	22M2
In tube deck media	
Angle for installation of TDM	60°
	Dimensions in mm details dimensions in tube settler calculation sheet
Use	Gives the required surface area for settling of sludge

3.19 **Chlorine Dosing System**

Dosing Pumps	
Quantity	1 working + 1 standby
MOC	Standard, Electronic dosing pumps
Capacity	0-10 lph, 4 M head (Dose Subject to the site condition)
Motor capacity	80 W, 1P
Make	Milton Roy (Asia LMI)
	Complete with PU flexible pipe, inlet & outlet NRV's
Dosing Tankss	
Quantity	1 No.
MOC	HDPE
Capacity	100 Ltr
Make	Sintex
Mixing	Agitation by air

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	Use	Dosing of Sodium Hypochlorite in the Filter Feed/Chlorine Contact tank to attain 2ppm of residual free chlorine in treated water
3.20	**Filter Feed/Chlorine Contact Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	52.4M3
	HRT	95 minutes
	Dimensions in mm	4675 x 2800 x 4000 + 500mm FB
	Mixing	Agitation by air
	Use	This tank collects the treated water & act as a relay tank for water to be fed to the filters. It also acts as chlorine dosing tank.
3.21	**Filter Feed Pumps**	
	Quantity	2 working + 1 standby
	MOC	Standard CI, Horizontal centrifugal pumps
	Capacity	30M3/Hr, 28 M head, with low & high level sensors
	Motor capacity	5.5KW, 3P
	Make	KBL, Model KDS/GMC 844+ or equiv
		Complete with MS base frame, antivibration pads, NRV, pressure gauge, valves etc.
	Use	Feeding of treated sewage to the PSF and ACF at desired flow and pressure
3.22	**Pressure Sand Filter**	
	Quantity	1 No.
	Filtration velocity	10M3/Hr
	MOC	MS EP
	Dimensions in mm	2000 dia x 1800 HOS, both side dish ends, 1manhole and one hand hole
	MS sheet thickness in mm	HOS-6mm, dish ends-8mm, flanges-8mm
	Frontal Piping	MSEP/GI, 65NB,
	Valves	5Nos 63NB butterfly control valves, 1 No 1" air release valve
	Media	Graded sand-3800 Kgs
	Filter vessel	Fabricated
	Valves make	Zoloto
3.23	**Activated Carbon Filter**	
	Quantity	1 No.
	Filtration velocity	10M3/Hr
	MOC	MS EP
	Dimensions in mm	2000 dia x 1800 HOS, both side dish ends, 1 manhole and one hand hole
	MS sheet thickness in mm	HOS-6mm, dish ends-8mm, flanges-8mm
	Frontal Piping	MSEP/GI, 65NB,
	Valves	5Nos 63NB butterfly control valves, 1 No 1" air release valve
	Media	Supporting media pebbles-500 kgs, Granular activated carbon-1600 Kgs
	Filter vessel	Fabricated
	Valves make	Zoloto
3.24	**Filter Backwash Pumps**	
	Quantity	1 working + 1 standby

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	MOC	Standard CI, Submersible centrifugal pumps
	Capacity	45M3/Hr, 15 M head, with low & high level sensors
	Motor capacity	3.3KW, 3P
	Make	KBL, Model KDS/GMC 515+ or equiv
		Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
	Use	Back washing of PSF and ACF at desired flow and pressure
3.25	**UV Sterilizer Unit**	
	Quantity	1 No.
	MOC	SS-316
	Capacity	for water flow of 30M3/Hr
	UV Dose	60,000 uW-sec/cm2
	UV Transmission per cm	80%
	Voltage	220-240V
	Wattage	1370W
	Make	Alfa
	Model	WL12
3.26	**Filtered Water Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	86M3
	HRT	2 hrs and 30 minutes
	Dimensions in mm	5200 x 3800 x 4350 + 500mm FB
	Use	This tank collects the final treated & filtered to send to drain/re use/ horticulture etc, Chlorine is also dosed in this final water to achieve 2ppm of residual free chlorine in final treated water
3.27	**Sludge Transfer Pump**	
	Quantity	1 working + 1 standby
	MOC	Semi Open impeller pump
	Capacity	15M3/Hr, 15 M head, with low & high level sensors
	Motor capacity	5.5KW, 3P
	Make	KBL, Model SP1H or equiv
		Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
	Use	Transfer of sludge from settlers to sludge holding tank
3.28	**Sludge Holding Tank**	
	Quantity	1 No.
	MOC	Civil
	Effective Volume	31M3
	HRT	1 hrs
	Dimensions in mm	2750 x 2800 x 4000 + 500mm FB
	Mixing	Agitation by air
	Use	This tank collects the sludge received from the settlers and is used as sludge thickner also, apart for feed tank to filter press
3.29	**Filter Press Feed Pump**	
	Quantity	1 working + 1 standby
	MOC	CI body, SS 304 shaft, Screw pump
	Capacity	5M3/Hr, 50 M head
	Motor capacity	3.3KW, 3P

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	Make	Roto, Model RLAB541 or equiv Complete with MS base frame, anti vibration pads, NRV, pressure gauge, valves etc.
	Use	Screw type pump is suitable for transfer of semi solids, slurries etc and therefore it is used for feeding of sludge from sludge holding tank to filter press

3.30 **Filter Press**

Quantity	1 No.
MOC	CI mounting structure and PP recessed plates/plate frame
Size of plates	24" x 24"
No. of plates and frames	23
Type of operation	Hydraulic
Sludge Holding Capacity	290 Ltrs in one load
Calculation for sludge generation:	
BOD	300 mg/L
Sludge generation in BOD x 0.5	
Flow/Day	600 KLD 6,00,000 m3/Day
BOD/Day	300 x 600000 180,0.00,000 mg 180 Kgs
Sludge generated	180 x 0.8 **144 Kgs/Day** Selected Filter press of capacity 290 Kgs per lot

3.31 **Sludge Holding Area**

Quantity	1 No.
MOC	Civil
Dimensions in mm	6000 x2825 x300, open space
Use	This space is meant for storing the wet cake of sludge from filter press till disposal, it can take 16 loads (290Ltr x 16 loads) of sludge output from filter press.

3.32 **Platform for EC Reactors**

Quantity	1 No.
MOC	Civil structure
Dimensions in mm	12975 x 6530 at a height of 4500
Use	Civil structure for placing of EC reactors along with walking and working space

3.33 **Platform for Flash Mixers and Settlers**

Quantity	1 No.
MOC	Civil structure
Dimensions in mm	6000 x 6530 on a platform of 250mm height
Use	Civil structure for placing of flash mixers and settlers along with walking and working space

3.34 **Electro Magnetic Flow Meter**

Quantity	2 Nos.
MOC	Standard, Sensor SS
Pipe connections	80mm, flange type
Bore	Full bore
Power	Battery operated

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	Type	Flow Indicator, transmitter, flow totalizer, Backlit display, aluminium frame for glass mounting, factory calibrated
	Make	Micro Flow
3.35	**pH Meter**	
	Quantity	2 Nos.
	MOC	Standard, Sensor glass
	Pipe connections	20mm, threaded
	Power	240 V AC from the electrical control panel
	Type	pH range 0-14, digital LED display, Online installation, factory calibrated
	Make	Aster
3.36	**Pressure Gauges**	
	Quantity	Set
	MOC	SS, glycerine filled
	Dial size	4"
	Range	0 – 7 kgs/cm2
3.37	**Level Sensors/Controllers**	
	Quantity	Set
	MOC	Standard
	Type	Float Type NO/NC circuit
	Range	low and high limits adjustable
3.38	**Pipes, Fittings and Valves**	
	Quantity	Set
	MOC	CPVC, GI and MSEP
	Size	Variable sizes of pipes, fittings and valves will be used in the piping system depending upon the flow and pressure requirements at that point
3.39	**Electrical Control Panel**	
	Quantity	1 Set IP 55 LT panel with all incoming and outgoing feeders as per the capacity of the instruments. All feeders shall have overload, short circuit and phase reversal protection. Required PLC and starters etc will be the part of the panel.Incomer feeders shall multifunctional meters, CT's, push buttons and indicating lamps. Panel shall be supplied as per specifications and requirements for auto operation of the sewage treatment plant with manual over rides. Earthing shall be provided for each electrical instrument with GI strip or GI wire as required at the specific place. All power and control panels (from panel to the individual electrical instrument, termination of cables and cable trays (inside the STP) are considered in this item. All cables wires etc will be wrapped with PP/PU insulation sheets.
3.40	Antifreeze Flexible Heating Cables	Antifreeze flexible heating cables will be installed with the CPVC piping system tied by PP cable ties

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SECTION IV
DESIGN CALCULATIONS

4.1 Calculation for Coarse Screen

No. of Bars in bar Screen

Width of Bar Screen	800	mm
Effective Length of bar screen	1300	mm
Bar spacing	10	mm
Bar width	40	mm
Total width used by each bar	50	mm
Total Nos. of bars	16	mm
Available spacing width wise	150	mm
Total area available for water flow	195000 mm2	0.195 m2

Approach Velocity at Bar Screen

A = Flow/Velocity

Peak Flow of water	60	M3/Hr
	0.017	M3/Sec
Min. Reqd Approach velocity	0.3	M/Sec
Cross section reqd for desired approach velocity	0.056	M2

Channel dimensions before bar screen: 1800mm (L) X 200mm (W) x 300 mm(H)

Length of the channel is less due to space constraint

Head loss thru the screens

$h = .0729(V^2-v^2)$

h	Head loss in metre
V	flow velocity thru the screen in m/s
Factor	0.0729
V	0.3 m/s
V^2	0.09
V	0.017 m/s
v^2	0.000289
V^2-v^2	0.09
H	0.01 m< 150 mm hence Ok

Head Loss taken is 150mm as standard practice as per CPHEEO, Chapter 5, Section 5.6.1.8 &5.6.1.9

4.2 Calculation for Fine Screen

$h = (1/2g)(Q/CA)^2$

Discharge Flow in M/sec Q		0.017	M3/sec
Coefficient of discharge C		0.6	
Effective submerged open area A	0.4M x 0.6M	0.24	M2
Gravity		9.8	M/Sec^2
2g	9.8 x 2	19.6	
1/2g		0.05	
CA		0.144	
Q/CA		0.12	
(Q/CA)2		0.014	
Head Loss H		0.0007	

Head Loss taken is 150mm as standard practice as per CPHEEO, Chapter 5, Section 5.6.1.9

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4.3 Calculation for Grit Chamber

Settling Velocity		
Vs = g (Ss-1) d2		
18 μ		
Gravity g	9.8	
Specific Gravity of grit Ss	2.65	
Particle size of grit d	0.15	mm
	0.00015	M
g/18	0.544444444	
Ss-1	1.65	
d2	2.25E-08	
Viscosity	0.00000114	
d2/μ	0.019736842	
Vs	0.017730263	M/sec
Reynolds Number R = Vs x d/μ	2.332929363	
	2.3>0.5 Hence Stoke law doe not apply	
Applying transition law for 0.5 < R < 103		
Vs = [0.707 x (Ss-1) d1.6 - v-0.6]0.714	0.0168	M/sec 1451.52
Computation of Surface Overflow rate		
Surface overflow rate for 100% removal Efficiency in an ideal Grit Chamber = Settling velocity of minimum size of particle		
Convert Vs to M/day	1451.52	M3/m2/day
Determine actual overflow rate		
n = 1 - {1+nVs/Q/A}-1/n		
Assuming η= 0.75 and n = 1/8 then		
Q = Vsn	959	M3/m2/day
A (1- η)-n -1		
Flow per day	600	KLD
flow per hour/60 minutes Q		
Determine of Dimension of grit chamber	30	M3/Hr
Plan area of grit chamber = Q	0.031282586	M2
Q/A		
Proposed a grit chamber of dimensions	**900mm x 900mm x 1500mm**	
As per CPHEEO manual page No. A-112 critical		

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displacement velocity for above parameters Vc	0.161	m/sec
As per CPHEEO manual Horizontal velocity Vh should < Vc		
assuming depth of 900mm Vh	1.20689E-06	

Ref: CPHEEO manual appendix 2, page No. A-111 to A-113

4.4 Calculation for Oil & Grease Trap

Flow per day	600	KLD
Effective working Hours	20	HRS
flow per hour/60 minutes	30	M3/HR
Retention time for removal of oil and grease	15	MINUTES
Min. Volume of oil & grease trap required	**7.5**	M3

4.5 Calculation sheet for Equalization/Collection tank

Flow per day	600	KLD
Effective working Hours	20	HRS
flow per hour/60 minutes	30	M3/HR
Peak load flow (2 times of normal flow in M3/Hr)	60	M3/HR
Retention time for collection tank	8	HRS
Min. Volume of collection tank required	240	M3

Ref: Wastewater Engg. Metcalf & Eddy, CPHEEO Manual. 5,Sec. 5.6.3

4.6 Calculations for EC Reactor

Electro Coagulation Calculator by Faradays Law

$$m = \frac{E \times i \times t}{96485} \quad \text{or} \quad i = \frac{m \times 96485}{E \times t} \quad \text{or} \quad \text{Watts } W = \frac{m \times 96485 \times \text{Voltage } V}{E \times t}$$

	Anode Aluminium		Cathode Iron	
Flow per cell	100	KLD	100	KLD
	100000	LPD	100000	LPD
Working Hrs	20	Hrs	20	Hrs
flow per Hr	5000	LPH	5000	LPH
HRT per cell	30	Minutes	30	Minutes
	1800	Seconds	1800	Seconds
Flow per cell in 30 minutes	2500	LPH	2500	LPH
	2.5	KL	2.5	KL
Equivalent Wt of Anode material	27	Aluminium	56	Iron
Mass of substance dissolved per Ltr	15	mg/Ltr	15	mg/Ltr
Mass of substance dissolved/cell in 30 minute (2500L)	37500	mg	37500	mg
	37.5	gms	37.5	gms
	0.0375	kgs	0.0375	kgs
Mass of substance dissolved/cell in a day (100KL)	1.5	kgs	1.5	kgs
Number of days for replacement of suicidal electrode	120	days	120	days

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	Anode Aluminium		Cathode Iron	
Mass of substance dissolved/cell in above days)	180	kgs	180	kgs
Faraday Number	96485		96485	
Min. Current required for dissolution of anode	0.074	Amp	0.074448	Amp
	74	mA	74	mA
Voltage applied	12	Volts	12	Volts
Min. Power required per cell	0.89	Watts	0.89338	Watts
Electrode Area to Volume ratio, A/V, (100-1000)	156	cm2/Ltr	156	cm2/Ltr
Area of Electrode material required/cell with A/V ratio	29034.84	cm2	29034.84	cm2
	29.03	m2	29.03484	m2
Number of electrodes/cell	52	Pairs	52	Pairs
Area per electrode	0.56	M2	0.558362	M2
	5583.62	cm	5583.623	cm
Thickness of electrode	5	mm	3	mm
	0.00005	M		M
Length of electrode	0.8	M	0.8	M
Width of electrode	0.7	M	0.7	M
Distance between 2 electrodes	2	cm	2	cm
Depth of cell	1.5	M	1.5	M
Free board	300	mm	300	mm
Width of cell	1	M	1	M
Length of cell	3	M	3	M
Specific gravity of Material	2.7	Al	7.87	Fe
Weight per electrode (L x W x Thickness x sp.gravity)	7.56	kgs	13.22	Kgs
Min. Current density required/electrode	2	mA/cm2	2	mA/cm2
Actual current required per cell (parallel connections)	11167.25	mA	11167.25	mA
	11.17	Amp	11.17	Amp
Voltage applied	12	Volts	12	Volts
Power per cell	134.01	Watts	134.01	Watts
	0.13	KW	0.13	KW

4.7 Calculations for Flash Mixer

Calculation sheet for Flash mixers

Flow per day	600	kld
No. of Flash mixers in parallal	3	Nos
Flow in each mixer	200	kld
Effective working Hours	20	Hrs
flow per hour/60 minutes	10	M3/Hr
Mixing time required for mixer	20	minutes
Min. Volume of flash mixer required	**3.3**	M3

Ref: Wastewater Engineering, Metcalf & Eddy
CPHEEO, Chapter 5, Section 5.7.3.2

4.8 Calculation for Tube Settler

Calculation for Tube Settler

Flow per day	200	KLD	
Flow of effluent/Hr.	10	M3/Hr	Q
Settling Velocity of effluent	10	M/Hr	V
Angle of inclination	60	degree	
Area in per M3 of Tube deck	11	M2	
Factor for Tube deck media	19		
M3 of Tube deck media	1.727	M3	
Add 10% extra	1.90	M3	
Tube deck Media required in L			
Ht of Tube deck media	1.00	M	
Length & Width required for fixing Tube deck media			
Width of settler	1.30	M	
Length required	1.46	M	
Size required for fixing tube deck media	1.5 x 1.3 x 1	LWH in M	
Height of settler			
Free port top	500	mm	
Inlet Chamber	800	mm	
Free port bottom	300	mm	
Height of Chamber	1500	mm	
Height of cone	500	mm	
Height of legs	500	mm	
Total Height of Tube settler	**3600**	**mm**	
Difference in ht of Inlet and outlet chamber	300	mm	
Length of components of settler			
Inlet chamber	300	mm	
Outlet chamber	300	mm	
Length of media chamber & cone	1461.54	mm	
Total Length of Settler	**2061.54**	mm	
Width of components of settler			
Inlet chamber	1300	mm	
outlet chamber	1300	mm	
Cone	1300	mm	
Main body	1300	mm	
Total width of settler	**1300**	mm	

Technical Data Sheet for Tube deck media attached in section VIII, 8.11

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4.9 Calculations for DMF and ACF vessels

Calculation sheet for DMF and ACF

Flanged Vessels

	Nos		3.14xDiaxDia/4x250			
Flow Rate in M3/Hr.		30				
Velocity, M/Hr		10				
		3.821656				
Vessel dia.		**1.954906**	Mtr			
Shell Thickness		5	mm			
Shell Height		1.8	m	Media Ht	1000	mm
Shell Wt.		433.6782	Kgs	Shell Vol.	5400	Ltrs
Dish end Dia.		2.736868		Vol of media	3000	
Dish end Thickness		8	mm			
Top Dish End Wt.		369.264	Kgs	Sand Vol.	1950	Ltrs
Bottom Dish End Wt.		369.264	Kgs			
Outer Dia of Flange		2.054906	m	Pebbles Vol.	450	Ltrs
Inner Dia of Flange		1.954906	m	Total sand	2400	Ltrs
Thickness of Flange		8	mm	Wt.of sand & pebbles	4320	Kgs
		208.1676	Kgs	Anthracite Vol.	600	Ltrs
		188.4	Kgs	Wt of Anthracite	300	Kgs
Flanges Wt. Bottom/top	1	39.53514	Kgs			
Thickness of Strainer Plate		8	mm			
Strainer plates Wt. bottom/Top	1	208.1676	Kgs			
Wt. of Manhole	1	75	Kgs			
Wt of handhole	1	25	Kgs			
Wt of Legs	4	80	Kgs			
Wt of Hooks	2	10	Kgs			
Wt of Nozzles & Flanges		30	Kgs			
Wt of Funnel		10	Kgs			
Total Wt. of Vessel		**1649.909**	Kgs			
No of Strainers,Top		0	Nos			
No of Strainers,Bottom		147	Nos			

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SECTION V

ELECTRICAL LOAD, AUTOMATION LOGIC, EQUIPMENT WEIGHTS

5.1 Electrical Load

Electrical Load Data Sheet

S.No.	Equipment name	Qty in Nos	KW per unit	Total Electrical Load in KW
1	Oil Skimmer	2	0.37	0.74
2	Air Blowers	3	5.5	16.5
3	Sewage Transfer Pumps	3	5.5	16.5
4	Dosing Pump for Acid	2	0.08	0.16
5	Dosing Pump for NaOH	2	0.08	0.16
6	Dosing Pump for NaCl	2	0.08	0.16
7	Electro coagulation unit	6	3.5	21
8	Poly Dosing System	6	0.08	0.48
9	Chlorine Dosing System	2	0.08	0.16
10	Filter Feed Pump	2	5.5	11
11	Filter Backwash Pump	2	3.7	7.4
12	Screw pump	2	2.2	4.40
13	Filter press, Hydraulic	1	3.7	3.7
	Total Connected Electrical Load			**82.36**

5.2 Automation Logic

1. **Collection tank**
   a) The Sewage transfer pumps will stop if the level in the collection tank is low and will restart as soon as the level reaches high.
   b) The blower will continue working even at low level. Needs to be stopped manually

2. **Electrolysis Reactors**
   a) The DC Circuit will trip as soon as the level in the reactor tank gets low and will restart when the level reaches high.
   b) Low level in the reactor tank will also trigger the sewage transfer pump to start if the level in the collection tank is sufficient.
   c) Low level in Reactors will also stop agitation in flash mixers.

3. **Filter Feed Tank**
   a) Filter feed pump will trip if water in the filter feed tank is low and will restart on sensing high level.

4. **Treated Water Tank**
   a) In case level in the Treated Water Tank is sensed high, whole plant will stop including the DC power supply of the Electrolysis reactors and the Dosing system.
   b) The blower will continue working. Plant will restart at low level in Treated water tank.

5. **Manual Overrides**
   a) Manual override will be provided for all the automation. In case the plant is run in manual mode all automation systems will cease to work.
   b) All working and standby equipment have a selector switch to manually switchover to the desired equipment if required.
   c) An emergency switch will be provided in the panel to completely cut off power supply to the complete unit.

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5.3 Mechanical Weights of Equipment

Weights of SS, MS FRP and MS EP Fabricated Instruments

S.No.	Equipment name	Qty	Unit	Wt./unit In Kgs	Total Wt. In Kgs	Total Wt. In Kgs with Water
1	Bar Screen	2	Nos	103	206	206
2	EC Reactors	6	Nos	897	5382	35586
	Wt of Anodes/reactor	1	set	190	1140	
	Wt of cathodes/reactor	1	set	344	2064	
	Wt of water per EC Reactor			4500	27000	
3	Settling tanks	3	Nos	2270	6810	66810
	Wt of water per Settler			20000	60000	
4	Pressure Sand Filter Vessel	1	No	1870	1870	10170
	Wt of media			4800	4800	
	Wt of water in PSF Vessel			3500	3500	
5	Activated Carbon Filter	1	No	1870	1870	8570
	Wt of media			3200	3200	
	Wt of water in ACF Vessel			3500	3500	

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SECTION VI

DRAWINGS (ANNEXURE – A)

Gawar Construction Limited Dehradun

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592

PROJECTS FOR HPCL

STP

GOVERNMENT OF UTTARAKHAND

SCHEDULE OF PACKAGES	DATE

DRAWING LIST PACKAGE - 01

DR	HPCL	Drawing Date
	SEWAGE TREATMENT PLANT	

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

CK3/WEB

STP

COVER SHEET

A2

KR-STP-G101

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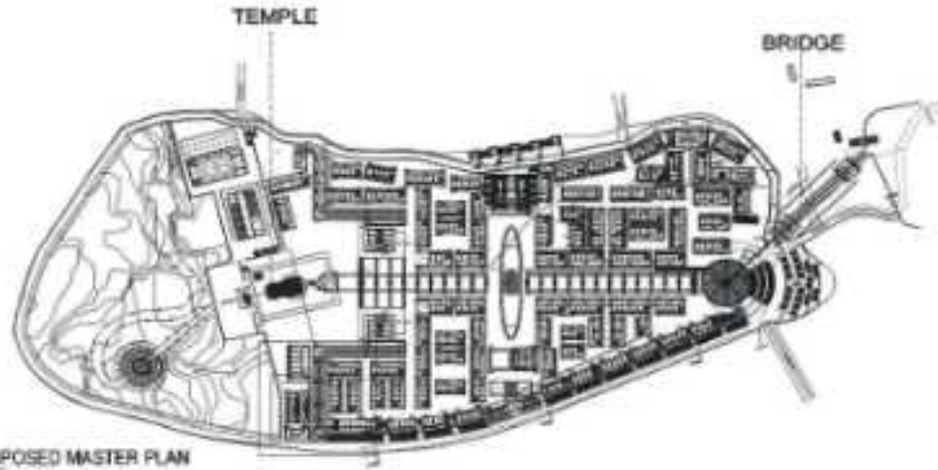
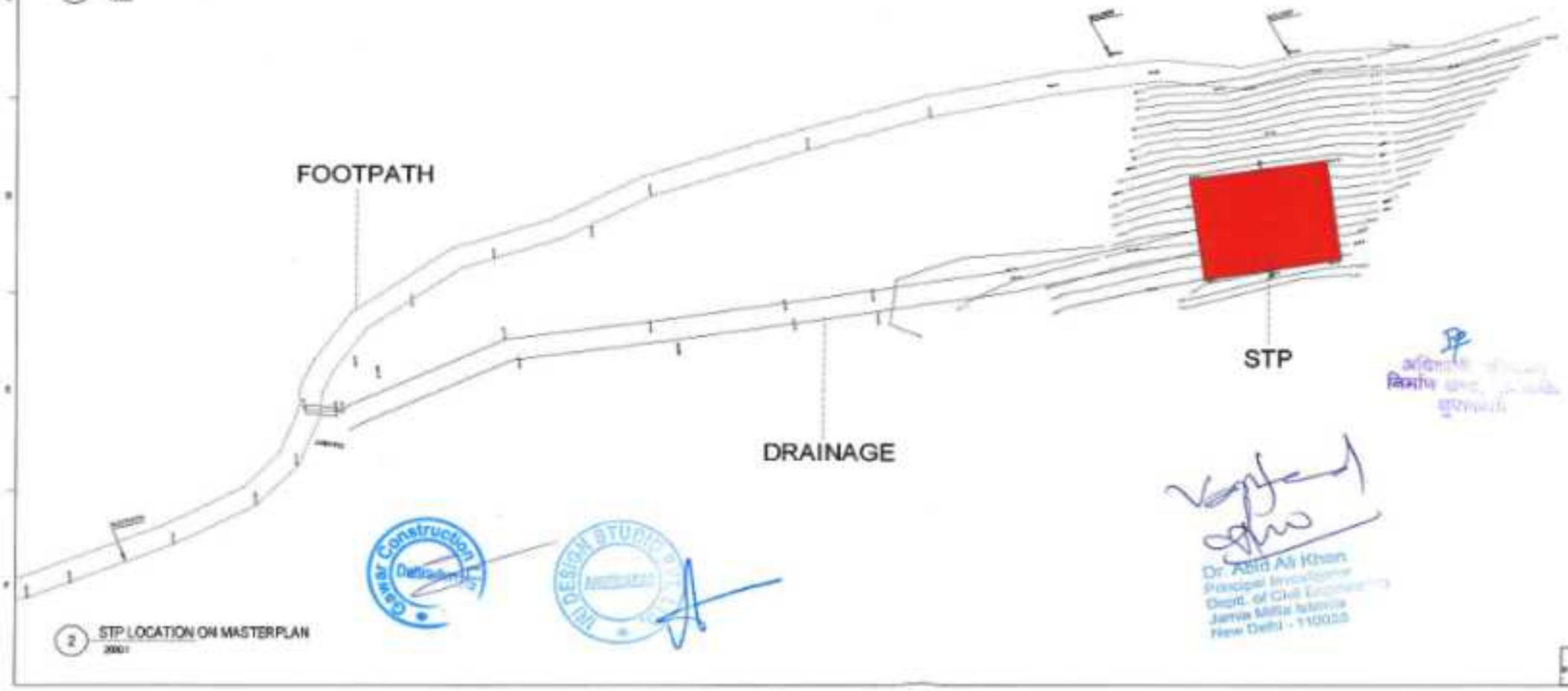
New Delhi - 110025

अतिरिक्त अभियन्ता
निर्माण खण्ड, पी.एच.ई.
गुप्तकाशी



1 OVERALL PROPOSED MASTER PLAN



2 STP LOCATION ON MASTERPLAN

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GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

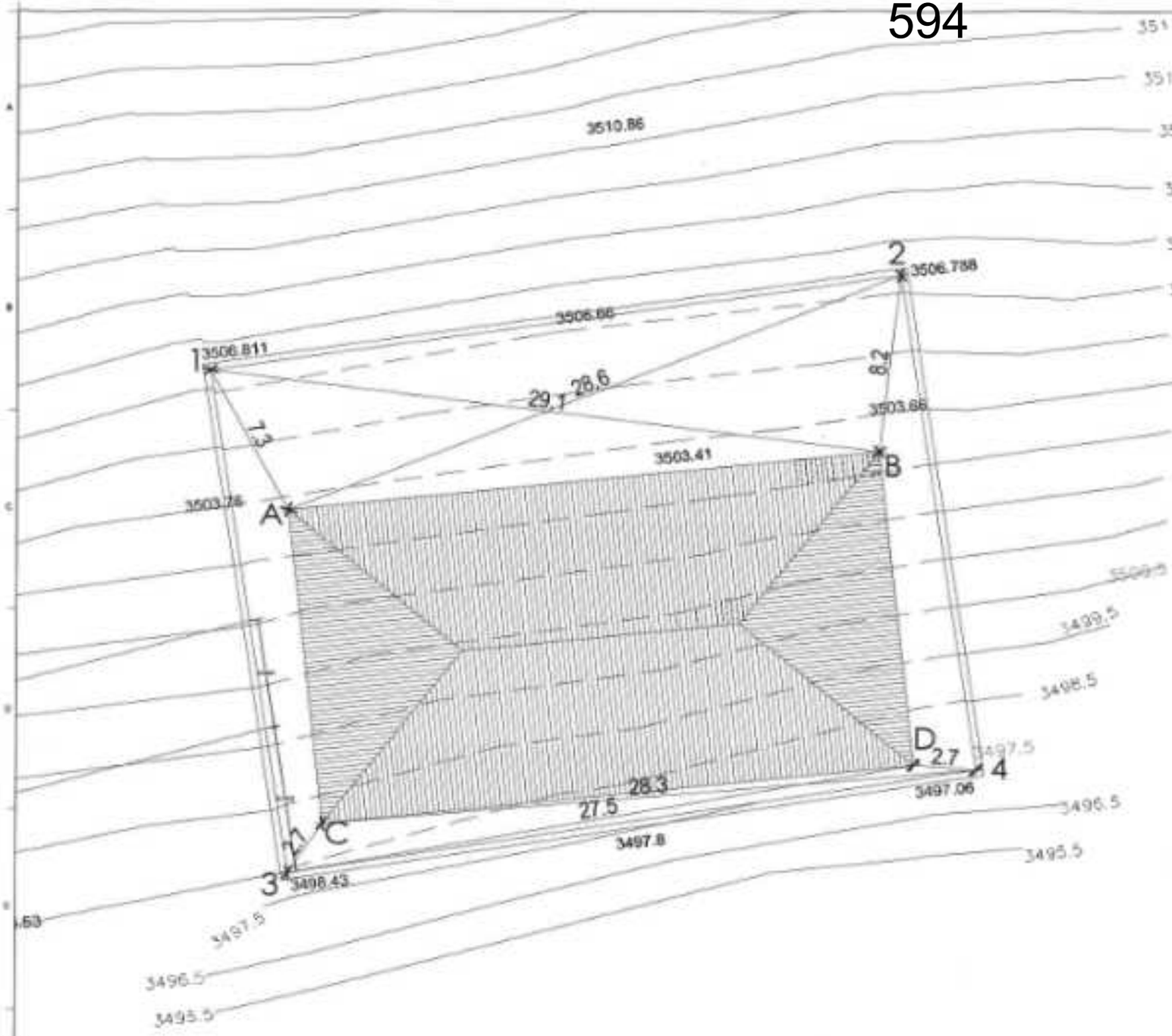
GOVERNMENT OF UTTARAKHAND

MASTER PLAN

SEWAGE TREATMENT PLANT LOCATION IN MASTERPLAN

A2

KR-DTP-C101



Dimensions:

A1 = 7.3 M C3 = 2.7 M
A2 = 28.6 M C4 = 28.3 M

B1 = 29.1 M D4 = 2.7 M
B2 = 8.2 M D3 = 27.5 M

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

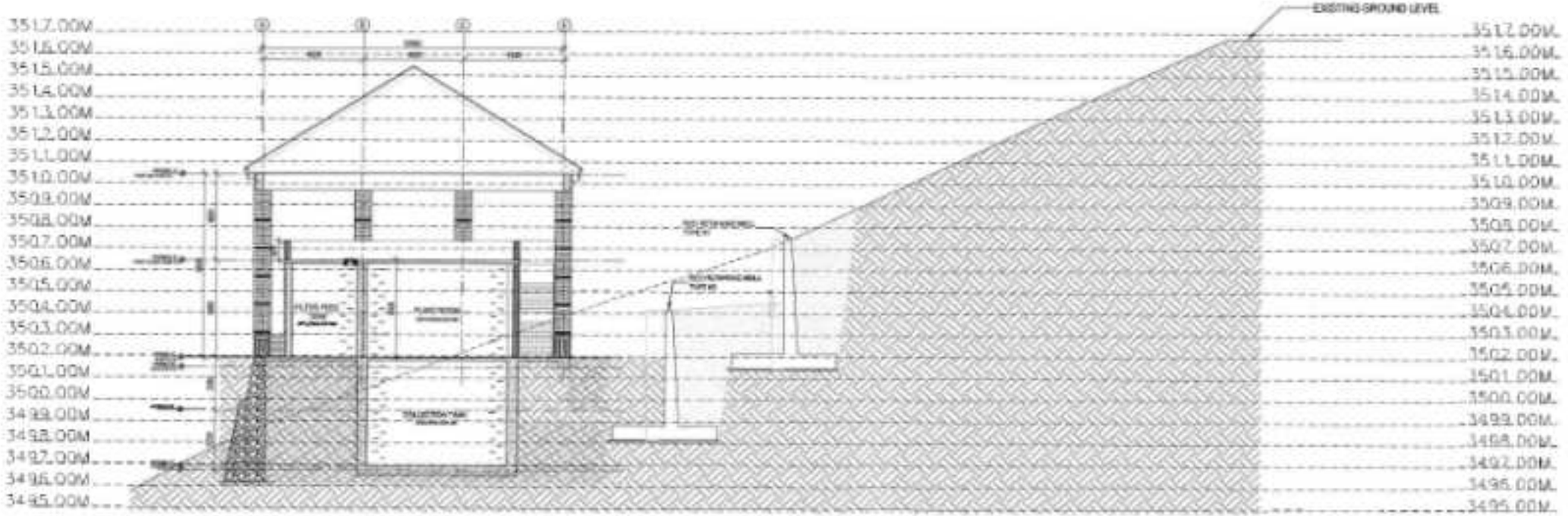
GOVERNMENT OF UTTARAKHAND

MASTER PLAN

SEWAGE TREATMENT PLANT
MARKING PLAN

KR-STP-C102

595



1 SECTION A
1:100

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SHISTRU

12025004

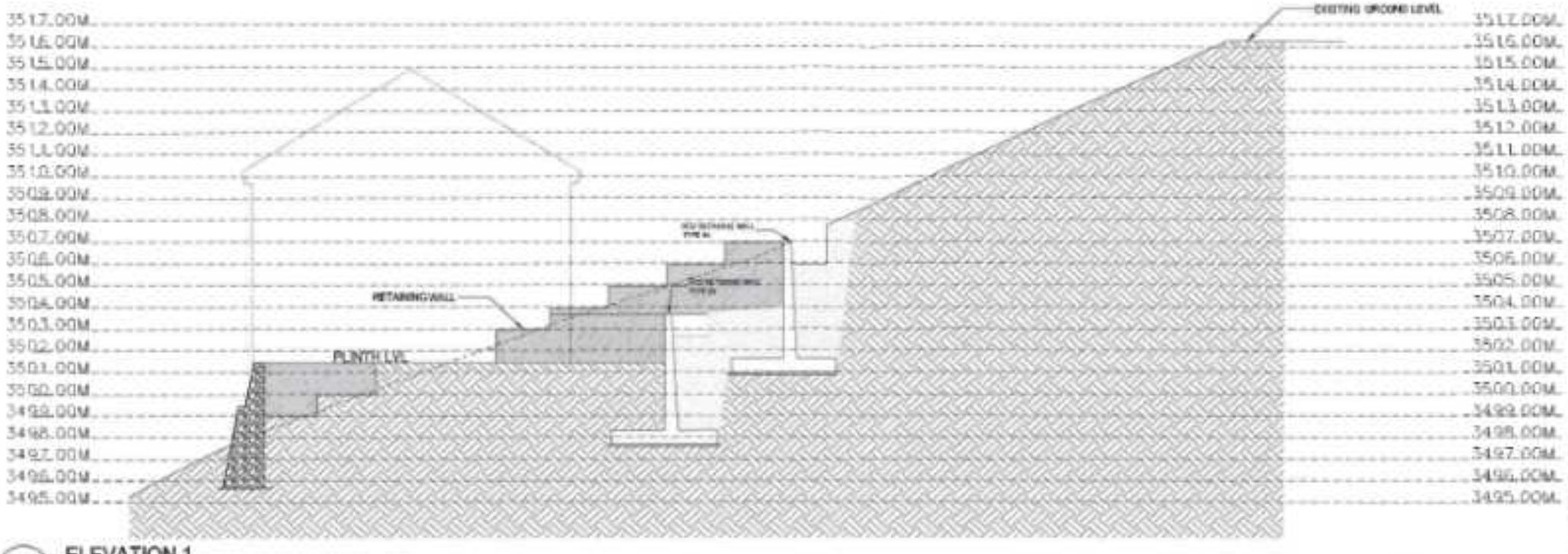
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT RETAINING WALL SECTION

A2

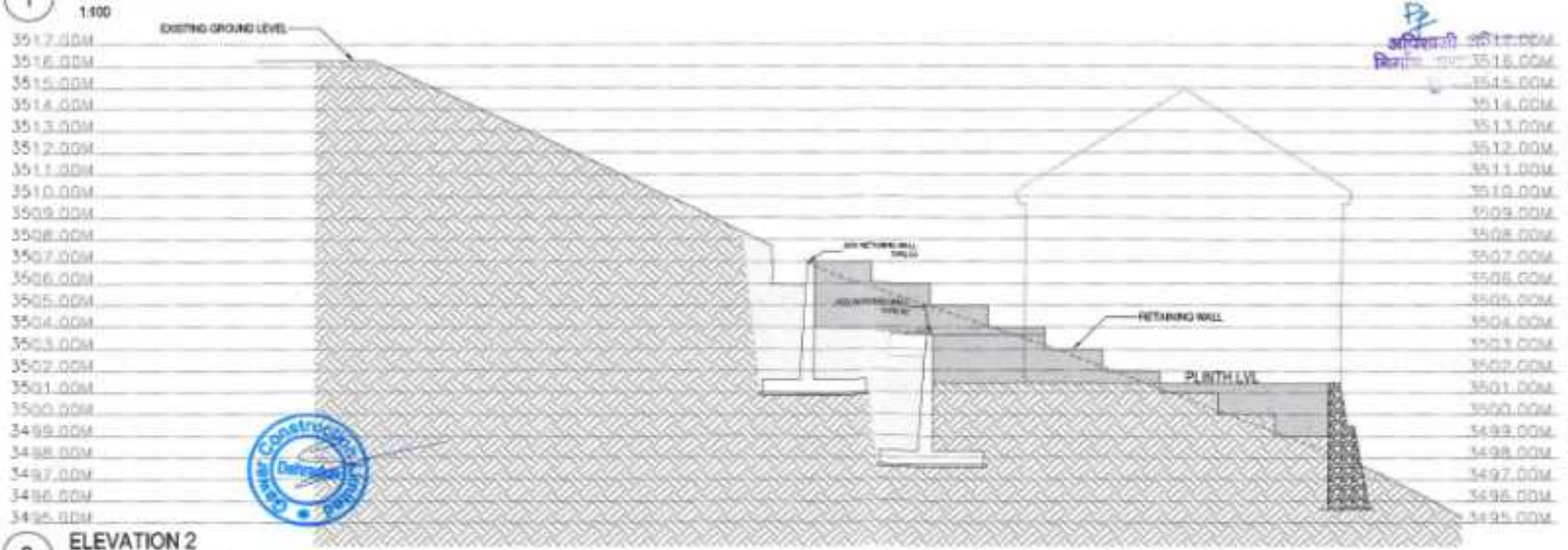
KR-STP-C102A

596



1 ELEVATION 1

1:100



2 ELEVATION 2

1:100

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

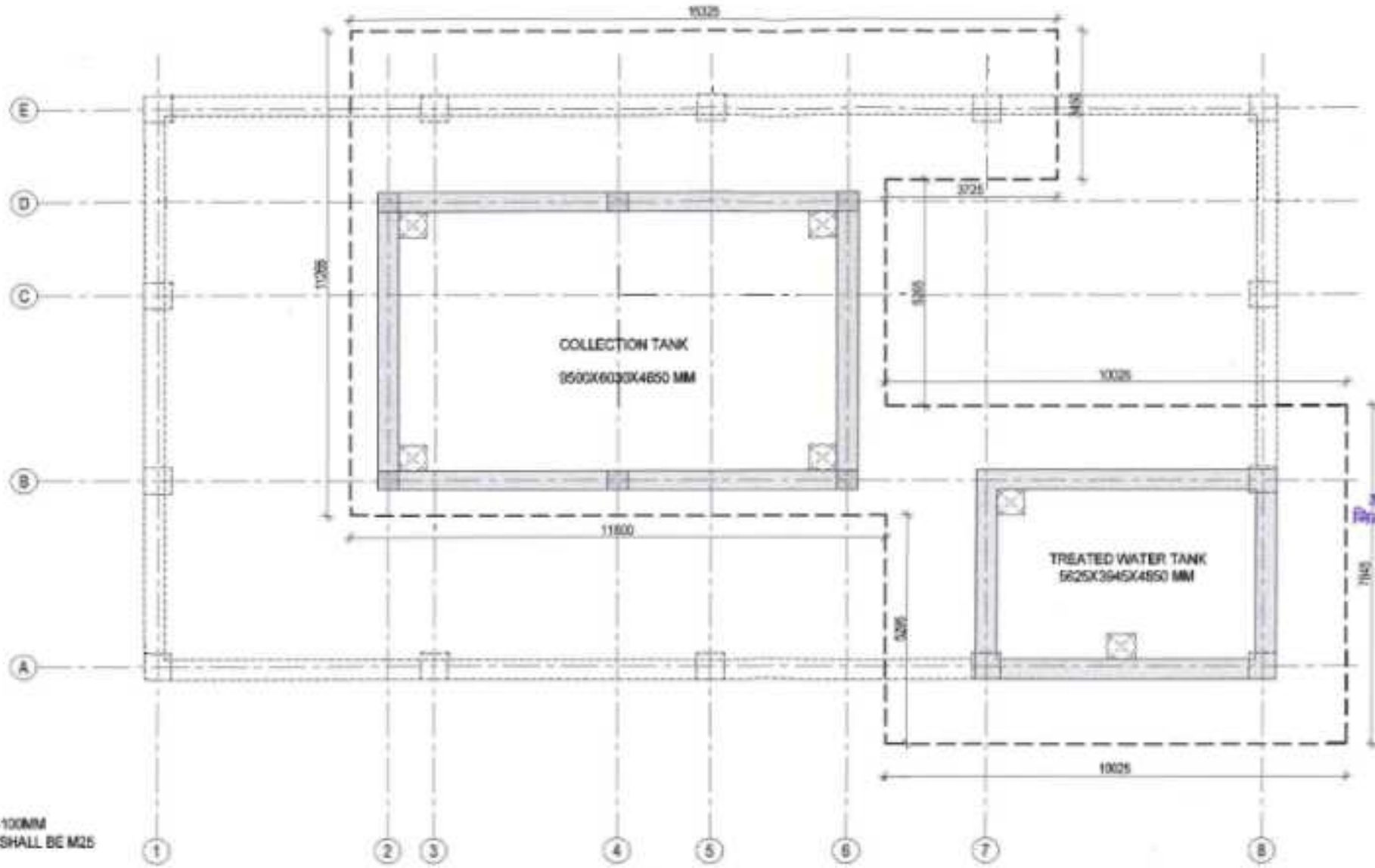
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
RETAINING WALL ELEVATIONS

KR-STP-C1029

597



PCC THICKNESS - 100MM
GRADE FOR PCC SHALL BE M25

1 PCC LAYOUT
1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

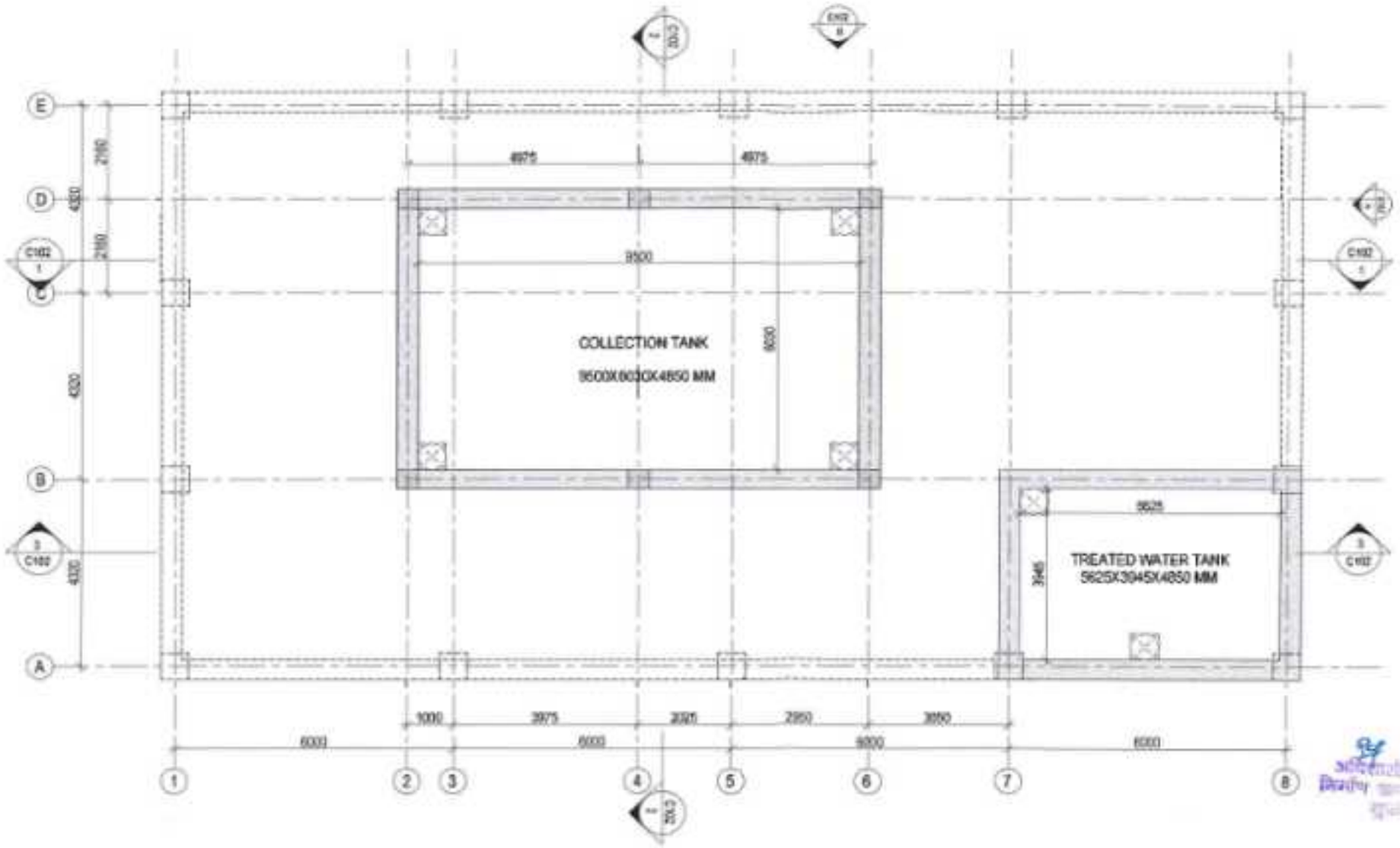
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
PCC LAYOUT

KR-STP-C103

598



1 PLAN AT -3000MM FROM GROUNDLEVEL
1:50

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

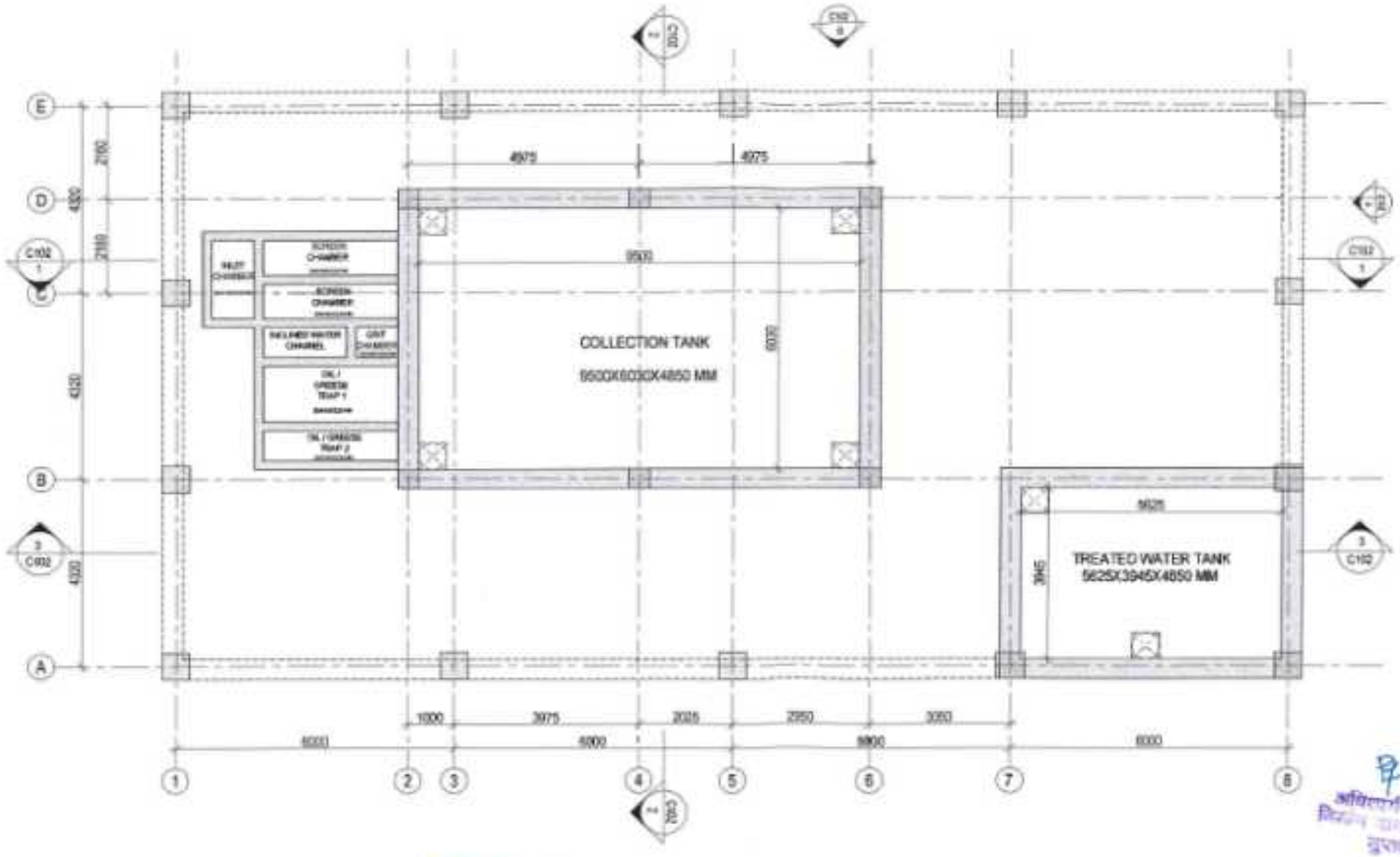
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT -3000 MM LEVEL

A2

KR-STP-C104

599



1 PLAN AT -600MM FROM GROUND LEVEL
1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

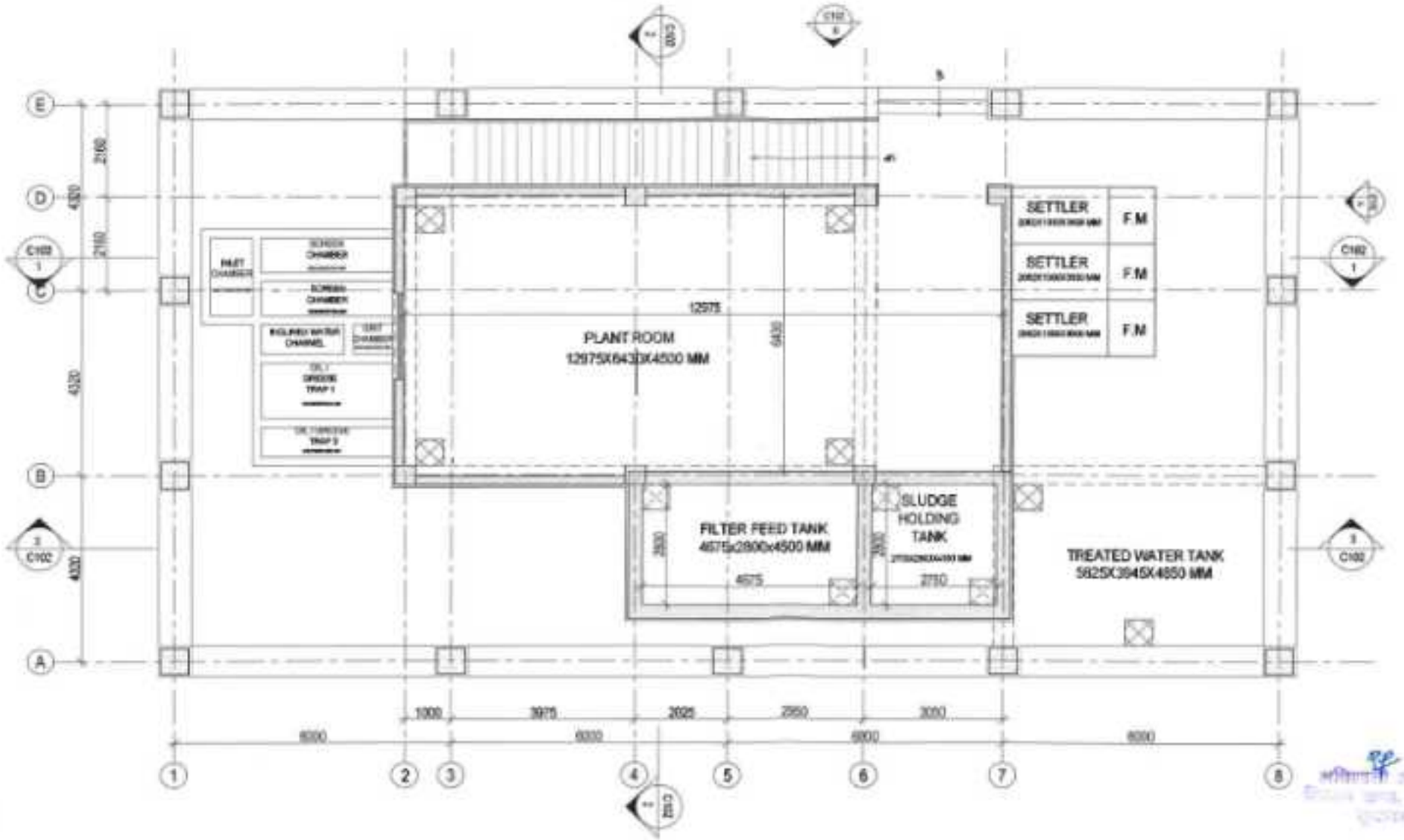
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT -600 MM LEVEL

A2

KR-GTP-C105



PLAN AT +1200MM FROM GROUND LEVEL
1:50

Construction Limited
Dehradun

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION
AND REDEVELOPMENT

GOVERNMENT OF
UTTARAKHAND

SEWAGE TREATMENT PLAN

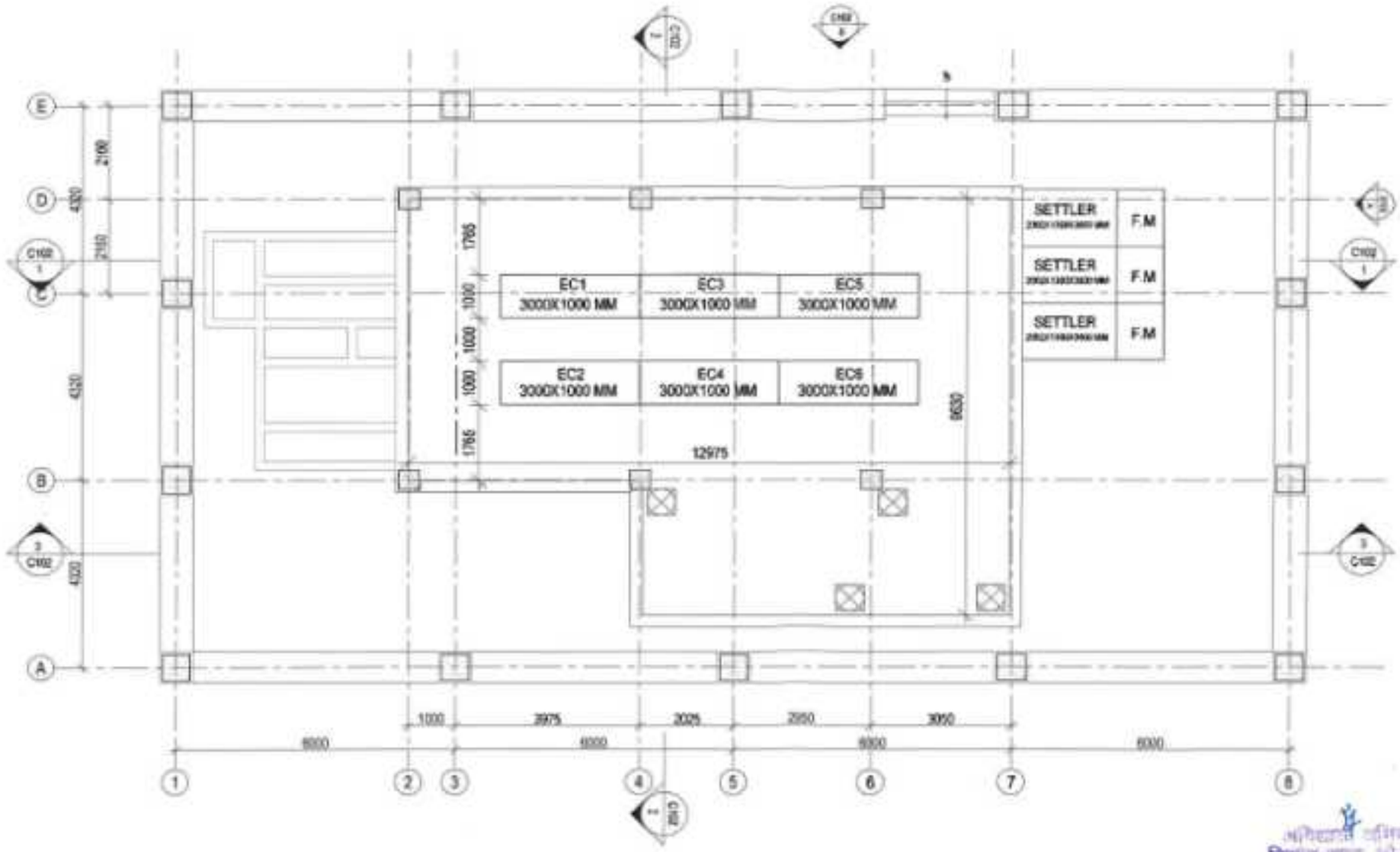
SEWAGE TREATMENT PLANT
FLOOR PLAN
AT +1200 MM LEVEL

A2

KR-STP-C106

अधिशासी अभियन्ता

601



1 PLAN AT +6000MM FROM GROUND LEVEL
1:50

GOOD FOR CONSTRUCTION

Key Plan

RISHIKESH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

CI2030804

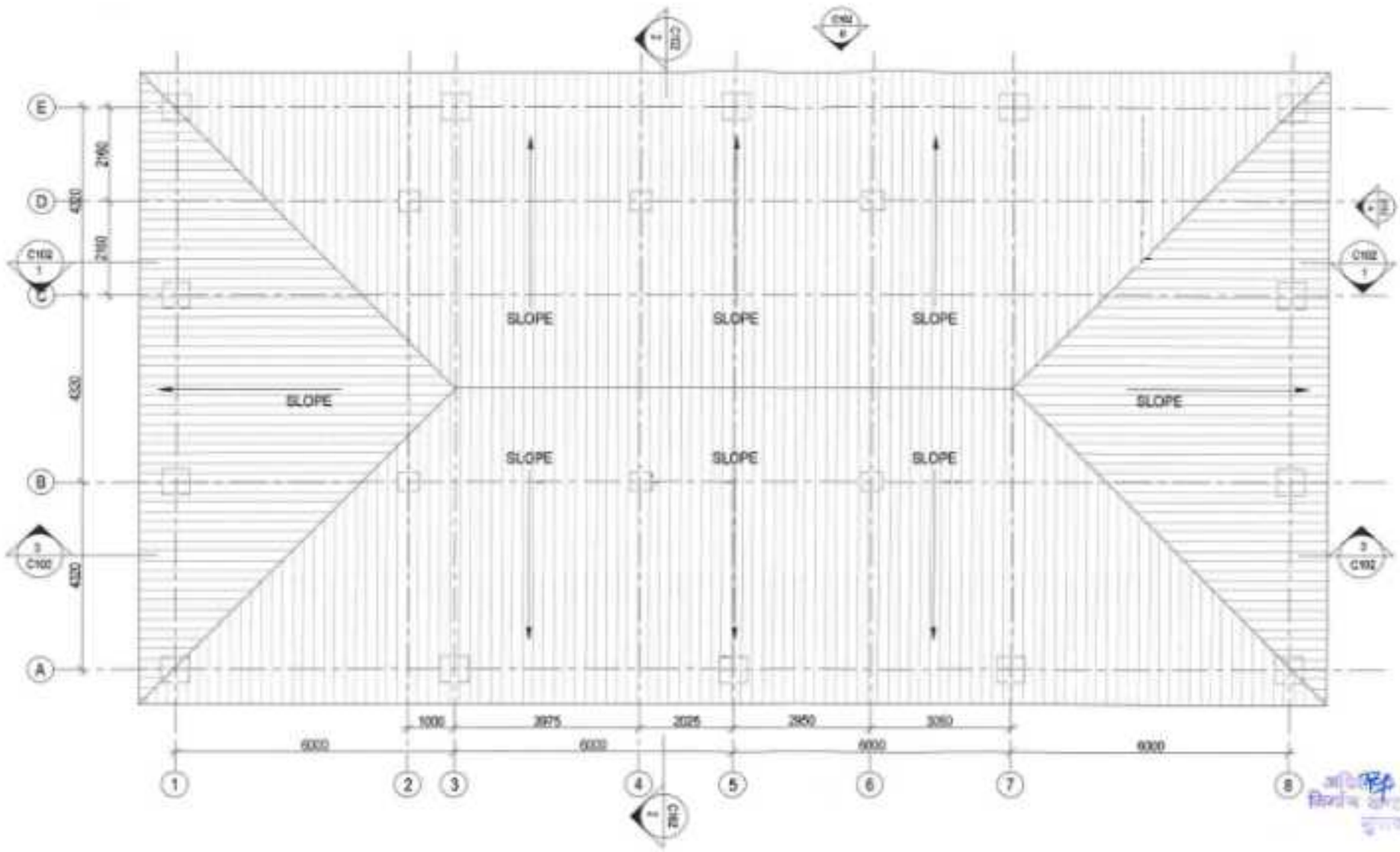
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
FLOOR PLAN
AT +6000 MM LEVEL

A2

KR-STP-C107

602



1 ROOF PLAN
1:50

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

GEOTECH

GEOTECH/2023/0824

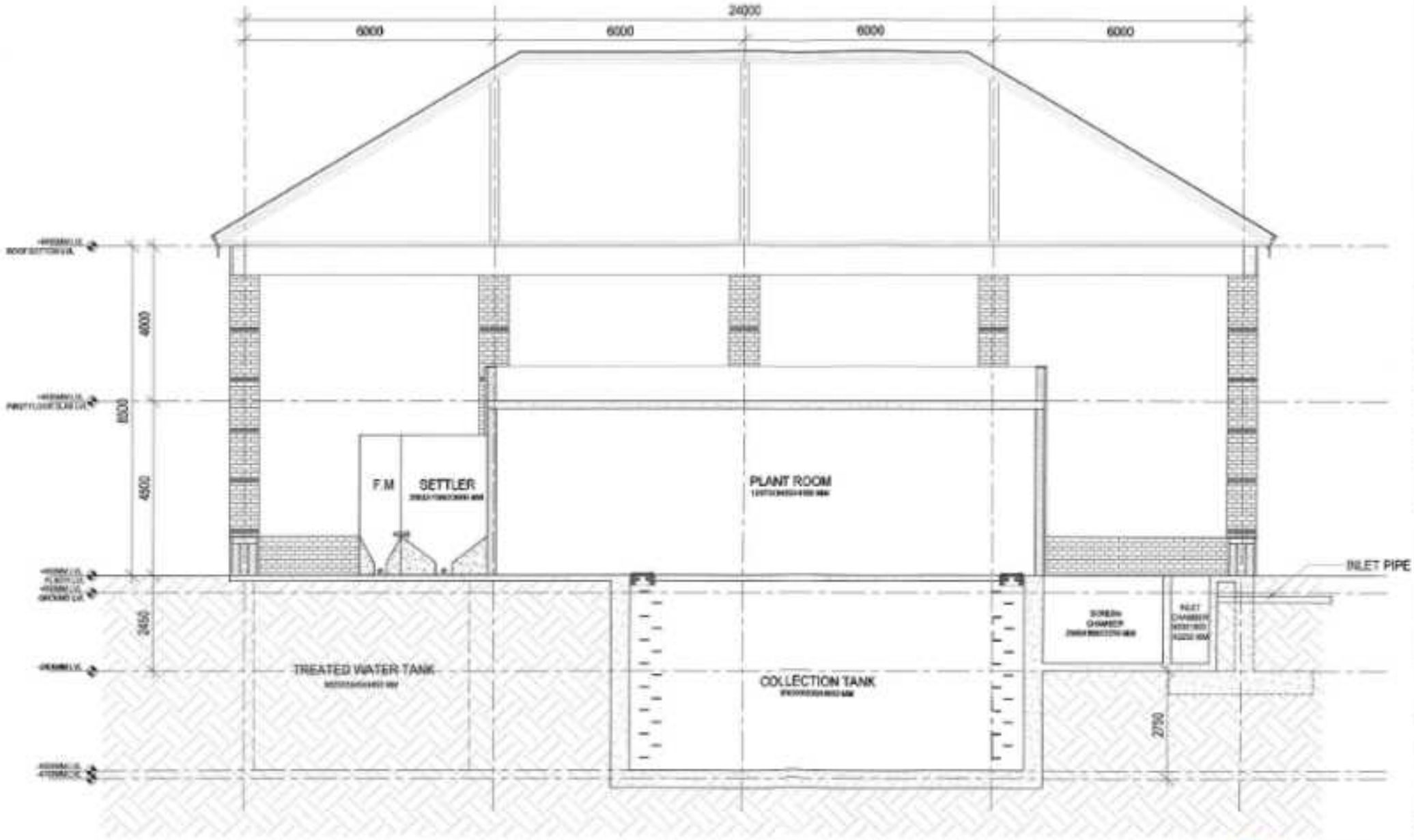
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
ROOF PLAN

A2

KR-STP-C108

603



1 SECTION - 1
1:50

Sewer Construction Limited Dehradun Permit

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

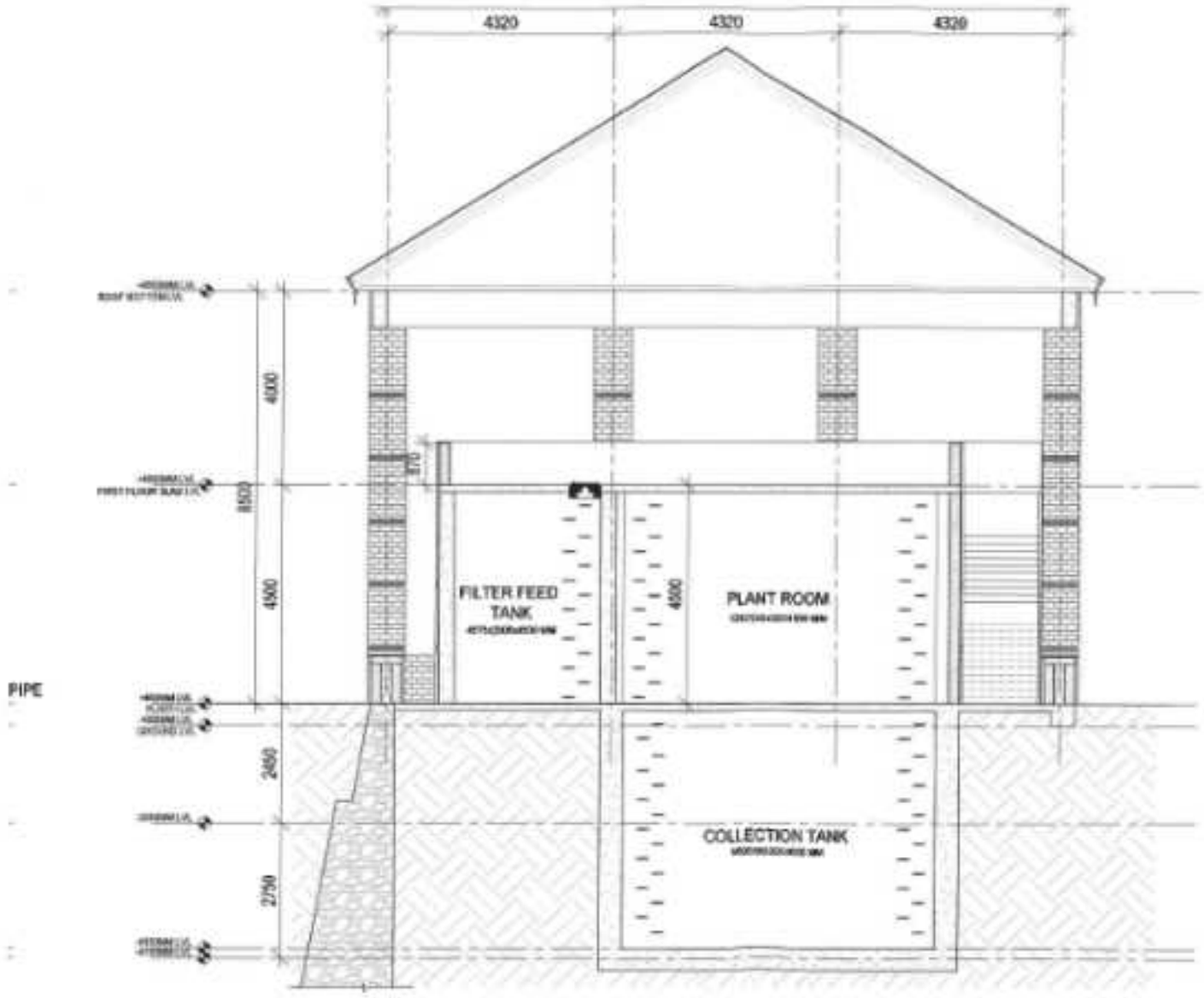
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
SECTION-1

KR-STP-C109

604



1 SECTION - 2
1:50

Sewer Construction

GOOD FOR CONSTRUCTION

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

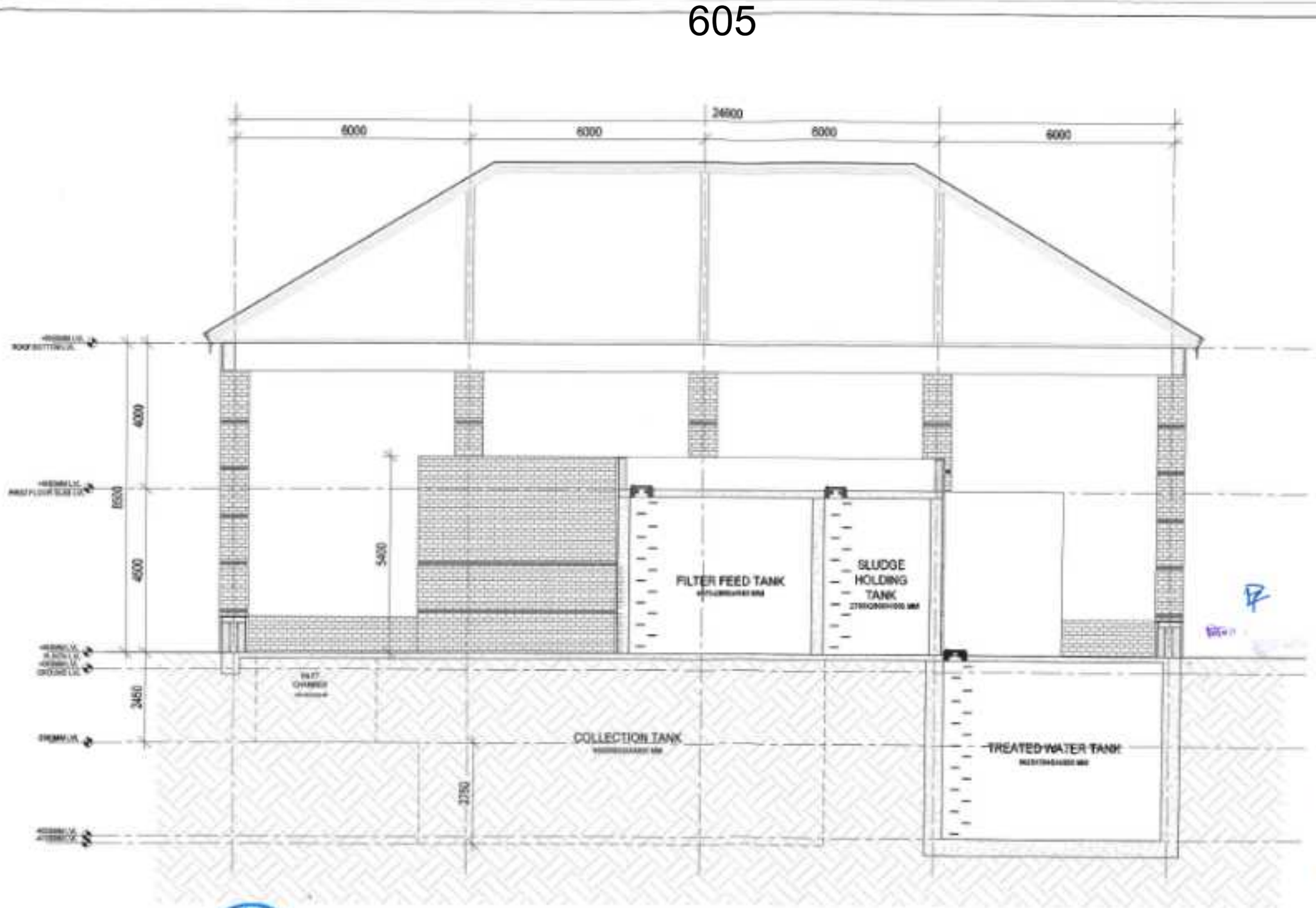
SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
SECTION-2

A2

KR-STP-C110

605



1 SECTION - 3
1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

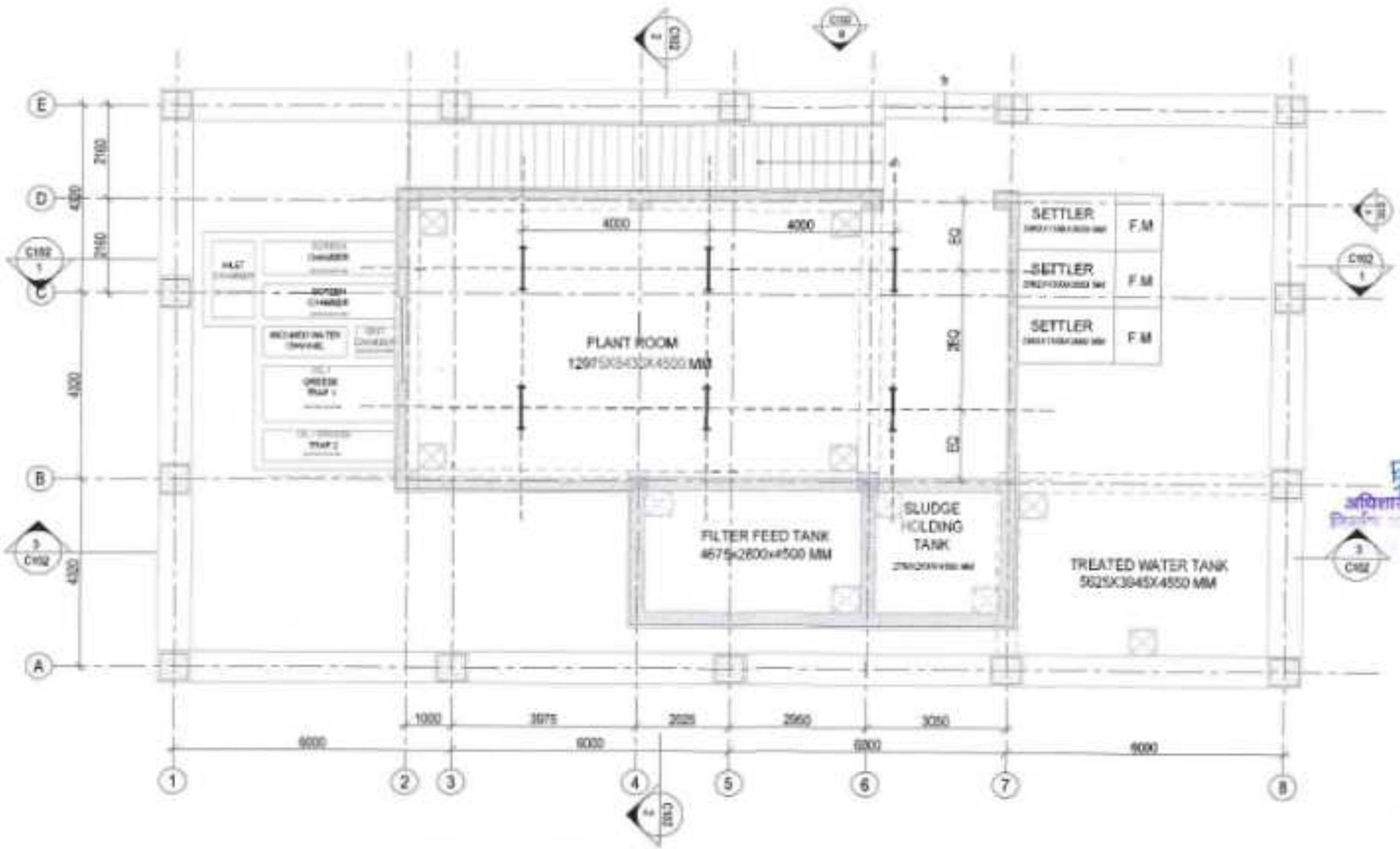
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

SEWAGE TREATMENT PLANT
SECTION-3

KR-STP-C111

606



1 FLOOR PLAN AT +1200 MM LEVEL
REFLECTED CEILING PLAN - LIGHTING INTENT

SCALE 1:50

GOOD FOR CONSTRUCTION

Key Plan

GANGA RIVER RESTORATION AND REDEVELOPMENT

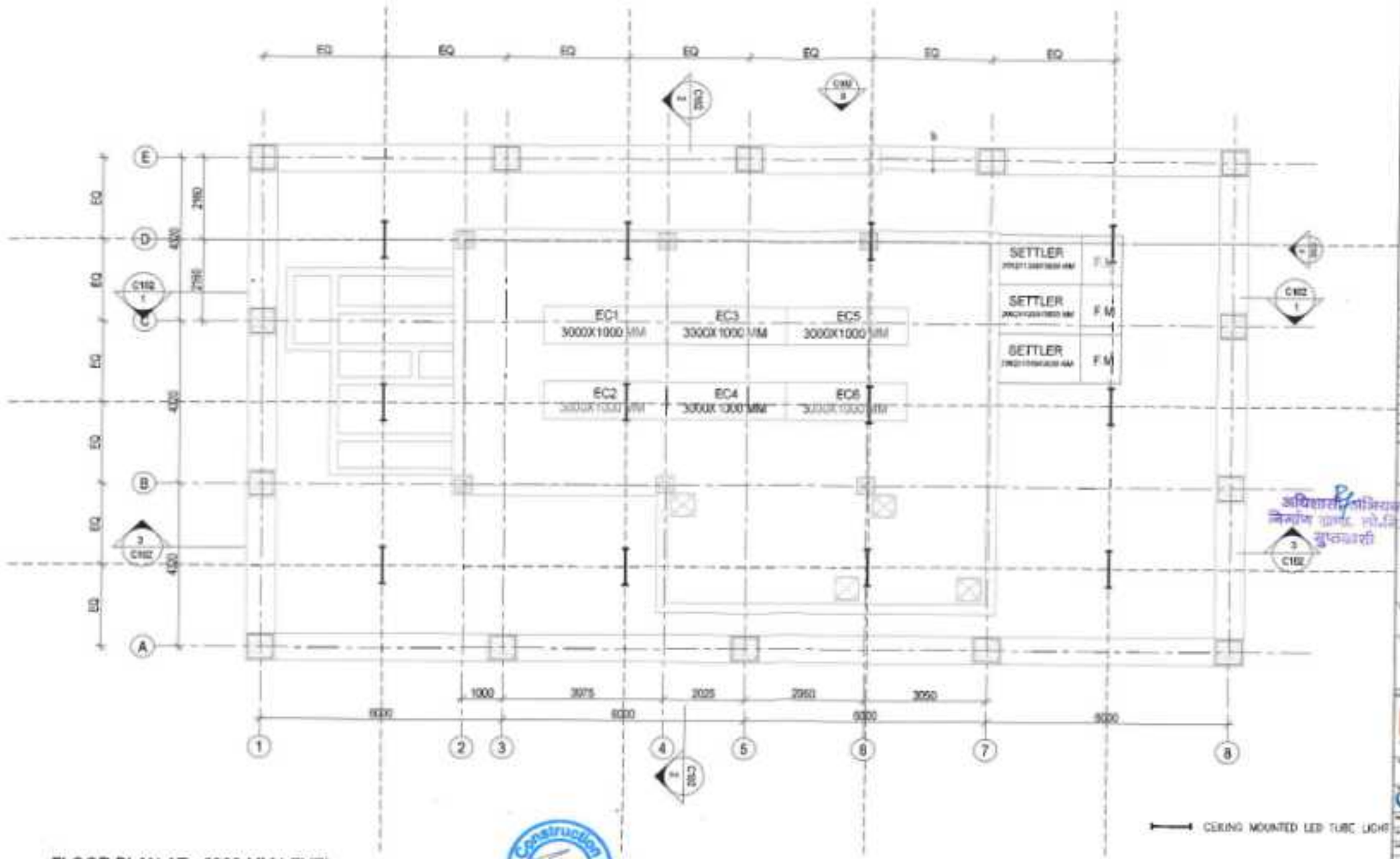
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

FLOOR PLAN AT +1200 MM LEVEL
REFLECTED CEILING PLAN
LIGHTING INTENT

A2

HR-STP-C112



1 FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN - LIGHTING INTENT
SCALE 1:50

GOOD FOR CONSTRUCTION

KEDARNATH REDEVELOPMENT AND REDEVELOPMENT

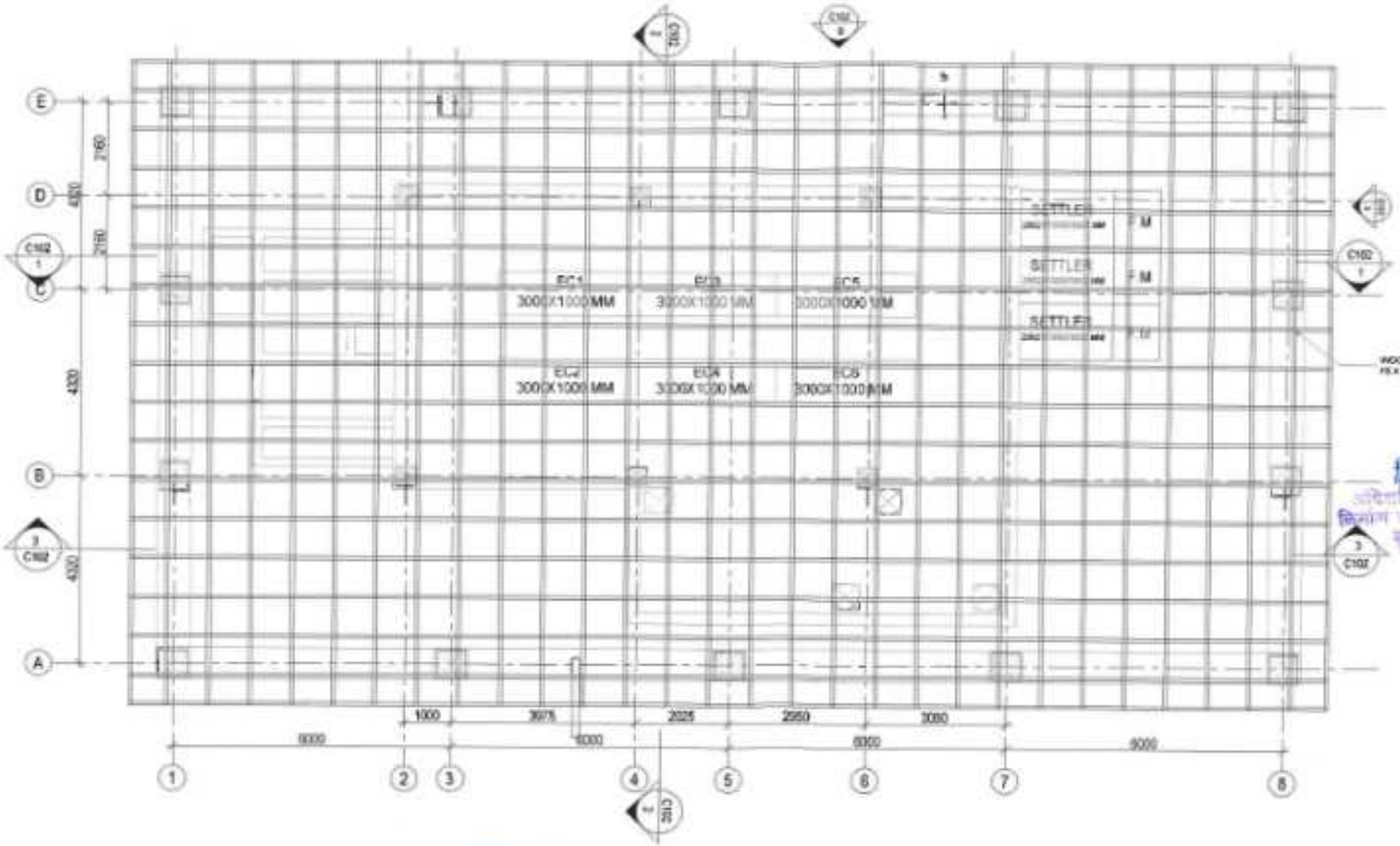
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN
LIGHTING INTENT

KR-STP-C113

608



FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN - RAFTER GRID

1

SCALE 1:50

GOOD FOR CONSTRUCTION

KEDARNATH RESTORATION AND REDEVELOPMENT

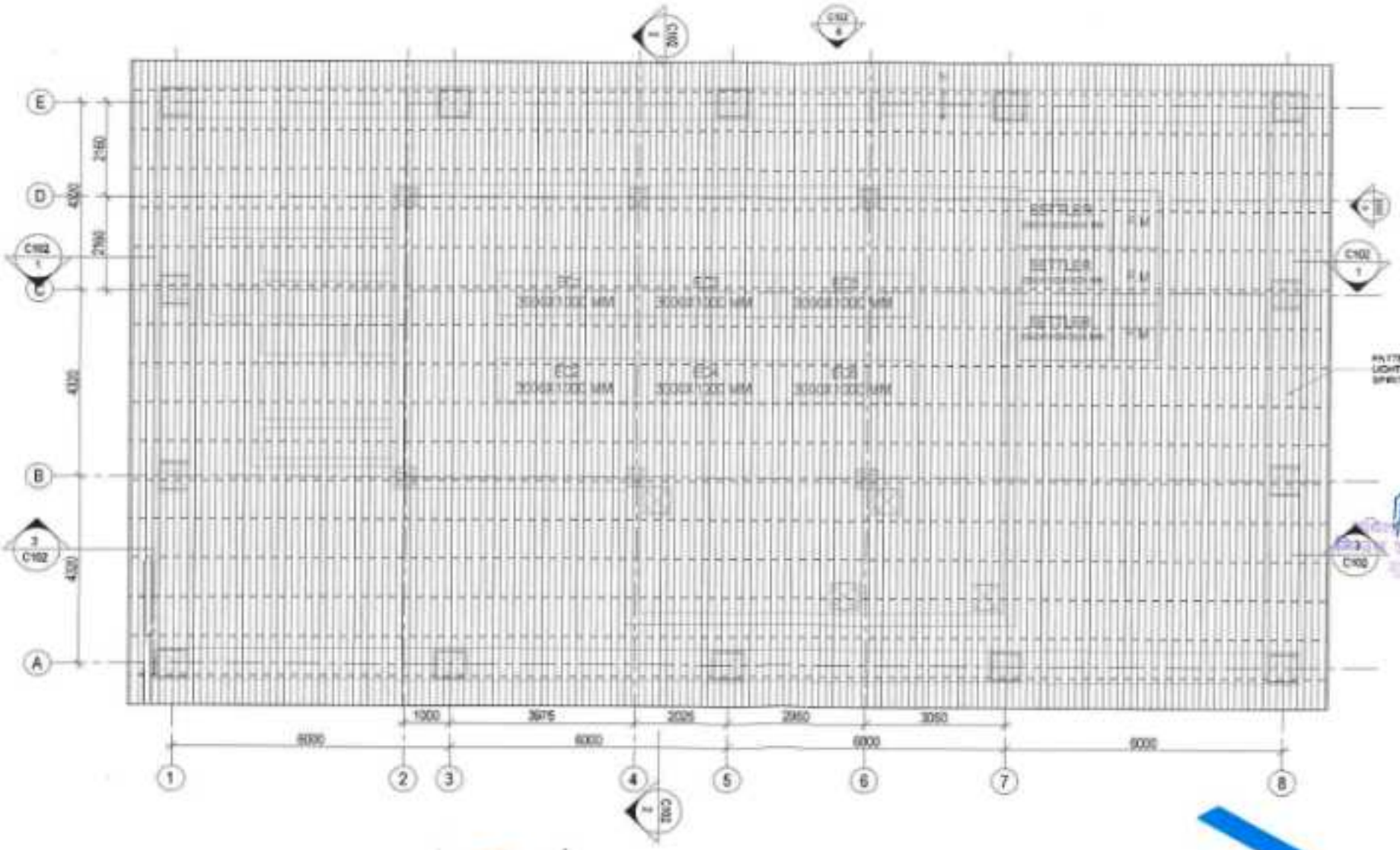
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLAN

FLOOR PLAN AT +6000 MM LEVEL
REFLECTED CEILING PLAN
RAFTER GRID

KR-STP-C114

609


E
D
C
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4
5
6
7
8
C102
2150
4000
2950
4320
1000
3975
2025
2950
3050
8000
8000
8000
8000
C302
C103
C104
C105
C106
C107
C108
C109
C110
C111
C112
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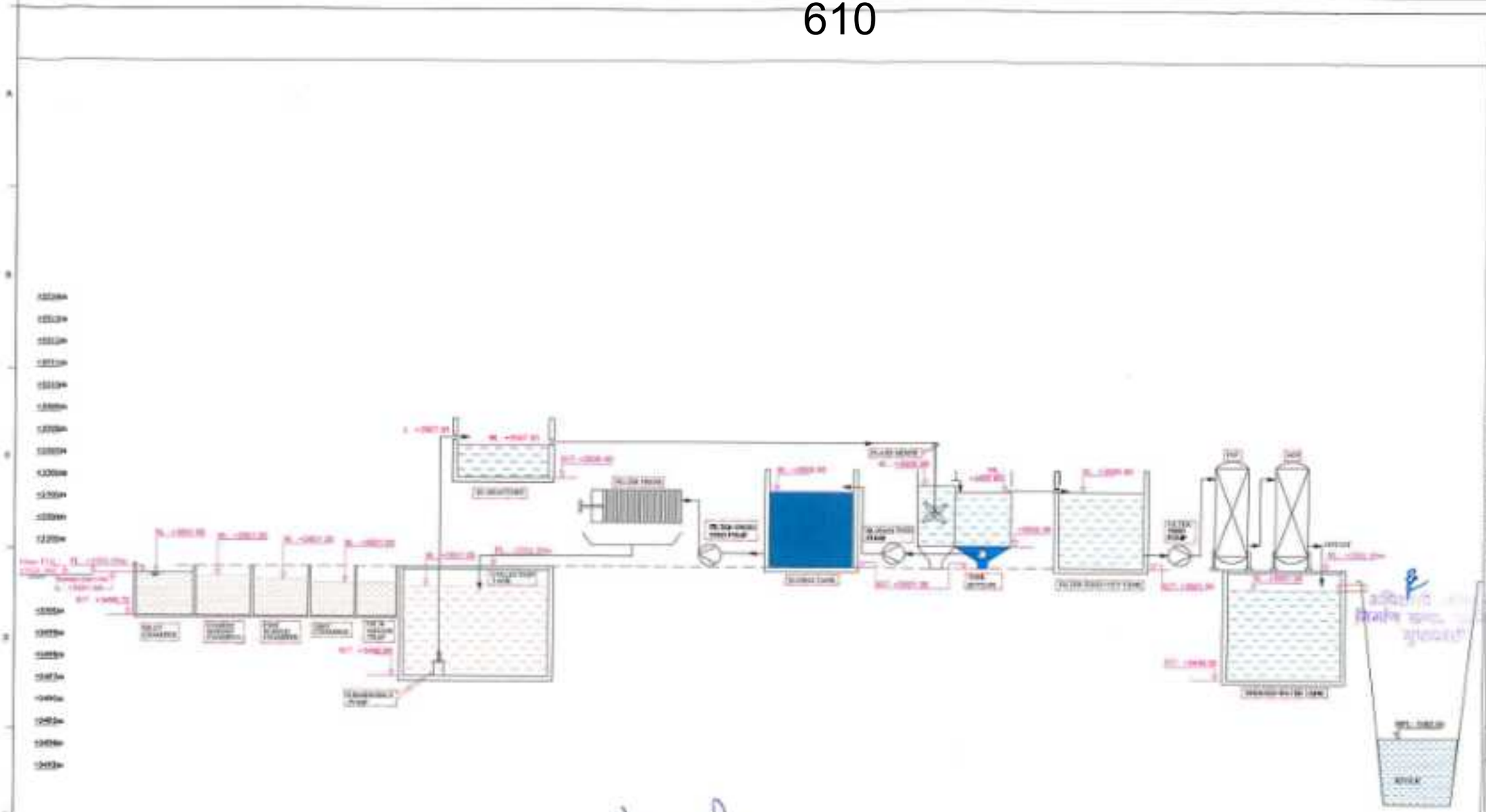
C142



ABBREVIATION
FGL : FINISH GROUND LEVEL
FB : FREE BOARD
LD : LIQUID DEPTH
WL : WATER LEVEL
TOW : TOP OF WALL
BOU : BOTTOM OF UNIT

ABBREVIATION
EGL : EXISTING GROUND LEVEL
BOT : BOTTOM OF TANK
PL : PLINTH LEVEL
IL : INVERT LEVEL

REFERENCE DRAWINGS & DOCUMENTS/DATE
1. ENVIRONMENTAL DESIGN CALCULATION
2. HEAD LOSS CALCULATION

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KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

600KLD STP ELECTROLYSIS TECHNOLOGY, UTTRAKHAND

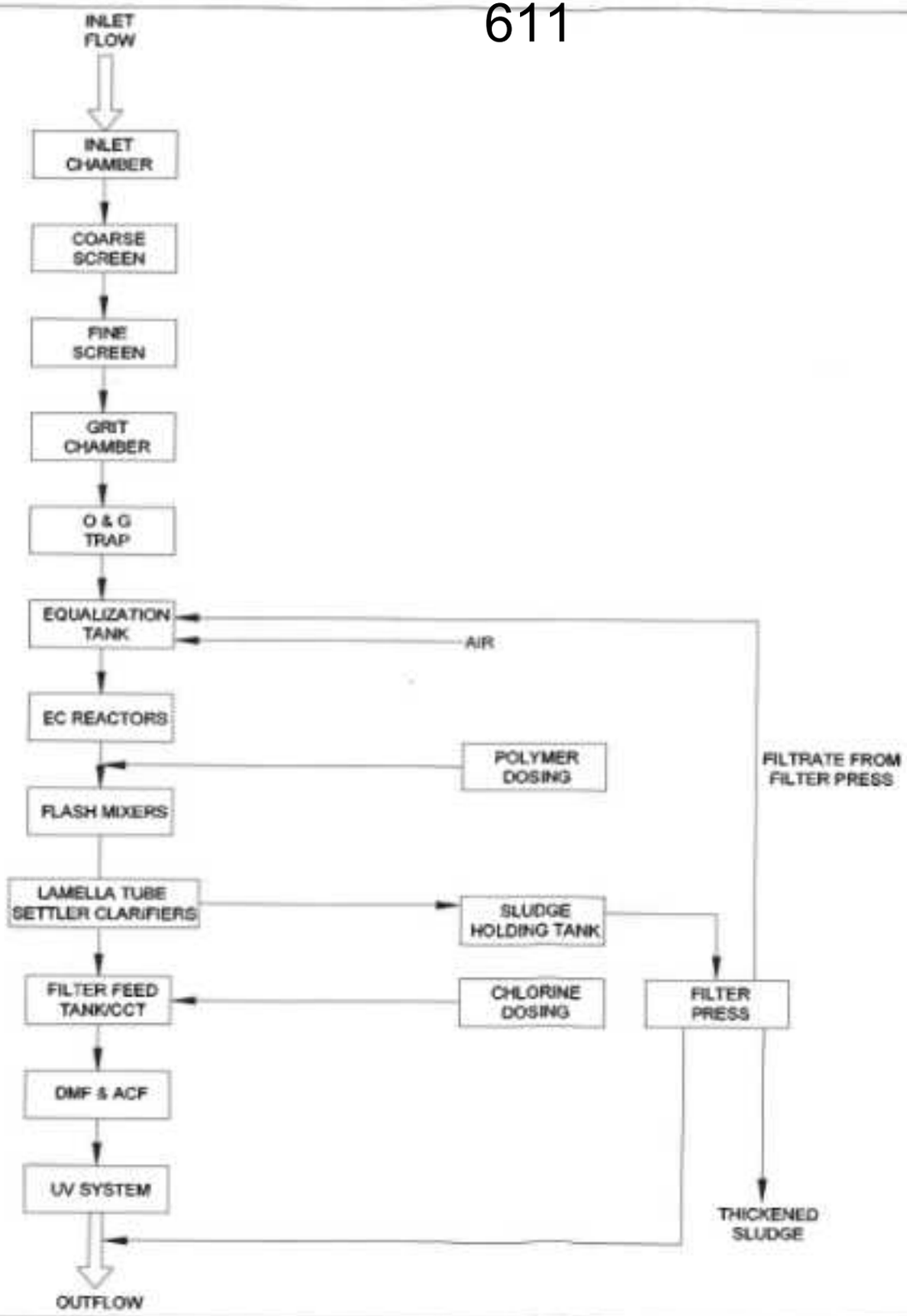
600 KLD STP

HYDRAULIC FLOW DIAGRAM

A2

STP600KLDUTRKHNDKVR4006

611



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New Delhi - 11

Construction Limited
Dehradun

Key Plan

KEDARNATH RESTORATION AND REDEVELOPMENT

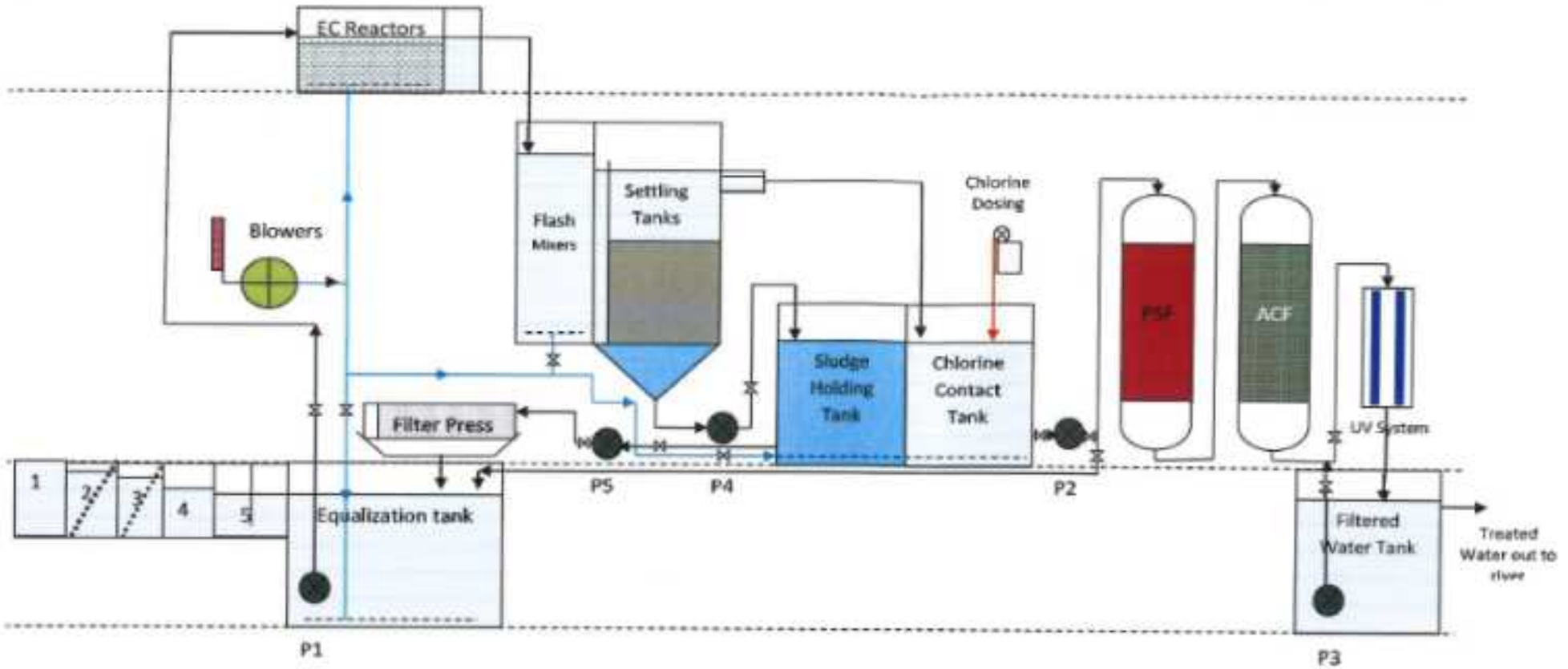
GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

60KLD STP (ELECTROLYSIS TECHNOLOGY)
UTTRAKHAND
60 KLD STP
PROCESS FLOW DIAGRAM

A3

STP60KLDUTTRAKHDKYH008



Legends	Item Name	Description	Qty
1	Inlet Chamber	Civil, Size: 900x1800x1500mm	1 Nos
2	Coarse Screen Chamber	Civil, Size: 2700x800x1500mm	1 Nos
	Coarse Screen	SS, Size 600x2000mm, with frame, 10mm dia hole size, angle of inclination 60 degree	2 Nos
3	Fine Screen Chamber	Civil, Size: 2700x800x1500mm	1 Nos
	Fine Screen	SS, Size: 600x 2000mm, with frame, 5mm hole size, angle of inclination 60 degree	2 Nos
4	Grit Chamber	Civil, Size: 900x900x1500mm	1 Nos
5	Oil & Grease Chamber	Civil, Size: 900x1800x1500mm	1 Nos
	Equalization Tank	Civil, Size: 9500x4000x4350+500mm FB, HRT	1 Nos
P1	Sewage Transfer Pumps	Submersible cutter Pump, 30M3/Hr, 15M head, 5.5 KW, KBL	3 Nos
	pH Correction System	Dosing pump, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Aslo LMI	2 Nos
	Electrolyte Dosing System	Dosing pump, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Aslo LMI	2 Nos
	Electrocoagulation Reactor	MSFRP inside, MSFP outside, size: 2500x1000x1800mm, No. of electrodes 52 Nos, 12V, DC	4 Nos
	Flash Mixer	MSFP, Size: 1000x1000x2000mm, agitation thru air	3 Nos
	Poly Electrolyte Dosing System	Dosing pump, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Aslo LMI	4 Nos
	Settling Tanks	MSFP, Size: 2000x2000x1900+1800 slant+500mm FB, Surface Area 16.8M2	3 Nos
	Chlorine Dosing System	Dosing pump, 0 to 10 lph, 4 bar, Dosing tank 100 Ltr, HDPE, Aslo LMI	2 Nos
	Filter Feed/Cl2 Contact Tank	Civil, Size: 4675x2000x4000+500mm FB, HRT 90 minutes	1 Nos

P2	Filter Feed Pumps	Horizontal Centrifugal, 30M3/Hr, 28M Head, 5.5KW, KBL	3 Nos
	Pressure Sand Filter	MSFP, Size, HCS 1800Dia2000mm, Media quantity 3900 Kgs, approx., graded sand	1 Nos
	Activated Carbon filter	MSFP, Size, HCS 1800Dia2000mm, Media quantity 1400 Kgs, approx., GAC	1 Nos
P3	Filter Backwash Pumps	Submersible Pump, 45M3/Hr, 15M Head, 3.7KW, KBL	2 Nos
	UV sterilizer Unit	SS-316, 30M3/Hr, UV Dose 40000uW-sec/cm2, 200V AC, 1.5KW	1 Nos
	Filtered Water Tank	Civil, Size: 3625x3625x4350+300mm FB, HRT 2Hr 30minutes	1 Nos
P4	Sludge Transfer Pump	Open Impeller Pump, 15M3/Hr, 15M Head, 3.7KW, KBL	2 Nos
	Sludge Holding Tank	Civil, Size: 2750x2800x4000+500mm FB, HRT 1 hour	1 Nos
P5	Filter Press Feed Pump	Screw Pump, 3M3/Hr, 50M Head, SS shaft, 3.7 KW, KOSO	2 Nos
	Filter Press	PP Recessed plates, 24"x24"x23 Nos, Sludge holding capacity 250 Ltr, Hydraulic	1 Nos
	Valves	Varied types, valed sizes depending upon the use, plate size etc	1 Nos

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River Construction Ltd.

KEDARNATH RESTORATION AND REDEVELOPMENT

GOVERNMENT OF UTTARAKHAND

SEWAGE TREATMENT PLANT

400KLD STP-ELECTROLYSIS TECHNOLOGY
UTTRAKHAND
400 KLD STP

PROCESS FLOW DIAGRAM

STP400KLDUTTRKHNDKVH006

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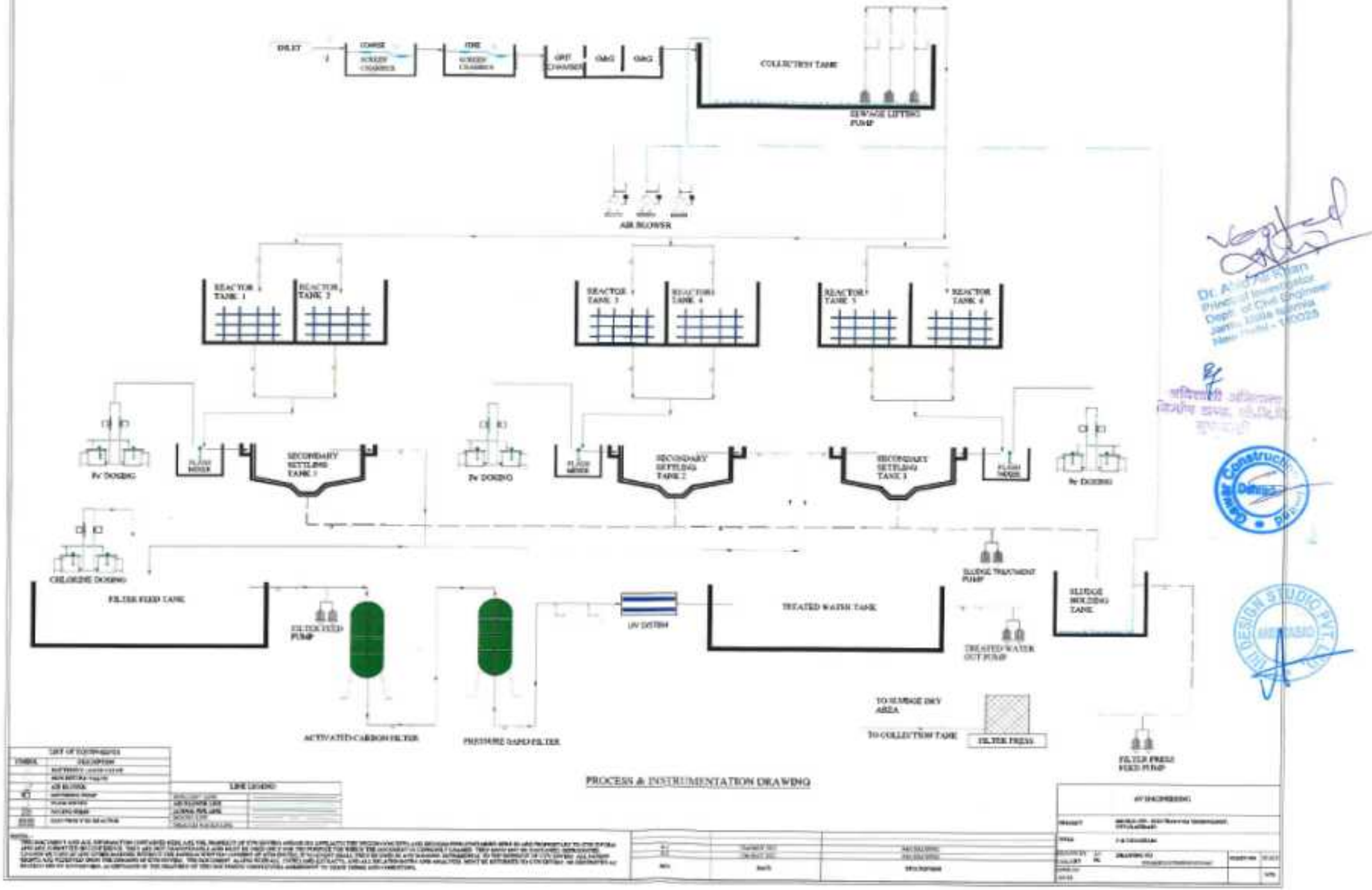

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Sewer Construction Delhi

M/S DESIGN STUDIO PVT. LTD.

SECTION VII

CATALOGUES AND BROCHURES

Gawar Construction Limited Dehradun

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7.1 Oil Skimmer

UNIVERSAL TECH TRADE PVT. LTD.

TEST CERTIFICATE

Product : Oil Skimmer		**INVOICE NO. : UTT/0573/21-22**
		DATE : 25-09-21
		CLIENT : Meridian Micro Technology
S.NO	**Description**	
1	Make	Universal
2	Model/Size	UTT-OS100
3	Quantity	1Nos.
4	Size of Belt	4"x 2400 M End Less
5	MOC	Roller in GI & Other Parts in MS.
6	RPM	48
7	Type	Horizontal Type Gear
8	Motor	0.18kw/1450Rpm/Flanged
9	Power Supply	3 Phase/415Volts
10	Motor Make	CG
11	Oil Removal Capacity	50 lph in pure oil
12	Connection Size:	1"

UNIVERSAL TECH TRADE PVT. LTD. Plot No. 45 First Floor, Peera Garhi New Delhi-87

IAS-ANZ

Authorised Dealer : wilo Mather+Platt Rato pumps SGI

Deals In : Water Supply Pump, Sewage Pump, Screw Pump, Dosing Pump, Filter Press, Centrifuge, Oil-Skimmer, U.V. System, Bio-Pac Media, Tube Deck Media, Air Diffusers & Agitator etc.

Regd. Office : G-12/6, Laxmi Park, Nangloi, New Delhi - 110041 | Works : G-555, Adhyapak Nagar, Nangloi, New Delhi - 110041

Ph. : 011-65689500 Mob. : 9971173988, 9810573576 E-mail : universaltechtrade@gmail.com www.universaltechtrade.com

Gawar Construction Limited Dehradun

7.2 Air Blower

ROOTS BLOWERS

AIR COOLED SERIES

EVEREST TWIN LOBE ROTARY AIR COMPRESSORS

A complete range of Standard Blowers is available for flow rates from 25 m3/hr through 7,000 m3/hr in single stage and upto any capacity in parallel configurations, for working pressures upto 1 kg/cm2. They are available as total package units, ready to install or as bare blower units for replacement.

Our technology is so flexible, we can custom manufacture "Special Air Blowers" by alloying and cross linking diverse designs to suit individual requirements and import substitutes.

STANDARD DESIGN AND CONSTRUCTION FEATURES

- 100% oil free air delivery.
- Factory engineered, factory guaranteed, superior product.
- Alloy steel hardened and ground timing gears.
- Anti-friction bearings.
- Rotary oil sealings.
- Rigid one piece CI casing and side plates.
- Horizontal and vertical configurations available.
- Easy rotor timing setting.
- No vanes, valves or rings to wear.
- Large inlet and outlet connections for minimum loss.
- Improved volumetric efficiency and reduced operating temperatures.
- Alloy steel toughened shafts ground to close tolerances.

APPLICATIONS

- ***Water Treatment Plants*** For backwashing of filter/mixed beds.
- ***Effluent Treatment Plants*** For diffused aeration and agitation of effluent.
- ***Cement Plants*** For Blending, Aeration, Fluidization, Conveying.
- ***Aquaculture*** For maintaining the dissolved Oxygen level.
- ***Chemical Plants*** For supplying of process air.
- ***Electroplating Plants*** For Oil Free air agitation of electrolyte.
- ***Paper Plants*** Knife edge coating, Drying, Conveying, Vacuum pickup.
- ***Yarn Drying*** Vacuum/Pressure Drying of Yarn.
- ***Vacuum Moulding*** For creating quick vacuum.
- ***Polyster Chip Conveying & drying*** For transfer of polyster Chips and other similar materials.
- ***Bag Filters*** For reverse cleaning of Filter bags.
- ***Pneumatic Conveying*** Vacuum, Pressure and Combination Conveying of cereals, cement, husk, baggase, granules, powders and other similar material.
- ***Regeneration of Dryers & Molecular Sieves.***

THE EVEREST ADVANTAGE

Retain your advantage with factory genuine replacement parts.

- All parts meet original manufacturing specifications and tolerances for guaranteed fit and function.
- Pre-packaged overall kits with detailed service manuals are available on request.

WE JUST DON'T OFFER BLOWERS, WE OFFER SOLUTIONS!

EVEREST transmission

PRODUCT RANGE

Air Blowers – Water Cooled Blowers – Gas Blowers – Vacuum Booster Pumps – Acoustic Hoods & Enclosures – Dry Vane Pumps

Gawar Construction Limited Dehradun

PERFORMANCE TABLE

AIR COOLED SERIES

MODEL	SPEED (RPM)	1000 MM WG		2000 MM WG		3000 MM WG		4000 MM WG		5000 MM WG		6000 MM WG		7000 MM WG		OPENING mm MS	STANDARD DIRECTION
		m³/hr	BHP	m³/hr	BHP	m³/hr	BHP	m³/hr	BHP	m³/hr	BHP	m³/hr	BHP	m³/hr	BHP		
0409	800	82	0.6	40	0.8	31	1.2	23	1.5	16	1.9	10	2.1	4	2.4	40	
	1100	83	0.8	71	1.2	62	1.5	54	2.0	47	2.4						
	1440	119	1.1	108	1.6	98	2.1	89	2.7								
42	1000	77	0.7	67	1.1	58	1.5	52	1.9	46	2.2	40	2.8	35	3.0	40	
	1300	108	1.0	98	1.4	90	1.9	83	2.4	77	2.9	71	3.4	66	3.9		
	1690	140	1.3	136	1.8	126	2.4	114	3.0	106	3.6	100	4.3	97	4.9		
44	1000	112	0.9	97	1.3	86	2.0	75	2.6	66	3.1	56	3.7	51	4.2	65	
	1300	157	1.2	142	1.9	130	2.6	120	3.4	111	4.1	102	4.8	96	5.5		
	1690	203	1.6	197	2.4	175	3.3	166	4.1	156	4.9	148	5.8	141	6.7		
47	1000	209	1.6	183	2.6	162	3.6	148	4.6							80	
	1300	260	2.1	244	3.4	244	4.7	227	6.0								
	1690	338	2.7	318	4.4	309	6.1										
51	1000	167	1.6	171	2.4	160	3.3	150	4.0	141	4.8	133	5.7	126	6.5	85	
	1300	234	2.0	228	3.1	227	4.2	217	5.2	208	6.3	200	7.5	193	8.4		
	1690	304	2.6	298	4.0	294	5.4	282	6.7	270	8.2	260	9.7	251	10.9		
55	1000	234	1.8	211	2.8	194	3.9	179	4.9	166	6.0	154	7.0	143	8.1	80	
	1300	321	2.3	298	3.6	280	5.0	265	6.4	252	7.8	241	9.1	230	10.5		
	1690	418	3.0	398	4.6	380	6.4	365	8.3	350	10.1	338	11.8	328	13.6		
59	1000	448	3.0	406	5.0	370	7.0									80	
	1300	582	3.8	555	6.0	483	9.1										
	1690	756	4.9	721	7.7	627	11.8										
63HP16	1100	338	2.8	307	4.1	264	5.5	264	7.1	247	8.8	231	10.1	217	11.6	80	
	1300	411	3.3	401	5.0	377	6.9	358	8.7	340	10.8	325	12.4	310	14.2		
	1600	507	3.8	497	6.0	474	7.8	454	9.7	437	11.7	421	13.5	406	15.5		
65HP8	1000	167	1.6	171	2.4	160	3.2	150	4.0	141	4.8	133	5.7	126	6.5	85	
	1300	234	2.0	228	3.1	227	4.2	217	5.2	208	6.3	200	7.3	193	8.4		
	1600	308	2.4	304	3.8	293	4.8	283	6.0	273	7.3	265	8.5	256	9.7		
65HP20	1000	234	1.8	211	2.8	194	3.9	179	4.9	166	6.0	154	7.0	143	8.1	80	
	1300	321	2.3	298	3.6	280	5.0	265	6.4	252	7.8	241	9.1	230	10.5		
	1600	378	2.8	388	4.5	380	6.3	365	7.4	310	8.9	300	10.4	288	12.1		
65HP15	1000	307	2.2	295	3.6	271	5.1	250	6.8	232	8.1	216	9.5			100	
	1300	446	2.8	417	4.7	392	6.7	372	8.8	353	10.4	337	12.4				
	1600	630	3.5	488	5.5	473	7.7	450	9.9	434	12.1						
65S20	1000	457	3.0	419	5.0	390	7.0	368	9.0							100	
	1300	622	3.9	584	6.5	555	9.1	531	11.7								
	1600	770	4.5	684	7.5	680	10.5	640	13.5								
69	1000	300	2.4	270	3.7	247	5.1	227	6.4	210	7.8	194	9.2	179	10.5	80	
	1300	413	3.1	382	4.8	358	6.8	336	8.4	322	10.2	306	11.9	292	13.7		
	1600	535	3.8	494	6.0	471	8.1	451	10.3	434	12.5	418	14.7	404	16.9		
67	1000	464	3.8	410	5.1	376	7.1	347	9.2	322	11.2	299	13.3	278	15.3	125	
	1300	603	4.8	538	6.6	544	9.2	515	11.9	490	14.6	467	17.3	446	19.8		
	1600	751	5.8	738	8.1	712	11.4	684	14.7	659	17.9	636	21.3	616	24.5		
610	1000	607	3.7	547	6.8	502	9.2	464	11.9	430	14.7	400	17.4	371	20.1	150	
	1300	832	4.8	772	8.4	727	11.9	688	15.5	656	19.0	634	22.6	598	26.1		
	1600	1058	6.0	967	10.3	903	14.7	913	19.1	880	23.4	848	27.8	821	32.2		
615	1000	821	5.2	836	8.3	775	13.4	721	17.4							100	
	1300	1268	6.7	1175	12.1	1111	17.4	1067	22.7								
	1600	1554	8.3	1511	14.8	1448	21.4	1394	27.5								
76	1000	802	3.8	967	8.3	539	8.8	516	11.3	496	13.8	477	16.3	461	18.8	100	
	1300	809	4.9	773	8.2	748	11.6	723	14.7	702	18.0	684	21.2	667	24.5		
	1600	1015	6.1	980	10.1	962	14.1	939	18.1	920	22.1	888	26.3	874	30.3		
79	1000	736	4.8	748	8.0	709	11.3	677	14.7	648	18.0	623	21.4	600	24.7	125	
	1300	1073	6.0	1023	10.4	995	14.7	960	19.1	934	23.4	898	27.8	875	32.1		
	1600	1349	7.4	1298	12.8	1260	18.1	1228	23.5	1200	28.9	1174	34.3	1150	39.5		
710	1000	1000	6.5	936	8.7	882	13.8	852	18.0	817	22.2	786	26.4	757	30.6	150	
	1300	1344	7.1	1293	13.6	1236	18.0	1196	23.4	1161	28.9	1130	34.3	1101	39.7		
	1600	1668	8.8	1627	16.5	1600	22.1	1540	28.9	1506	35.5	1474	42.2	1445	48.8		
713	1000	1295	8.7	1214	13.2	1152	17.8	1100	23.0	1054	28.4	1012	33.9	974	39.3	150	
	1300	1742	8.7	1662	15.8	1599	22.9	1547	29.9	1501	37.0	1459	44.0	1421	51.1		
	1600	2190	10.8	2109	18.5	2047	28.1	1984	36.9	1934	45.1	1890	54.3				
717	1000	1696	8.8	1590	16.9	1506	23.8	1440	30.1							150	
	1300	2206	10.8	1990	19.1	1869	27.6	1830	36.2								
	1600	2671	13.2	2466	23.9	2484	34.5	2418	44.7								
L917	1100	1881	8.7	1786	17.5	1703	28.3	1636	33.1							200	
	1360	2378	11.8	2273	21.8	2191	31.1	2123	40.7								
	1600	2869	14.1	2760	25.8	2679	36.8	2616	48.1								
86	1000	1076	8.3	1029	12.7	993	17.0	963	21.3	936	25.7	912	30.0	890	34.3	100	
	1300	1314	10.0	1267	16.3	1231	20.4	1201	25.6	1174	30.9	1150	36.0	1128	41.2		
	1440	1600	12.0	1553	16.3	1517	24.6	1488	30.7	1460	37.0	1435	43.2	1413	49.4		
812	1000	1439	8.8	1378	15.8	1328	21.4	1288	27.2	1252	33.0	1219	38.8	1190	44.6	125	
	1300	1757	11.8	1695	16.7	1646	26.7	1605	32.6	1570	39.8	1538	46.5	1508	53.6		
	1440	2139	14.1	2078	22.4	2028	30.8	1988	39.1	1953	47.5	1919	56.8	1890	64.2		
816	1000	1919	11.7	1838	18.5	1771	27.2	1717	34.9	1669	42.8	1628	50.4			200	
	1300	2343	14.1	2283	23.3	2195	32.6	2141	41.9	2093	51.3	2050	60.4				
	1440	2852	18.8	2788	26.0	2704	36.1	2660	50.3	2602	61.4	2553	72.3				
820	1000	2398	13.7	2294	22.2	2214	33.0	2148	43.6							200	
	1300	3029	18.4	2934	30.0	2742	38.8	2676	51.2								
	1440	3355	18.7	3481	33.6	3380	47.5	3313	61.4								
1012	1000	3460	14.9	2369	24.8	2271	34.7	2201	44.6	2140	54.5	2084	64.4	2034	74.3	150	
	1300	3004	17.9	2897	29.8	2814	41.7	2745	53.5	2684	65.4	2628	77.3	2578	89.2		
	1440	3987	21.5	3910	35.7	3407	50.0	3308	64.3	3238	78.5	3181	92.8	3130	107.1		
1016	1000	3306	18.3	2182	31.6	3051	44.9	2908	58.2	2875	71.8	2801	84.9	2733	98.2	200	
	1300	4027	22.0	3953	37.9	3782	53.9	3659	69.9	3605	85.9	3532	101.8	3464	117.8		
	1440	4914	26.4	4776	45.5	4589	64.7	4566	83.9	4483	103.0	4408	122.3	4341	141.4		
1020	1000	4229	22.0	4044	30.1	3902	58.1	3783	73.1	3678	90.1	3583	107.2			250	
	1300	5163	28.4	4979	46.9	4837	67.3	4718	87.7	4613	108.2	4518	128.6				
	1440	6286	31.7	6101	56.2	5959	80.8	5840	106.3	5734	129.8	5639	154.3				
1024	1000	4987	25.0	4750	45.0	4584	65.0	4442	85.0	4320	106.0					300	
	1200	6065	33.0	5848	54.0	5662	78.0	5541	102.0	5418	126.0						
	1440	7362	36.0	7106	64.8	6899	93.6	6859	122.4	6733	151.2						

Values in Blue are subject to temperature and drive limitations and must be referred to factory for proper application.
Conversions: 1 Cubic Mtr/Hour = 0.588 CFM ; 1000 mm WG = 1.42 PSIG = 0.1 Kg/Sq cm

B-44, Mayapuri Industrial Area, Phase-I, New Delhi 110 064, India
Telefax: 91-11-28116307, 28114944, 28114955, 28117469 Email: info@everestblowers.com Web: www.everestblowers.com

EVEREST Transmission

Series WWW

Jawar Construction Limited Debradun

7.3 Sewage Transfer Pump

KIRLOSKAR PUMPS

ETERNA CW

SEWAGE DE-WATERING SUBMERSIBLE PUMPS

TECHNICAL SPECIFICATION	
Head Range	: Upto 78 Metres
Discharge Range	: Upto 4800 LPM
Power Rating	: 0.75 to 15 KW (1 to 20 HP)
Voltage Range	: 380 to 440 Volts (Three phase)
pH Value	: 6.5 to 7.5
Maximum Density	: < 1050 kg/m³
Protection	: IP 68
Consistency of Medium	: < 1.2 x 10³ kg/m³
Maximum Ambient Temperature	: 40 °C
Insulation	: "B"/ "F" Class.

MATERIAL OF CONSTRUCTION	
Impeller	: Cast Iron
Delivery Casing	: Cast Iron
Motor Body	: Cast Iron
Pump Shaft	: Carbon Steel

APPLICATIONS

- Sewage pumping
- Dewatering from basements, multi-storeys, shopping malls, godowns
- Construction site
- Dewatering foundation, trenches and pits
- Flood water handling

High Efficiency and Energy Saving Design
Innovative design manufactured at state of art plant, delivers optimum efficiency at lower energy consumption resulting in significant cost savings.

Easy Maintainable Designs
Easy maintainable design and better interchangeability of components so that pump can be serviced even at remote locations by semi-skilled technicians.

Robust Construction
Heavy duty construction made from graded cast iron, carbon + silicon carbide mechanical seal makes the pump suitable for sewage and sludge.

Replaceable Wearing Parts
All wearing parts within the pumps are easily accessible and replaceable which facilitates ease of maintenance thereby extending the life of the pump.

Dynamically Balanced Rotating Parts
Minimum vibrations protect components from damages during the operations, thus ensuring consistent performance as concentricity is maintained.

PERFORMANCE CHART OF CW SERIES SEWAGE SUBMERSIBLE PUMPSETS, AT RATED SPEED THREE PHASE AC POWER SUPPLY

Sl. No.	Pump Model	Power Rating kW	Power Rating HP	Pipe Size (mm)	Rated Speed (RPM)	Min. Sump Size (mm)	TOTAL HEAD IN METRES: 4	8	6	10	12	14	16	18	20	22	Min. Sub. Type Suction Bend
							DISCHARGE IN LITRES PER MINUTE										
1	75CW	0.75	1	50	2800	300	-	400	300	200	140	-	-	-	-	-	450
2	100CW	1.5	2	80	2800	350	-	-	375	307	270	200	120	-	-	-	450
3	150CW	2.2	3	80	2800	350	-	-	600	500	420	340	260	200	120	-	600
4	210CW	3.7	5	80	2800	350	-	-	-	-	-	-	500	400	300	200	600
5	300CW	5.5	7.5	80	2800	350	-	1000	1400	1300	1200	1100	800	700	600	300	600
6	750CW	7.5	10	100	1440	450	2000	2100	2200	2200	1800	400	-	-	-	-	600
7	1100CW 4PL	11	15	100	1440	450	-	-	4200	4000	3600	3200	1800	800	-	-	600
8	1500CW 4PL	15	20	100	1440	450	-	4800	4800	4800	4800	4800	3100	2100	400	-	1000
							12	16	18	21	24	27	30	33	36	40	-
9	1500 DM 4P	15	20	100	1440	450	-	-	3600	3500	3400	3300	1500	1100	500	150	600
10	1500CW 2P	2.2	15	80	2800	350	1800	1400	1300	1210	1130	1020	800	670	450	200	700
11	1100CW 4P	11	15	100	1440	450	-	2800	2600	1870	1300	600	-	-	-	-	500
							95	70	50	40	45	40	35	30	45	70	-
12	1100CW 2P	11	15	80	2800	350	1200	900	800	600	400	180	-	-	-	-	600
13	1500CW 2P	15	20	80	2800	350	-	-	-	-	-	1200	900	600	300	40	500

Note: Performance applicable to liquid of specific gravity 1 and viscosity as of water.

KIRLOSKAR BROTHERS LIMITED
A Kirloskar Group Company
Established 1888

Service Toll Free No.
1800 103 4443

Registered Office & Global Headquarters : "Manasa", Survey No. 98 (13 to 7), Plot No. 3, Bunder, Pune 411 045, State Maharashtra, India.
Tel : +91 (20) 2721 1111 Fax: +91 (20) 27211950 Email: marketing@kbl.co.in Website : www.kirloskarpumps.com CIN No.: L29113PN1920PLC000570

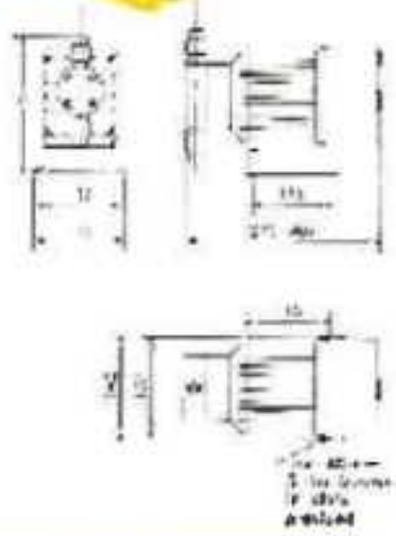
Gawar Construction Limited
Director

7.4 Dosing Pump

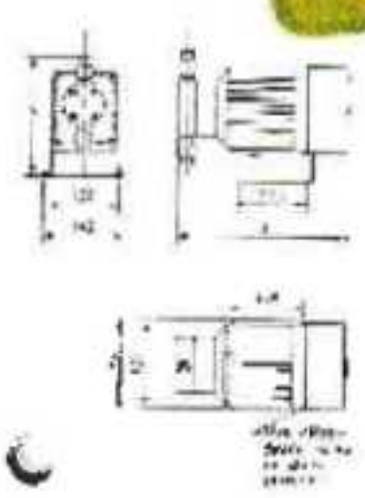
SERIES B

TYPICAL PERFORMANCE

PUMP MODEL	CAPACITY MIN CC/HR	CAPACITY MAX LPH	MAX. INJ. PRESS KG/CM²	DIAPHRAGM SIZE (Sq.Inch)	DIMENSION DETAILS A	SIZE OF TUBING OD x ID	NET WEIGHT
B-11, B-71, B91	60	6.0	10.0	0.9	210	3/8"X1/4"	Plastic Liquid end 5.5 kg Metallic Liquid end 6.0 kg
B-12, B-72, B92	95	9.5	7.0	0.9			
B-13, B-73, B93	170	17.0	3.5	1.8	210	1/2" x 3/8	



SERIES D



TYPICAL PERFORMANCE

PUMP MODEL	CAPACITY MIN CC/HR	CAPACITY MAX LPH	MAX. INJ. PRESS KG/CM²	DIAPHRAGM SIZE (Sq.Inch)	DIMENSION DETAILS A	DIMENSION DETAILS B	SIZE OF TUBING OD x ID	NET WEIGHT Plastic	NET WEIGHT Metallic
D-10/D-70/D-90	50	5.0	10.0	0.9	210	278	3/8"x1/4"	8.5 kg	9.0 Kg
D-11/D-71/D-91	100	12.0	9.0	.8					
D-12/D-72/D-92	150	17.0	7.0	1.8			1/2"x3/8		
D-13/D-73/D-93	250	35.0	4.0	3.0					
D-14/D-74/D-94	600	90.0	1.5	6.0	235	295	1/2"x3/8	9.0 kg	10.5 kg

MATERIAL OF CONSTRUCTION

PART	MATERIAL			
HEAD	PP	PVC	PVDF	CF8M
DIAPHRAGM	TEFLON FACED HYPALON	TEFLON FACED HYPALON	TEFLON FACED HYPALON	TEFLON FACED HYPALON
BALL	CERAMIC	CERAMIC	CERAMIC	CERAMIC
RING SEAL	TEFLON	TEFLON	TEFLON	TEFLON
SUCTION / DISCHARGE VALVE	PVC	PVC	PVC	SS - 316
ANTISYPHON VALVE	PVC	PVC	PVC	SS - 316
FOOT VALVE	PVC	PVC	PVC	SS - 316
TUBING	LDPE	LDPE	LDPE	LDPE

Gawar Construction Limited Dehradun

7.5 Filter Feed Pump

Enriching Lives

KDS+
Three Phase Monobloc Pumps

KDT+
Monobloc Pumps

Approximate performance of 'KDT+/ KDS+/++, 2 Pole, Monobloc Pumps, at rated voltage, 50 Hz, Three Phase A.C. Power Supply:

PUMP MODEL	POWER RATING		PIPE SIZE		TOTAL HEAD IN METRES																		RATED VOLTAGE (VOLTS)
					28	32	36	40	44	48	52	56	60	64	68	72	76	80	90	94	98	110	
	kW	HP	SUC.	DEL.	CAPACITY IN LITRES PER SECOND																		
KDT-544+	3.7	5.0	65	50	6.8	6.2	5.6	4.8	3.5														400
KDS-550++	3.7	5.0	80	40			4.1	3.7	3.3	2.7	2.0												400
KDT-566+	3.7	5.0	80	40			4.3	4.0	3.7	3.4	3.0	2.5	2.0	1.0									400
KDS-644++	5.5	7.5	65	65	10.3	9.5	8.4	7.1	4.7														400
KDT-944+	5.5	7.5	80	65	11.8	10.9	10.0	9.0	7.5														400
KDS-852++	5.5	7.5	65	50		8.6	8.1	7.5	6.8	5.9	4.5												400
KDT-864+	5.5	7.5	65	50			7.3	7.0	6.5	6.0	5.5	5.0	4.2	2.7									400
KDS-1050++	7.5	10.0	65	65	12.5	12.0	11.4	10.7	9.8	8.1	6.0												415
KDT-1050+	7.5	10	80	65	13.8	13.2	12.4	11.5	10.5	9.2	8.5												415
KDS-1065++	7.5	10.0	65	50				7.8	7.4	6.9	6.4	5.8	5.1	4.3	3.0								415
KDT-1078+	7.5	10.0	65	50			8.2	8.0	7.8	7.5	7.1	6.7	6.2	5.6	4.9	4.0	2.0						415
KDS-1348+	8.3	12.5	80	65	18.2	17.3	15.8	14.3	11.9	8.0													415
KDS 1360	9.30	13	65	50	12.2	11.9	11.7	11.0	11.0	9.6	8.8												415
KDT-1372+	9.3	12.5	80	65			11.5	11.0	10.5	9.5	9.2	9.0	7.8	7.0	6.0	5.5	2.5						415
KDT-1386+	9.3	12.5	65	50									7.5	6.9	6.5	6.2	5.8	5.4	3.8				415
KDS-1555+	11.0	15.0	80	65		19.2	18.5	17.4	16.0	14.5	12.2												415
KDS 1570+	11	15	65	50		13.0	12.7	12.5	11.7	11.5	10.7	9.7	9.0	8.0	6.5								415
KDS-1575+	11.0	15.0	65	50							8.1	7.7	7.4	6.9	6.4	5.8	4.8						415
KDT-1580+	11.0	15.0	65	65						11.2	10.5	10.1	9.5	9.0	8.3	7.8	7.1	6.2	3.2				415
KDT-1596+	11.0	15.0	65	50												7.8	7.1	6.7	5.7	5.3	4.8	1.75	415
KDS-2050+	15.0	20.0	100	80	30.4	28.8	27	25.0	22.6	19.4	2.0												415
KDT-2070+	15.0	20.0	80	65				20.0	19.0	17.8	16.5	15.1	13.9	12.0	10.0	8.0							415
KDT-2095+	15.0	20.0	65	65											12.0	11.5	10.9	10.2	8.0	7.0	5.5		415
KDS-2560+	18.7	25.0	100	80						24.5	22.0	18.8	13.0										415
KDS-3068+	22.0	30.0	100	80						28.0	26.5	24.5	21.5	17.5	10.0								415

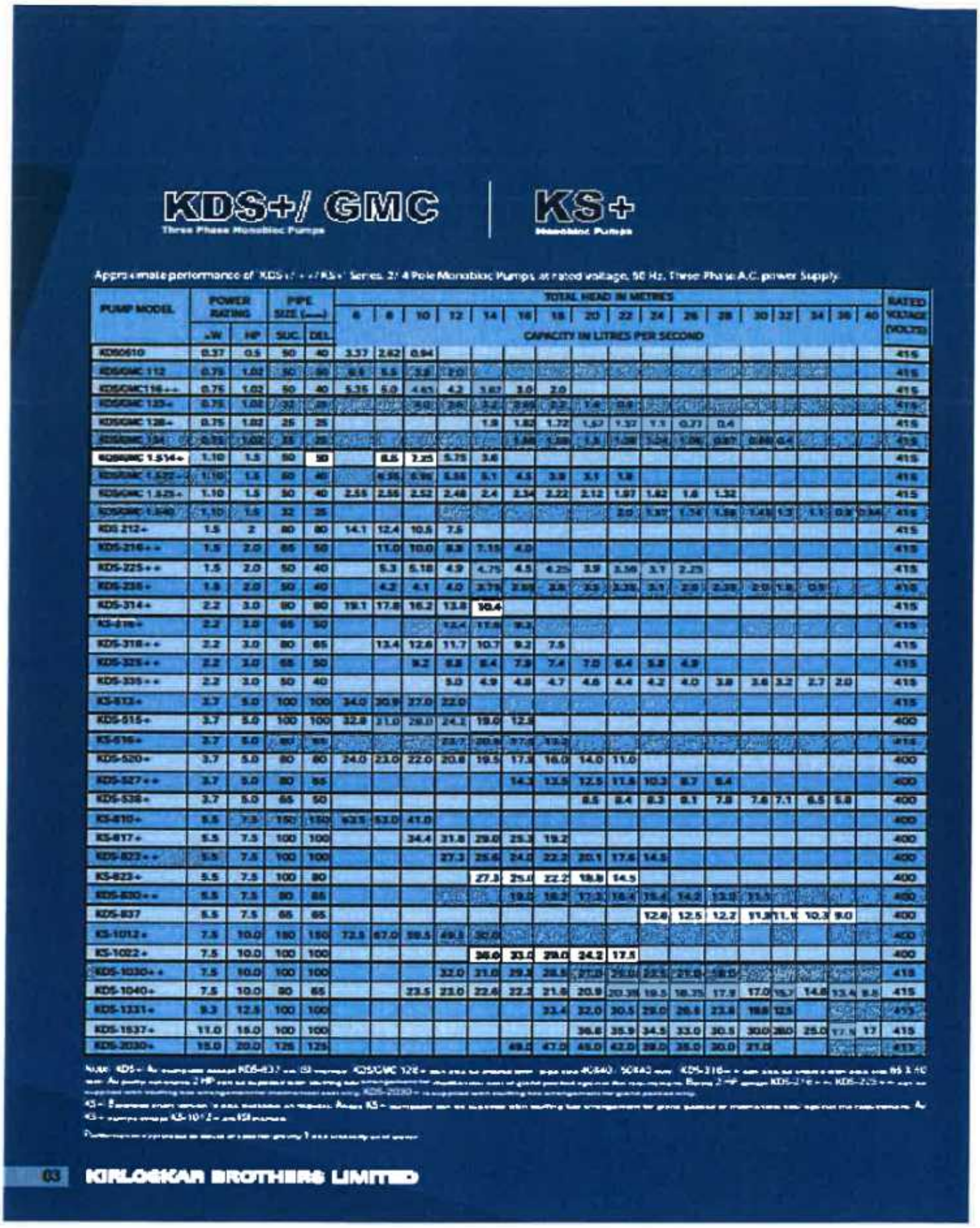
Note: KDT+: As previously known KDT-966+ and KDT-844+ are 19 mentioned.
KDS+: As previously known KDS-1575+ has 19 numbers. Above performance data are acquired under standing test arrangements for given packaging and pipework and may not be achievable.

Performance applicable as stated at capacities giving 1 bar discharge pressure.

04

Gawar Construction Limited
Dehradun

7.6 Filter Backwash Pump



KDS+/ GMC
Three Phase Monobloc Pumps

KS+
Monobloc Pumps

Approximate performance of 'KDS+' / 'GMC' / 'KS+' Series 2/ 4 Pole Monobloc Pumps at rated voltage, 50 Hz. Three Phase A.C. power Supply.

PUMP MODEL	POWER RATING		PIPE SIZE (mm)		TOTAL HEAD IN METRES																RATED VOLTAGE (VOLTS)
					6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	40	
	kW	HP	SUC.	DEL.	CAPACITY IN LITRES PER SECOND																	
KDS0610	0.37	0.5	50	40	3.37	2.82	0.94															415
KDSGMC 112	0.75	1.02	50	40	6.6	5.5	3.8	2.0														415
KDSGMC116++	0.75	1.02	50	40	5.35	5.0	4.61	4.2	1.87	3.0	2.0											415
KDSGMC 125+	0.75	1.02	32	25			3.0	2.6	2.2	2.05	2.2	1.4	0.8									415
KDSGMC 128+	0.75	1.02	25	25					1.9	1.82	1.72	1.57	1.37	1.1	0.77	0.4						415
KDSGMC 134	0.75	1.02	25	25						1.88	1.88	1.5	1.28	1.24	1.06	0.87	0.66	0.4				415
KDSGMC 1.5 14+	1.10	1.5	50	50		8.5	7.25	5.75	3.8													415
KDSGMC 1.522+	1.10	1.5	50	40		6.55	6.92	5.55	5.1	4.5	3.9	3.1	1.9									415
KDSGMC 1.525+	1.10	1.5	50	40	2.55	2.55	2.52	2.48	2.4	2.34	2.22	2.12	1.97	1.82	1.8	1.32						415
KDSGMC 1.540	1.10	1.5	32	25									2.0	1.37	1.74	1.98	1.48	1.3	1.1	0.9	0.54	415
KDS 212+	1.5	2	80	80	14.1	12.4	10.5	7.5														415
KDS-216++	1.5	2.0	65	50		11.0	10.0	8.3	7.15	4.0												415
KDS-225++	1.5	2.0	50	40		5.3	5.18	4.9	4.75	4.5	4.25	3.9	3.56	3.1	2.25							415
KDS-235+	1.5	2.0	50	40		4.2	4.1	4.0	3.75	3.55	3.5	3.3	3.25	3.1	2.9	2.35	2.0	1.5	0.5			415
KDS-314+	2.2	3.0	80	80	19.1	17.8	16.2	13.8	10.4													415
KDS-316+	2.2	3.0	65	50				12.4	11.8	9.2												415
KDS-318++	2.2	3.0	80	65		13.4	12.8	11.7	10.7	9.2	7.5											415
KDS-325++	2.2	3.0	65	50			9.2	8.8	8.4	7.9	7.4	7.0	6.4	5.8	4.9							415
KDS-335++	2.2	3.0	50	40				5.0	4.9	4.8	4.7	4.6	4.4	4.2	4.0	3.8	3.6	3.2	2.7	2.0		415
KS-813+	3.7	5.0	100	100	34.0	30.9	27.0	22.0														415
KDS-815+	3.7	5.0	100	100	32.8	31.0	28.0	24.2	19.0	12.5												400
KS-816+	3.7	5.0	80	65				23.7	20.8	17.6	13.2											415
KDS-820+	3.7	5.0	80	80	24.0	23.0	22.0	20.8	19.5	17.3	16.0	14.0	11.0									400
KDS-827++	3.7	5.0	80	65						14.3	12.5	12.5	11.8	10.2	8.7	8.4						400
KDS-838+	3.7	5.0	65	50								8.5	8.4	8.2	8.1	7.8	7.6	7.1	6.5	5.8		400
KS-810+	5.5	7.5	150	150	52.5	53.0	41.0															400
KS-817+	5.5	7.5	100	100			34.4	31.8	29.0	25.3	19.2											400
KDS-823++	5.5	7.5	100	100				27.3	25.6	24.0	22.2	20.1	17.6	14.5								400
KS-823+	5.5	7.5	100	80					27.3	25.0	22.2	18.8	14.5									400
KDS-830++	5.5	7.5	80	65						19.0	16.2	17.3	16.4	15.4	14.2	13.1	11.5					400
KDS-837	5.5	7.5	65	65										12.8	12.5	12.2	11.8	11.1	10.3	9.0		400
KS-1012+	7.5	10.0	150	150	72.5	67.0	59.5	49.5	30.0													400
KS-1022+	7.5	10.0	100	100					36.6	33.0	29.0	24.2	17.5									400
KDS-1030++	7.5	10.0	100	100				32.0	31.0	29.3	28.5	27.0	25.0	22.5	21.0	18.5						415
KDS-1040+	7.5	10.0	80	65			23.5	23.0	22.6	22.2	21.6	20.9	20.3	19.5	18.75	17.9	17.0	15.7	14.8	13.4	9.8	415
KDS-1331+	9.3	12.5	100	100							33.4	32.0	30.5	29.0	26.6	23.8	19.8	12.5				415
KDS-1537+	11.0	15.0	100	100								36.8	35.9	34.5	33.0	30.5	30.0	28.0	25.0	17.5	17	415
KDS-2030+	15.0	20.0	125	125						49.5	47.0	45.0	42.0	39.0	35.0	30.0	21.0					415

NOTE: KDS+ As compared to KDS-813+ on 13 meter, KDSGMC 125+ also has an enhanced water output over KDS-813+, 50/65 mm. KDS-216+ + can also be used in deep wells upto 95 ± 5 m. As pump consumes 2 HP can be operated under varying water conditions for medium cost of petrol pump set up than the conventional. During 2 HP range KDS-216+ + to KDS-225+ + are supplied with coupling less arrangement for petrol pump set. KDS-2030+ is supplied with coupling less arrangement for petrol pump set.

KS+ Stainless steel version is also available on request. Above KS+ monoblocs can be supplied with coupling less arrangement for petrol pumpset or monoblocs less agricultural pump sets. As KS+ pumps except KS-1012+ are ISI marked.

Performance is applicable for water at a specific gravity 1 and kinematic viscosity of water.

Gawar Construction Limited Dehradun

7.7 Filter Press & Screw Pump

WASTE WATER TREATMENT EQUIPMENT

POLYPROPYLENE FILTER PRESS

(Sizes - 12" - 30" Manual & Hydraulic Type)

MAKE: UNIVERSAL

Model	Plate Detail Size	No.	MOC	Cake Holding Cap.	Filtration Area	Operating Pre. Bar	Tightening Mechanism
UTFP-12X12	12"x12"	11	PP	24 Ltrs.	1.62 M2	3.0 - 4.0	Manual/Hydraulic
UTFP-18X18	18"x18"	17	PP	120 Ltrs.	6.20 M2	4.0 - 5.0	Manual/Hydraulic
UTFP- 18X24	18"x18"	23	PP	160 Ltrs.	8.26 M2	4.0 - 5.0	Manual/Hydraulic
UTFP- 24x24	24"x24"	23	PP	250 Ltrs.	15.59 M2	4.0 - 5.0	Manual/Hydraulic
UTFP-30x30	30"x30"	29	PP	530 Ltrs.	31.10 M2	5.0 - 6.0	Manual/Hydraulic

SCREW PUMP

PROGRESSIVE CAVITY (Screw) PUMPS

FLOW RANGE : UP TO 100M3/H

HOUSING : CI (IS 210FG 220)

ROTOR : SS -AISI 316/410

SHAFT : SS -AISI 316/410

STATOR : Nitrile Black

MAKE: Roto

WATER & WASTE WATER PUMPS

Horizontal/Vertical Multistage Pump : MOC - SS 304/SS 316

Flow Range : Up to 180 M3/h

Head : Up to 240 Meter

Sewage/ Drainage Pump :

MOC - CI Impeller/Body & SS Shaft/ Solid - Up to 100MM

MAKE: Wilo / Lea / Kirloskar

UV SYSTEM

APPLICATION : Clear Water & Waste Water Treatment

UV Lamp Type : Low pressure, high-performance quartz lamps

RECOMMENDED UV LAMP LIFE : Up to 8500 Hours.

BALLAST : Matched high frequency electronic ballasts.

INPUT POWER : 230-240V AC, 50-60 Hz.

UV CHAMBER : Electro-polished SS316L

LAMP FAIL ALARM : Audiovisual

MAKE : SUHRUT / UNIVERSAL

Gawar Construction Limited Dehradun

7.8 Electromagnetic Flowmeter

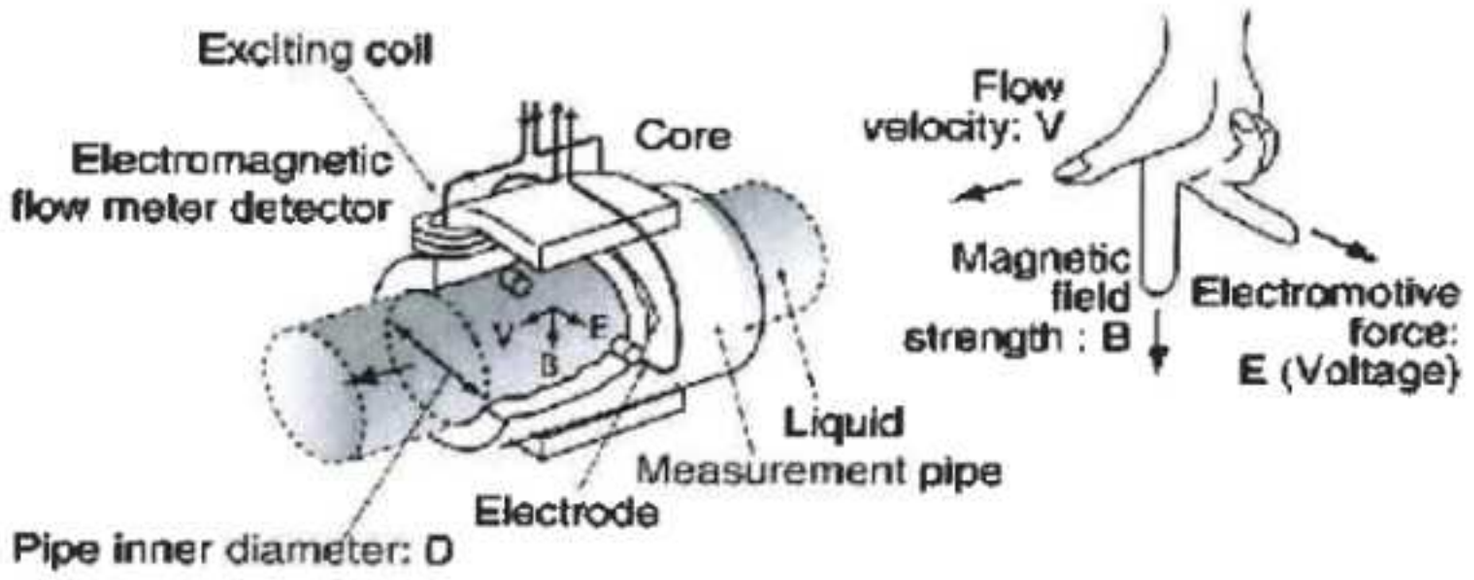
PRINCIPLES

Electromagnetic flow meters detect flow by using Faraday's Law of induction.

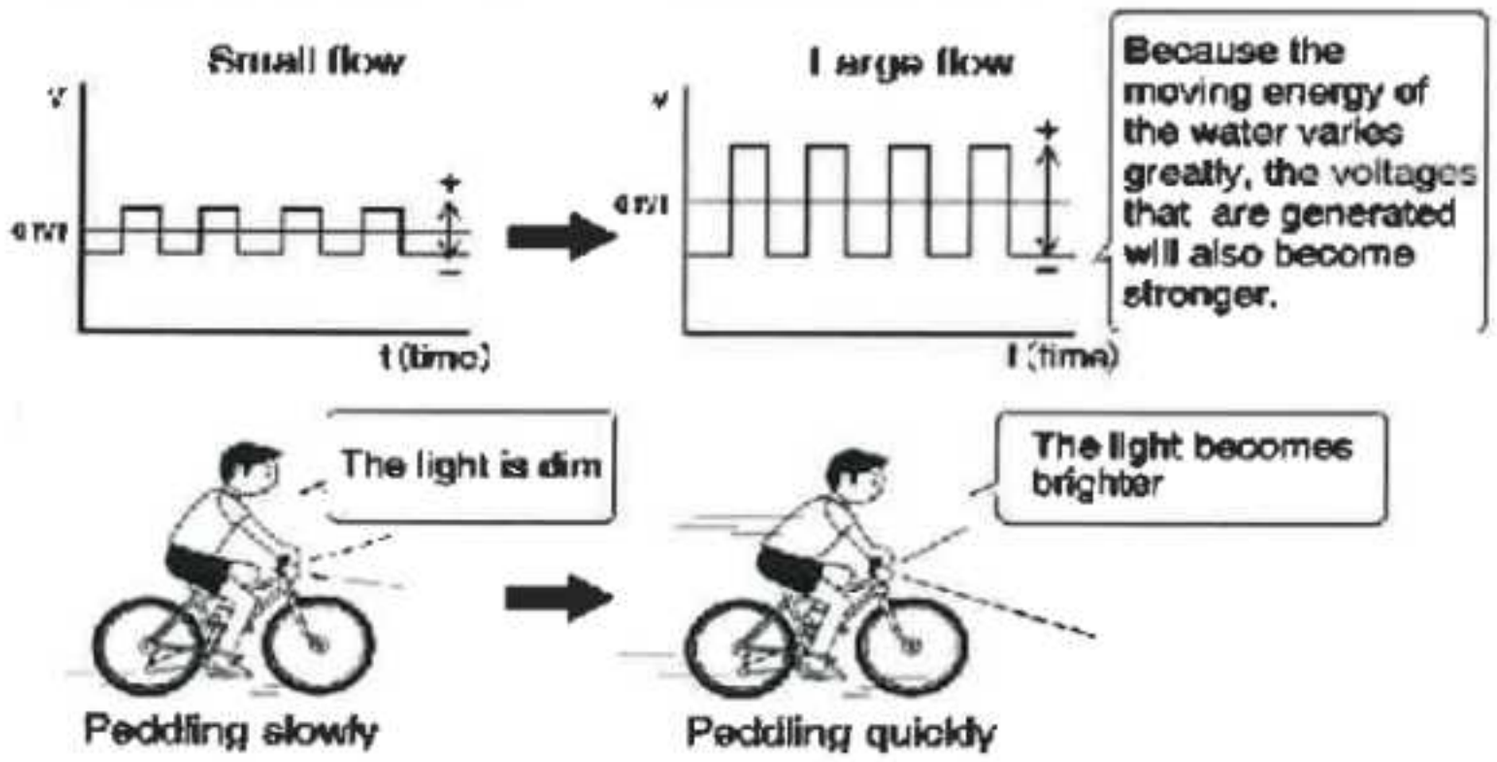
Inside an electromagnetic flow meter, there is an electromagnetic coil that generates a magnetic field, and electrodes that capture electromotive force(voltage).

Due to this, although it may appear as if there is nothing inside the flow pipe of an electromagnetic flow meter, flow can be measured.

Under Faraday's law of induction, moving conductive liquids inside of a magnetic field generates an electromotive force (voltage) in which the pipe inner diameter, magnetic field strength, and average flow velocity are all proportional. In other words, the flow velocity of liquid moving in a magnetic field is converted into electricity. (E is proportional to V × B × D)



As the flow changes, the electromotive force (voltage) captured by the electrodes changes as follows.



Gawar Construction Limited
Dehradun

7.9 pH Meter

pH/ORP METER

EMBARK
SENSE MEASURE CONTROL

pH is the measure of the hydrogen ion concentration in a liquid. pH measures the acidity or alkalinity of a liquid. The pH scale is logarithmic and runs from 0.0 to 14.0 with 7.0 being neutral. Readings less than 7.0 indicate acidic solutions, while higher readings indicate alkaline or base solutions.

Chlorine and Ozone are the most common disinfectants used in the water and waste water treatment industry. Oxidation-reduction potential (ORP) is the parameter commonly used to measure REDOX reactions and is the only practical method we have to electronically monitor disinfectant effectiveness.

PO 650 pH/ ORP

PO 650 pH/ORP with LCD

WHY CHOOSE THIS METER

- **TRACEABILITY?** to NABL/ SRL standards
- **PUSH BUTTON FRONT KEYS** for easy set up
- **INDIVIDUAL HIGH & LOW SET POINT RELAY** for alarm or signal to PLC or can be used for proportional acid/alkali dosing
- **PROGRAMMABLE CONTROL DELAY TIME TO PREVENT CHATTERING**
- **HYSTERISIS TO PREVENT RELAY CHATTERING** Hysteisis is the percentage of set point below which relay will reset after getting energized
- **IN-BUILT DIAGNOSTICS** for wrong calibration or sensor error
- **IN-BUILT ALARM ANNUNCIATOR** It's a facility to acknowledge high/low fault condition and reset relays by pressing the acknowledge key
- **MANUAL/AUTOMATIC** relay reset options

ADVANCED OPTIONS AVAILABLE:

- **AUTOMATIC TEMPERATURE COMPENSATION**
- **DUAL LINE BACKLIT LCD** which displays temperature and pH/ORP along with relay status
- **RS 485** for online monitoring/ data logging
- **ISOLATED 4-20 mA OUTPUT** with normal/inverse function and in-built current simulator

APPLICATIONS

Mineral Water Plants · Beverage Industry · Liquid Waste Management · Pharma & Chemical · Pulp & Paper Industry · Swimming Pool

FILTRA CONSULTANTS AND ENGINEERS LTD.

[illegible] Tel: [illegible]

7.10 UV Sterilizer

ACE HYGIENE PRODUCTS PVT. LTD.

ALFA THE UV EXPERT

Alfaa UV Technical Specifications Sheet

Sizing	Model	WL12
	Flow Rate	30.0 m³/hr
	UV Dose	60,000 uW-sec/cm²
	UV Transmission (per cm)	80%
Electrical	Voltage	220-240V / 50-60Hz
	Maximum Power Consumption (W)	1370 W
	Number of Lamps	12
	Max. Lamp Cable Length (meters)	4.5
	Ballast Type	Electronic with Programmed Start
Reactor	MOC	Stainless Steel 316L
	End Connections	3" BSP (M)
	Max. Operating Pressure	90 psi
	Max. Operating Temperature	45 degrees C
	Max. Sanitization Temperature	90 degrees C (lamps turned off)
	Quartz Jacket MOC	High Purity Quartz (UVT > 95%)
Features	Lamp Status Indicator	Yes
	Lamp Running Hour Counter	Yes
	UV Intensity Meter w/ 4-20 mA Output	Optional (UVM710)

1002 A, Peninsula Towers, Peninsula Corporate Park
Lower Parel (W), Mumbai 400013. India.
Tel: +91-22-66612300. E-Mail: info@alfauv.com.

Gawar Construction Limited Dehradun

7.11 Tube Deck Media

TECHNICAL DATA SHEET FOR TUBE SETTLER MEDIA

MODEL	M-T-V
PLAN SETTLING AREA OF MEDIA	92 M²/M² (BY SLOPE)
LAYING ANGLE	60 DEG. FROM HORIZONTAL
STRUCTURE	HEXAGONAL CHEVRON
STARIGHT HEIGHT OF MEDIA	750 MM & 1000 MM
GRDE OF MEDIA	PVC
THICKNESS	1.0 MM
FITTING ARRANGEMENT	TONGUE & GROOVE
CROSS SECTIONAL AREA	25 MM X 60 MM
MAX CONTINUOUS OPERATING TEMPERATURE	65° CELSIUS
ACTUAL PLAN AREA OF EACH TUBE SETTLER	69.23 SF
COLOUR	BLACK
SETTLING VELOCITY	0.00 m/sec
SLR	1.30 M³/M².HR
ANGLE CORRECTION	0.63 M
WIDTH OF INLET LAUNDER	0.30 M
HOPPER SLOPE	60.0 DEGREES
TOTAL NO. OF HOOPERS	4
HOPPER DEPTH	1.66 M
WEIR LOADING RATE	100 GPM/R-DAY
TOTAL WEIR LENGTH	16.67 M

5

Gawar Construction Limited Dehradun

13

SECTION VIII

VETTED DOCUMENT OF ELECTROCOAGULATION TECHNOLOGY STP IN UTTARAKHAND FOR REFERENCE (ANNEXURE – B)

Gawar Construction Limited Dehradun

भारतीय प्रौद्योगिकी संस्थान दिल्ली
INDIAN INSTITUTE OF TECHNOLOGY DELHI
Centre for Rural Development & Technology
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Dr. Vivek Kumar
Associate Professor

Ref No: IITD/CRDT/E-18732

03/07/2018

KK Rastogi
General Manager
Office of General Manager, Construction Circle (Ganga)
Uttarakhand Pey Jal Nigam, Haridwar (U.K.)

Dear Sir.

This is with reference to the vetting of 18 EC technology based STPs of Uttarakhand. Earlier we had sent 18 reports excluding the performance of EC Reactor. Now we are ready with 10 days performance analysis report of the pilot plant we had installed at IIT Delhi. Plant performance is now satisfactory and consistent. Find enclosed herewith vetting of Electrocoagulation technology for sewage treatment.

Thanking You,

Sincerely Yours,

Vivek Kumar

Gewar Construction Limited
Dehradun

Introduction

A pilot scale electro-coagulation plant has been installed at the IIT Delhi premises for the purpose of performance analysis and process optimization. 1 m^3/hr plant is installed at micro-model premises near an open unconstructed (Kachha Nala) drain. Drain carries the domestic waste water of Katwaria Sarai village, and IIT Delhi's staff colony. Units of the plant were transported from Coimbatore (M/s Confident Engineering) and installed on a concrete platform. A flowchart of the pilot scale plant shown in fig 1.

The primary focus of the study was to analyze performance of the plant with respect to selected parameters and further optimize the performance as per the targeted values of the selected parameters. Targeted values of the various parameters are shown in table 1. These values are the discharge norms as per the DNIT and Contract.

Table 1: Treated water parameters as per contract

S. No.	Parameter	Values
1.	pH	6.7-7.0
2.	TSS, mg/L	<10
3.	BOD, mg/L	<10
4.	COD, mg/L	<50
5.	Total Kjeldahl Nitrogen (as N) mg/L	<10
6.	Ammonia Nitrogen (as N) mg/L	<5
7.	Total Phosphorous (as PO_4) mg/L	<2
8.	Fecal Coliform Count (MPN)	<100

Before the installation of plant, survey of drain and sampling of wastewater was carried out at various point and time to observe variation in parameters to ease the plant operation. Based on the study it is found that peak flow and pollutant load occur at two times in a day, 8:00-10:00 AM in the morning and 8:00-10:00 PM in the evening. Sampling at Nala was done for 24 hours at the interval of 2 hours. Wastewater parameters were analyzed in CRDT, IIT Delhi following standard methods (table 2). The characteristics of wastewater flowing in the drain is shown in table 3. For the treatment purpose wastewater is being pumped from kaccha Nala, upstream (u/s)

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(about 20-30 m from the plant) to 3000 L storage tank by a 1 HP pump having 14 m^3/hr rated capacity and 8 m head. Pump is placed at the bank of the Nala. From the collection tank wastewater flows through the treatment plant by gravity and pump. Finally treated water is being used for gardening purposes. Pilot scale plant is being run at various daytimes on batch basis from morning 6 am to evening 10 pm to study the impact of variation in the flow and pollution load rate on the treatment performance of the plant. The treatment plant based on electrocoagulation technology consisted of EC reactor, followed by online ozone dosing. lamella clarifier. MGF. and ACF. Detailed design parameters of the pilot plant after modification are presented from tables 4a to table 4c.

Table 2: Methods and reference used for wastewater parameters

Parameters	Method	Procedure Reference
pH	Used a Labman scientific instrument	-
COD (mg/L)	Closed Reflux method	5220 B
BOD (mg/L)	Winkler method	5210 B
TSS (mg/L)	Filtration method	2540 D
Total phosphorus (as PO_4)	Colorimetric test	4500-PD
Fecal Coliform (MPN)	-	9221 B-C

Table 4: Analysis of Drain wastewater

Parameters	Range (Average)
pH	6.5-7.2 (6.85)
COD (mg/L)	190-362 (332)
TSS (mg/L)	170-400 (310)
TDS (mg/L)	800-1100 (1030)
EC (µs)	1330-1650 (1200)
Fecal coliform (MPN)	5.60-9.80 x 10^4 (820 x 10^4)

Table 4 (a): Equalization tank

Descriptions	Parameters
Volume of the tank	0.5 m^3
Retention time Actual/design @ 1 m^3/h	30 min
Retention time peak (Assuming peaking factor 3)	10 min
Ozone applied in equalization tank	
Rate of Ozone dosing	3 g/m^3

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Table 4 (b): Electro-Coagulation tank detailed description

Description	Value
Design flow	1 m^3/h
Peak flow (Assuming peaking factor 3)	3 m^3/h
Dimension (L*W*d) of the EC tank (meter)	0.465*0.390*0.903
EC tank Volume	0.1637 m^3
One plat Dimensions (L*W*thickness) (meter)	0.6*0.3*0.004
One plate one side surface area	0.18 m^2
Total one plate surface area	0.36 m^2
Total number of electrodes	53 No's
Gaps between two electrodes	5 mm
Total volume occupied by electrodes	0.03816 m^3
EC tank effective volume	0.12554 m^3
Current	6 amp
Optimum power range	300-500 watts
Optimum energy density range	15.72 – 26.20 (watts/total surface area m^2)
Total plats surface area	19.08 m^2
Retention time Design	7.5324 min
Retention time Peak	2.51 min
Maximum electrodes consumption	10 g/ m^3(m^3 of sewage)

Table 4 (c): Other Pilot scale plant unit's capacities

Descriptions	Parameters
Flash Mixer Tank Dimension Volume	0.6*0.54*0.7
Flash Mixer Tank Volume	0.2268 m^3
Lamella Tube settler dimensions	4.18 m^3
Area	3.05 m^2
Angle	55
MGF and ACF Dimensions	1.450 m Height and 0.5 m diameter
Area	0.196 m^2

Methodology:

After initial performance analysis on the basis of COD, SS, and TDA it was found that plant was neither stable nor performing as per the set targets. Further detailed design of the plant was

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studied and after discussion with M/s Confident Engineering, process optimization study was carried out to achieve discharge norms and stable performance of the plant. Parameters chosen for, optimization study were Power density, gaps between electrodes, location of ozone treatment, change in the angle of Tube settler media.

Results and Discussion:

Electro coagulation unit was run at 6 Amp constant current using iron electrodes plates with varying power density 13.10-26.20 (watts/ m^2). Tube settler media was adjusted at different angles varying from 45-60°. Angle 55° is found more suitable for proper particle settlement, the same is described in literature also. Location of ozone treatment has a significant impact on pollutant removal efficiency, ozone treatment was tried at two different locations keeping dosing rate constant, (i) after tertiary treatment (MGF and ACF) and (ii) before EC treatment. Ozone treatment before EC reactor has shown significant pollution reduction efficiency, therefore ozone treatment was continued before EC reactor for further work. The gap between two electrodes was varied -4 mm gap (58 No's plates), 5 mm gap (53 No's plates), 6 mm and 10 mm gap (39 No's & 24 No's plates) and uniformity of space electrodes was also maintained. 5 mm gap was found suitable as it enhance contact between wastewater and electrodes, which leads high performance. Lesser gap was not found suitable probably due to the fact that very low gap creates problems in cleaning which leads low performance. Higher gap is not found suitable too, probably it results in poor contact between wastewater and electrodes. After optimization of all the above variables, electrode gap was fixed at 5 mm. Tube settler media at 55°, and Ozone-treatment location at before EC and then optimization of power density was carried out by varying it from 13.10-26.20 (watts/ total surface area m^2) keeping current constant at 6 amp. Range of power density 15.72 – 26.20 watts/total surface area m^2 was found achieving almost similar result. At the optimum conditions outlet parameters were found under target limits. After optimization study plant performance was studied for 10 days continuously and the results are presented in table 5. It is clear from the results that now plant is performing well and achieving treated water quality targets shown in table 1.

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Table 5: Analyzed parameters of pilot scale EC plant

Parameter	Inlet Range (Average)	Outlet range (Average)
pH	7.15-7.34 (6.85)	7.25-7.39 (7.3)
COD (mg/L)	190-362 (332)	28-48 (36)
BOD (mg/L)	70-270 (240)	8-9.7 (8.6)
TSS (mg/L)	170-360 (290)	7.5-13.5 (9.5)
Total phosphorus (as PO_4)	4.6-5.8	0.9-1.7 (1.5)
Fecal Coliform (MPN)	$5.60\text{-}9.80 \times 10^4$ (8.20×10^4)	80-95 (84)

Recommendation:

Following are the recommendation for the implementation in all the 18 plants to be installed:

1. Ozone treatment should be done before EC reactor
2. Plate spacing in EC reactors should be kept at 5 mm.
3. EC plants need to be operated at the energy density range from 16-26 Watt/total plate surface area m^2.
4. Angle of the media in lamella clarifier should be kept around 55^o
5. Polishing treatment

Conclusion: The EC based treatment plant in IIT Delhi is performing consistently now. The retention time of EC reactor is much lower than any biological reactor with better plant performance. Therefore the foot print of EC based treatment system will be much lower than conventional treatment system. The treatment system also reduces fecal coliform significantly due to the ozone addition. It is also reported in the literature that ozone is a better option for disinfection as compare to conventional disinfection treatment technologies.

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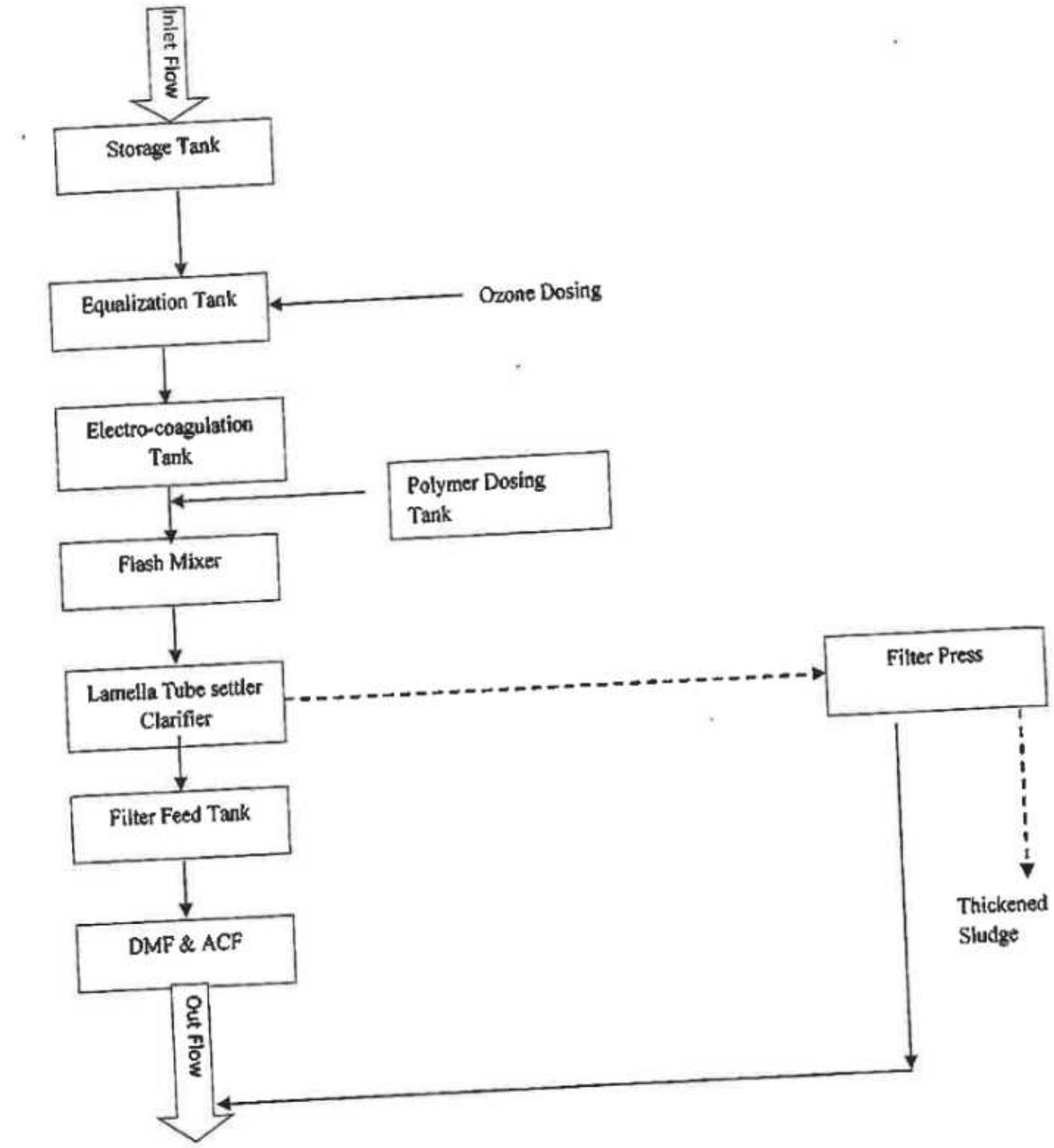

Figure 1: Schematic flow chart of pilot scale sewage treatment plant based on Electro-coagulation in IIT Delbi

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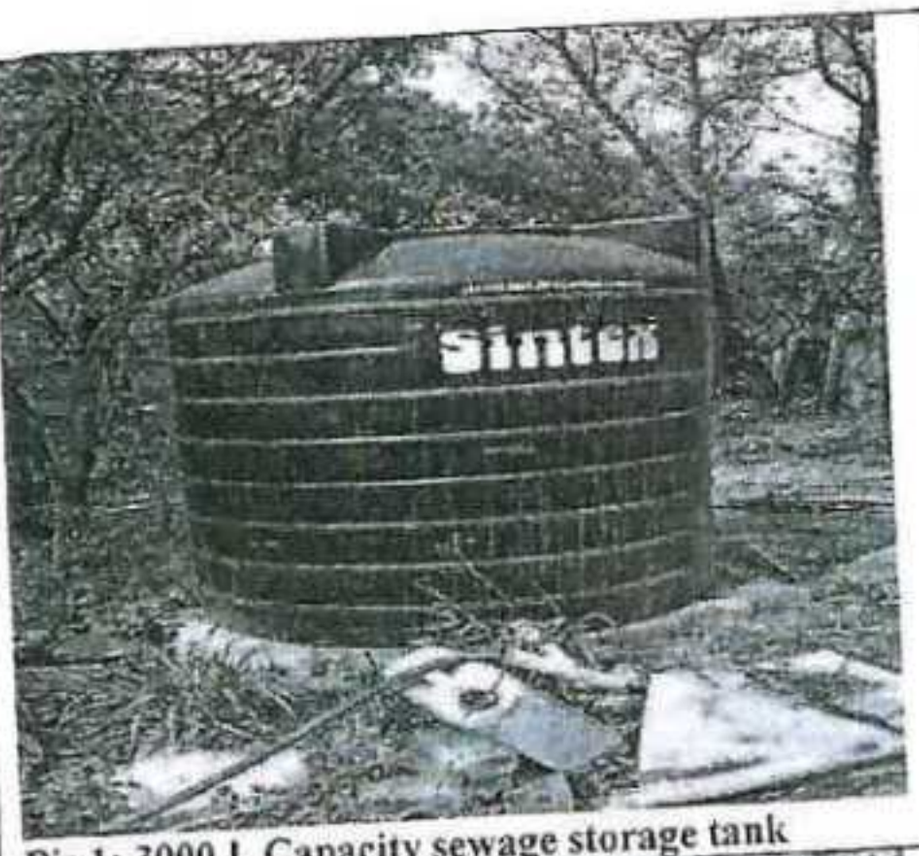
Photos and Video of pilot scale plant installed in IIT Delhi

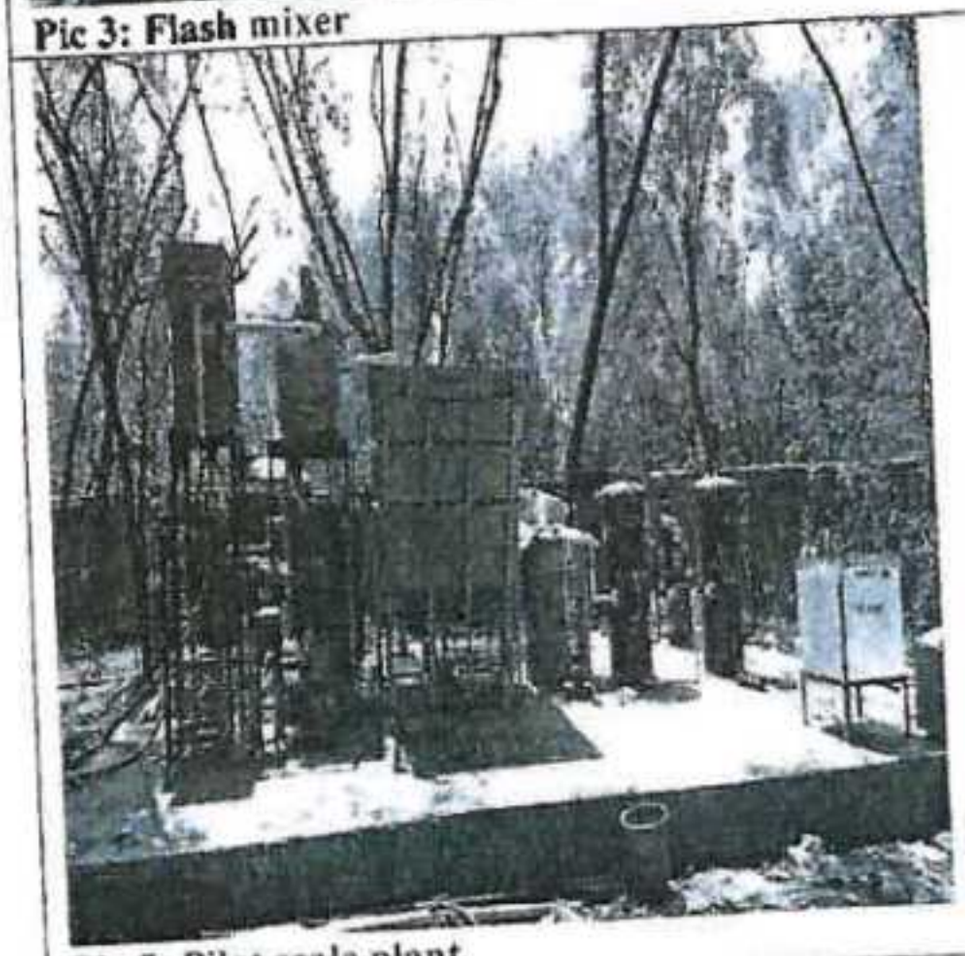


Pic 1: 3000 L Capacity sewage storage tank

Pic 2: Electro coagulatio n

Pic 3: Flash mixer

Pic 4: Top view of EC tank



Pic 5: Pilot scale plant

Pic 6: Lamella tube settler

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Design criteria on

STP-1, 75KLD, ANOOP NEGI SCHOOL, RUDRAPRAYAG,

Distt. - Rudraprayag (Uttarakhand)

SUBMITTED TO:

Project Manager
Uttarakhand Peyjal Nigam
Dehradun

SUBMITTED BY:

TECHNICAL CONSULTANCY SERVICES
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1. Introduction:- 2
2. Design philosophy and modeling:- 2
3. Soil: 2
4. Material Properties: 2
5. Loadings: 2
5.1. Live loads: 2
5.2 Super imposed dead loads (SIDL): 3
5.3 Earthquake loads: 3
5.4 Wind loads: 3
6. Load combinations: 3
7. Special notes: 3

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1. Introduction:-

This report concerns with the design assumptions considered while designing proposed various STP buildingsin Uttarakhand. This report includes design philosophy and various loadings taken into account while modeling and designing different structural members. The substructure and upto plinth level the building is of RCC and above it the building is of structural steel. For fast construction the contractor has agreed to procure steel tanks for various treatment processes.

2. Design philosophy and modeling:-

The building had been designed as framed structure and modeling hadbeen done using finite element based software ETABS v9.7.4. Column and beam elements had been modeled as frame elements while slab had been modeled as shell element. Foundation had been considered fixed at least 1.2m below stilt for foundation resting on soil and at least 300mm for footing resting on rock. To incorporate the cracked section properties of concrete members the following property modifiers had been considered while modeling:
Column - 0.7; beam - 0.35 and slab - 0.25.

Since the building is in earthquake prone area, ductile detailing as per IS-13920 had been followed.

3. Soil:

Safe bearing capacity of soil has been considered asper the concerned building soil report.

4. Material Properties:

Concrete: M-25; E_c = 25000 N/mm^2; Density = 25 kN/m^3.
Steel: Fe500D; E_s = 2.0E+5 MPa; Density = 78 kN/m^3.
Structural steel – E250 (BR); Bolt grade – 10.9;
Welding electrode (As/ IS 814) – EX41XX with a ultimate stress of 410-510 MPa and a min yield stress of 330 MPa;
Steel deck - 6mm thkchequered plate.

5. Loadings:

This section includes various loading applied on the structure to design various elements.

5.1. Live loads:

STP tank	-	30kN/m^2
Machine area	-	5kN/m^2

5.2 Super imposed dead loads (SIDL):

Decking is of steel chequered plate only painting shall be done to protect from corrosion. Weight of steel deck has been taken while modeling.

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5.3 Earthquake loads:

Following parameters has been considered for earthquake loading:

Zone IV; Z = 0.24; Soil type: II; R = 4 (Steel building with ordinary braced frame);

Importance factor = 1.0; Damping (ζ) = 2%.

Calculation of base shear:

$T_a = 0.085 * h^{0.75}$;

Percentage of live load considered for seismic weight is 50%.

5.4 Wind loads:

V_b = 47m/s, $V_z = k1*k2*k3*V_b$; Terrain category – 2; Building class - B

Maximum force = $C_f * A * Pz$.

6. Load combinations:

The following load combinations have been considered for designing structural elements:

A) Limit state of serviceability:
   DL + LL
   DL + EQ
   DL + 0.8 LL + 0.8 EQ
B) Limit state of collapse:
   1.5 DL + 1.5 LL
   1.5 DL + 1.5 EQ
   0.9 DL + 1.5 EQ
   1.2 DL + 1.2 LL + 1.2 EQ

Where, DL is dead load, LL is live load and EQ is earthquake loads.

7. Special notes:

- Since the steel structure is not showing any signs of uplift, 16 diameter holing down bolts have been used.
- Bracing shall be provided to at least two adjacent edges of building.

Vetted

&

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Roorkee-247667, Uttarakhand

TECHNICAL CONSULTANCY SERVICES PLANNING

Dehradun

Tiwari Construction Limited

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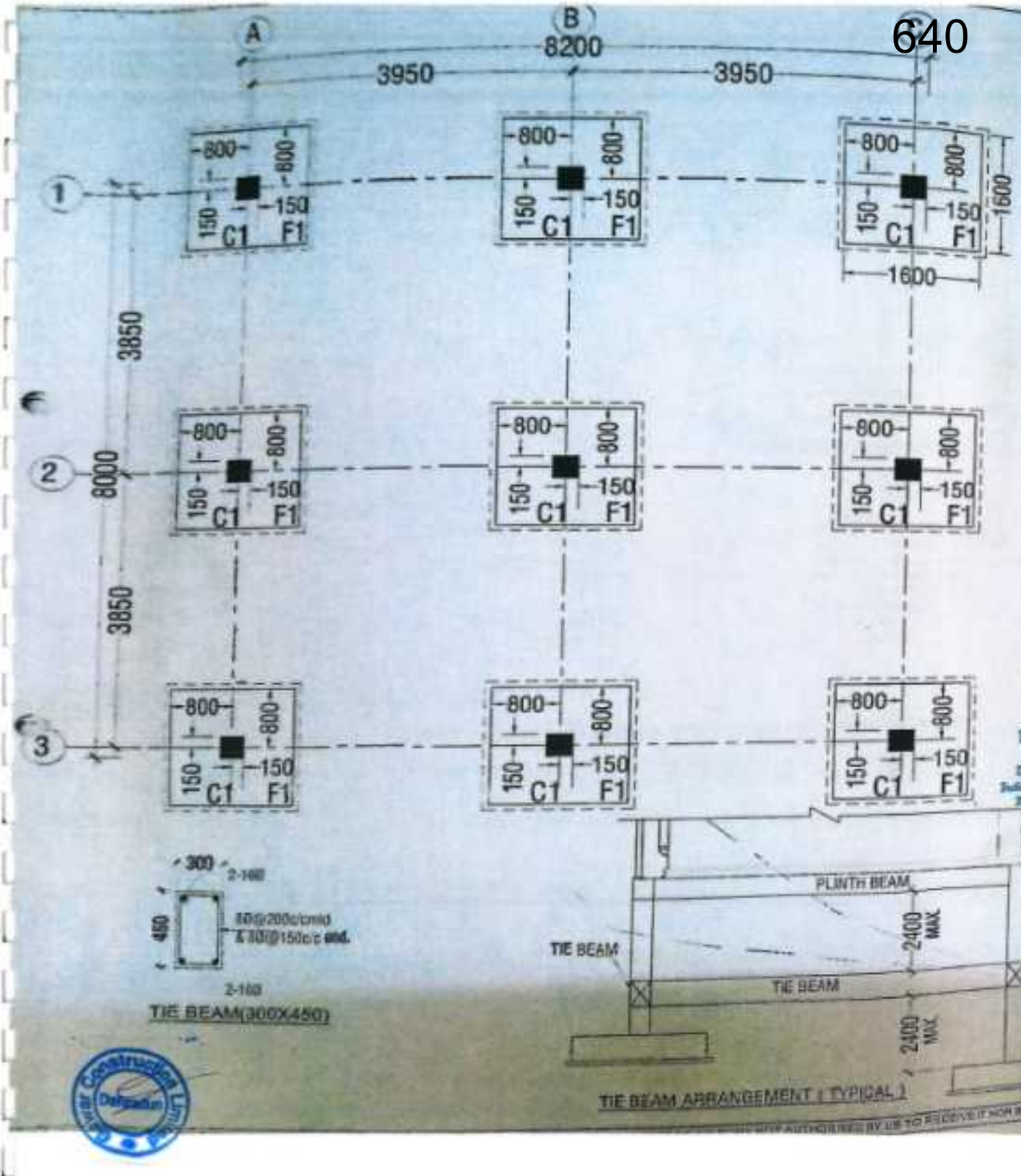

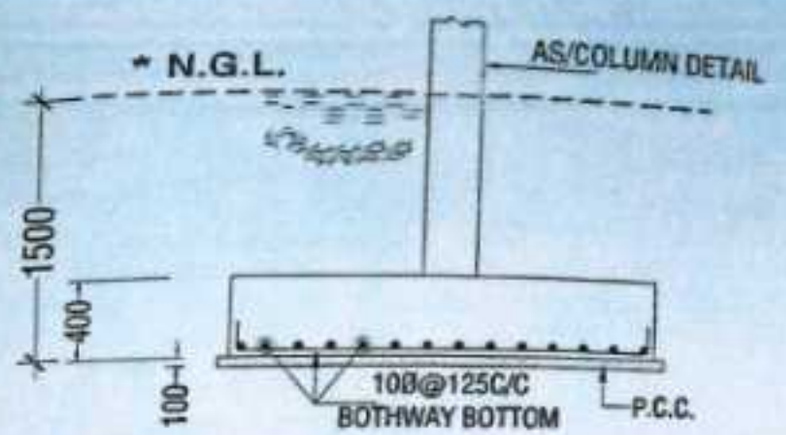

REINF./DIMENSION DETAIL OF FOOTING F1
ELEVATION

TIE BEAM(300X450)

TIE BEAM ARRANGEMENT (TYPICAL)

FOUNDATION LEVEL TO GROUND LVL.		
NO. OF BAR		• 8-16ϕ
COLUMN RING.		
RING	H2	8ϕ@150C/C
	H1	8ϕ@100C/C
COLUMN SIZE		300X300
COLUMN NO.		C1

COLUMN DETAIL

★ NOTES:-

- ALL FOUNDATION ARE ON RIVER BANK.
- NGL SHALL BE CONFIRMED DURING EXCAVATION.
- TIE BEAMS SHALL BE PROVIDED AFTER EVERY 2.4M CLEAR SPACING. ADDITIONAL TIE BEAMS SHALL BE PROVIDED TO SATISFY THE SPACING OF TIE BEAMS

Vetted

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NOTE:- FOR NOTES REFER DRG. NO. REV:- 130193

PROJECT:-
STP I, 15KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- FOUNDATION & COLUMN DETAIL

PROJ. Mgr.- TCS/ BY
DRG. No. - 130/01

DATE	SCALE	DRAWN BY	DESIGN BY
16-04-2018	N.T.S.	PRAVEEN	KAPINJAL

CHECKED BY R.J

REVISION DRG	DATED	DETAILS OF REVISION
REVISION - 1		
REVISION - 2		
REVISION - 3		

DRAWING RELEASED FOR:- TENDER APPROVAL

CONTRACTOR:- For IBM CEIPL "N" JV - (IBM - CEIPL)
Auth. Signatory

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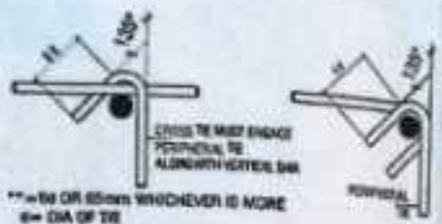
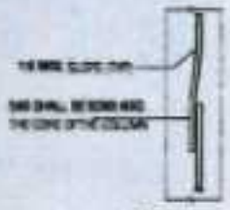
Power Construction Limited Dehradun

TYPICAL DETAIL OF CONTINUOUS SLAB
(LAP LOCATIONS ARE INDICATIVE AND SHALL BE AVOIDED IF POSSIBLE)
* = SHOULD NOT BE LESS THAN Ld

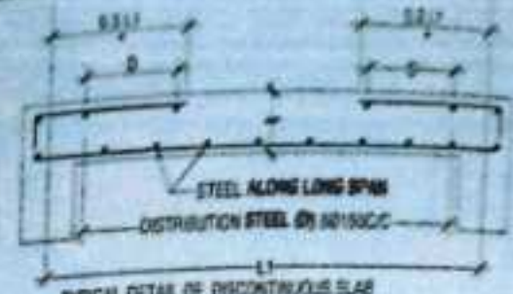


**= 6d OR 65mm WHICHEVER IS MORE
d= DIA OF TIE

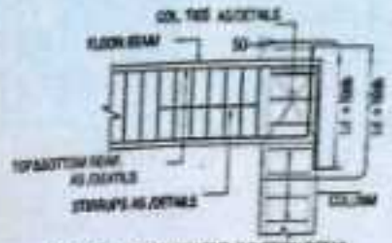
COLUMN TIE END DETAILS AS PER IS13920



NOTATIONS:-
NGL = NATURAL GROUND LEVEL
PCC = PLAIN CEMENT CONCRETE
RCC = REINFORCED CEMENT CONCRETE
THK = THICKNESS/ THICK
Ld = DEVELOPMENT LENGTH
(BTM) = BOTH WAYS
(T) = TOP
(B) = BOTTOM

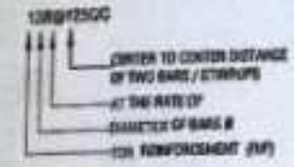


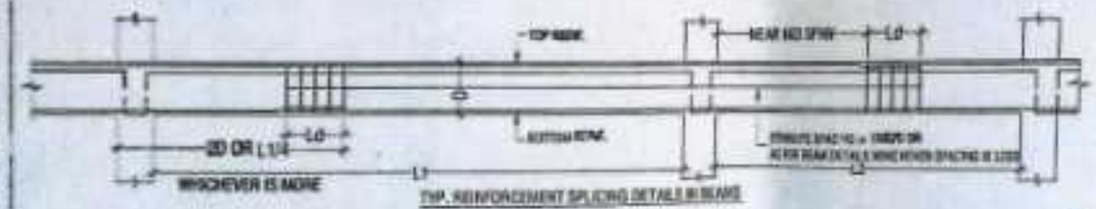
TYPICAL DETAIL OF DISCONTINUOUS SLAB
* = SHOULD NOT BE LESS THAN Ld



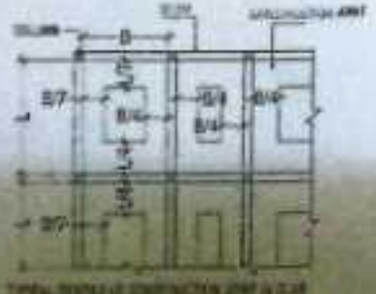
TYP. BEAM & COLUMN END JUNCTION DETAIL

(TYP. SECTION OF 2-LEGGED STIRRUPS)





TYP. REINFORCEMENT SPLICING DETAILS IN BEAMS



TYPICAL DETAILS OF CONSTRUCTION JOINT IN SLAB

TYPICAL STRUCTURE REINFORCED

Vetted
&
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PROJECT:
STP 1, 75KLD., ANGOP NEG SCHOOL, REDMAPRAYAG

CLIENT: THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE: TYPICAL DETAIL

DATE | SCALE | DRAWN BY | DESIGN BY
26-04-2018 | N.T.S. | PRAVEEN | GOPAL

CHECKED BY: S.J.

REVISION DRG. DATED DETAILS OF REVISION
REVISION - 1
REVISION - 2
REVISION - 3

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CONTRACTOR: For ITEM CEPL-JV
JV - CEPL - CEPL

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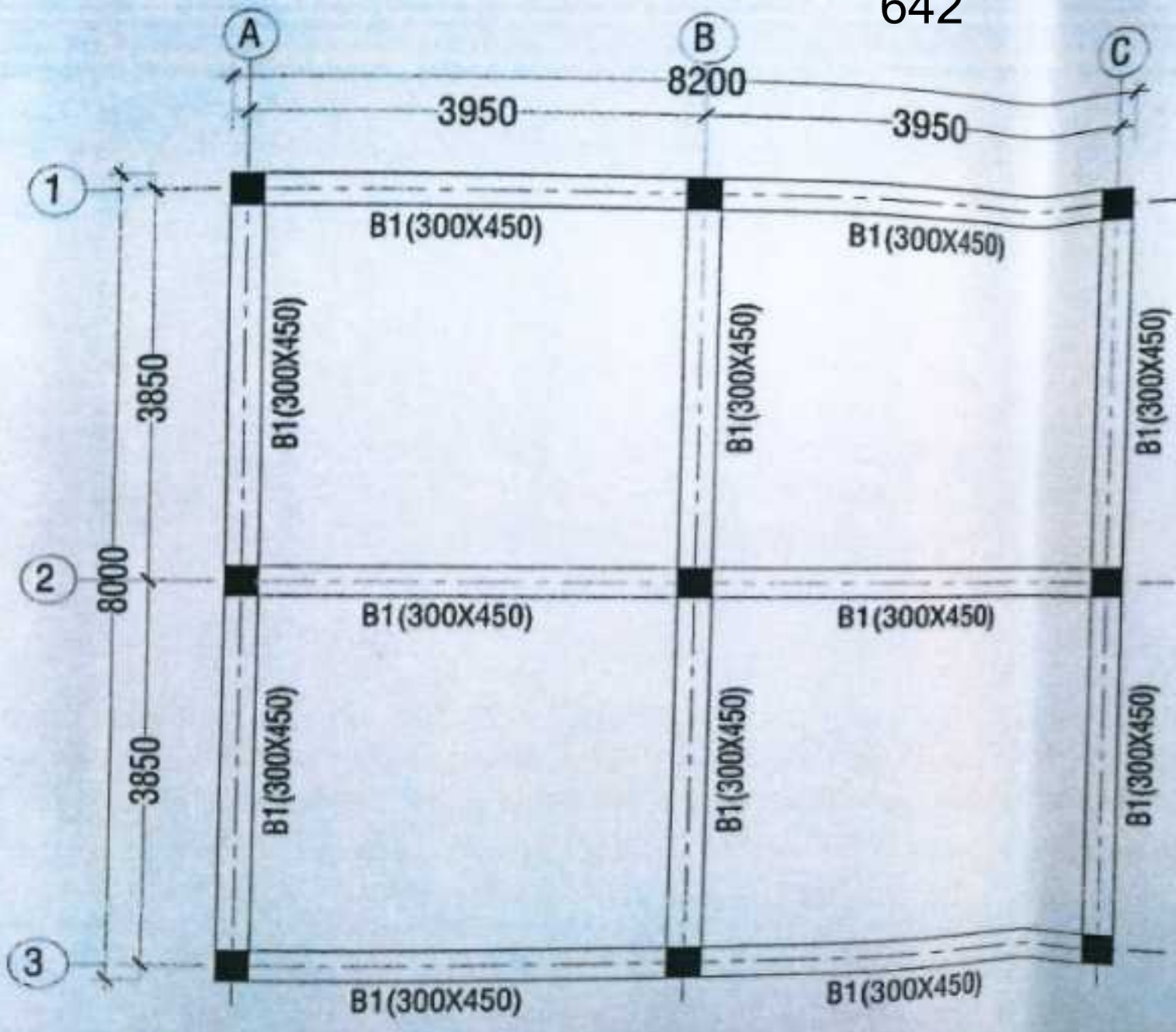

Verified

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Rudrap-247667, Uttarakhand

NOTE - FOR NOTES REFER DRAWING No:- 1/2010

PROJECT:
ATP I, 75KLD , 4/100P NEGI SCHOOL, RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:
PUNTI STAN DETAIL

DRG No:- 1/2010

DATE	SCALE	DRAWN BY	DESIGN BY
25-04-2018	N.T.S.	PRAVEEN	KAPRUAL
CHECKED BY		R.J	

REVISION DRG	DATED	DETAILS OF REVISION
REVISION - 1		
REVISION - 2		
REVISION - 3		

DRAWING RELEASED TENDER

For J&M CEPL - JV

CONTRACTOR:- JV - (J&M - CEPL)

Water Construction Limited
Dehradun

A B C

1 2 3

3950 3950 8200

C1 C1 C1

C1 C1 C1

TOE WALL

650

8000

7700

MEMBER DETAIL

N.G.L. 230

1000 300 100

150

TYPICAL DETAIL OF TOE WALL

Vetted

&

PROJECT:

STP L 75MLD , AVDHP NEGI SCHOOL, RUDRAPRAYAG

CLIENT: THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE: STPL COLUMN LAYOUT PLAN

DATE: 31-05-2018 SCALE: N.T.S. DRAWN BY: PRAVEEN DESIGN BY: KAPPLAL

CHECKED BY: RJ

REVISION NO. DATED DETAILS OF REVISION

REVISION - 1

REVISION - 2

REVISION - 3

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CONTRACTOR: JV - (3BM - CEIPL)

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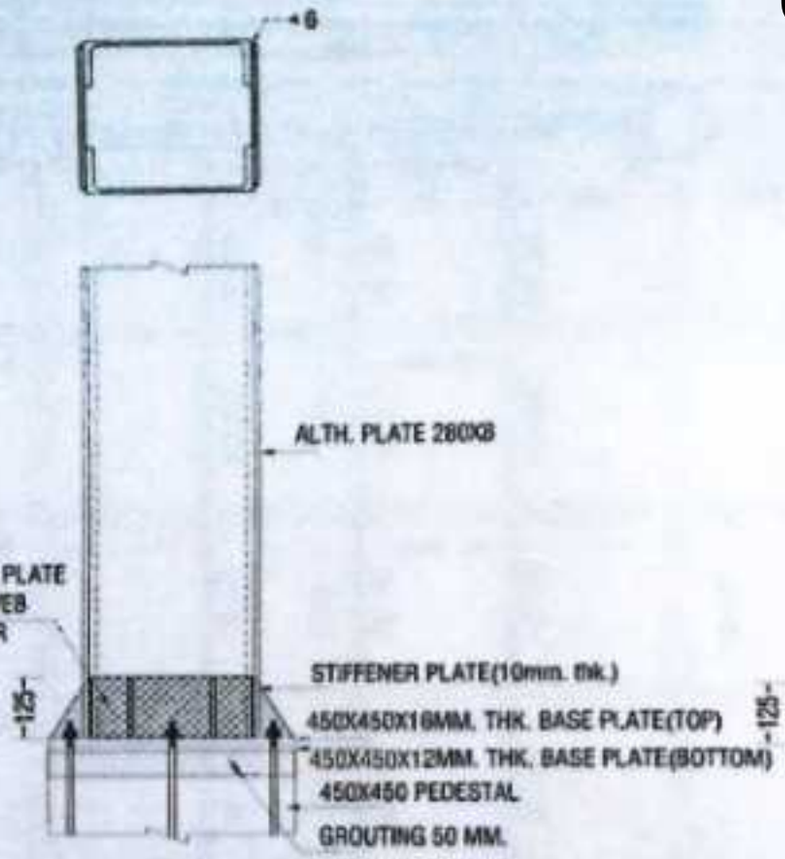
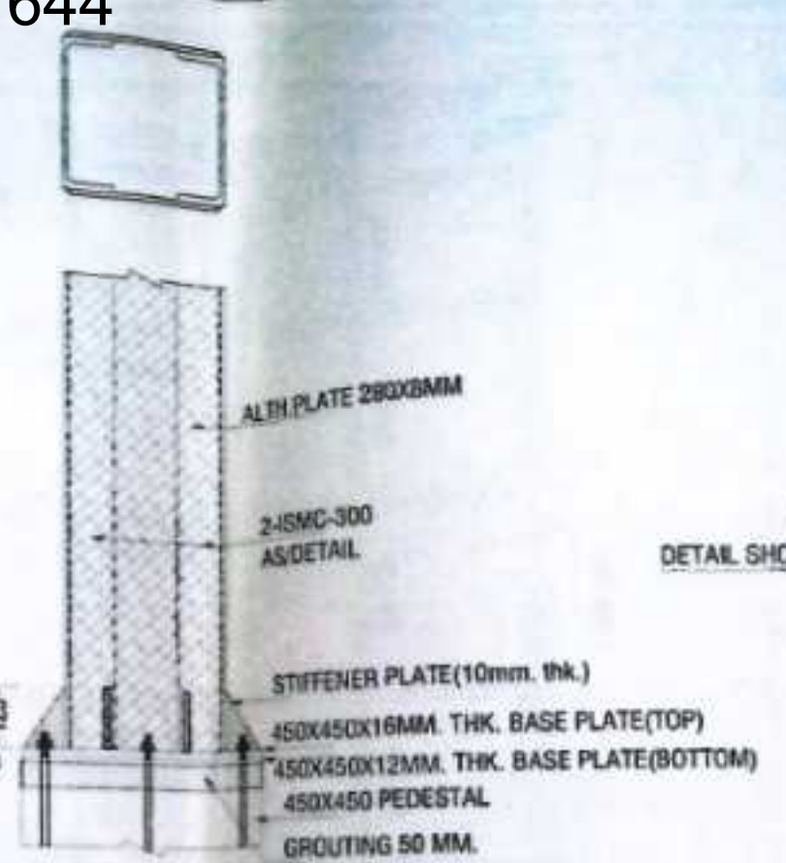
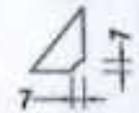
DESIGN STUDIO PVT. LTD. DEHRADUN



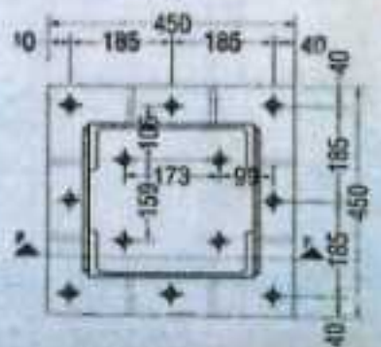
SECTION AT P-P
(ELEVATION)

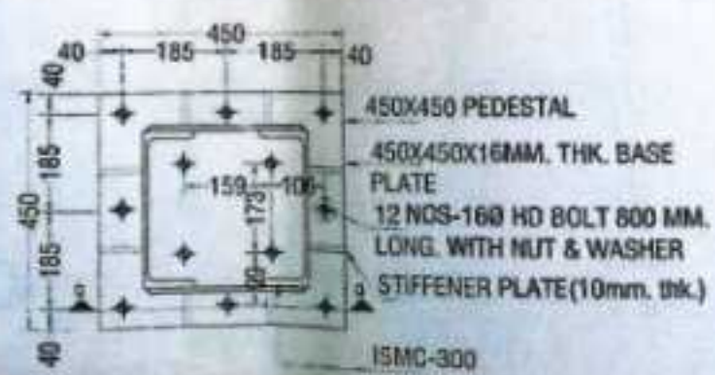


SECTION AT Q-Q
(ELEVATION)



DETAIL SHOWING COPING IN STIFFENER





DETAIL OF BASE PLATE
(TOP PLAN)

NOTE :- FOR NOTES REFER DRAWING NO. 135/05

PROJECT :- STEEL TRUSS BRIDGE, STEEL BRIDGE, RUDRAPRAYAG

CLIENT :- THE UTTARAKHAND PETZAL NIGAM, DEHRADUN

TITLE :- COLUMN DETAIL

PROJ. No. :- TCS/05/135

DRG No. :- 05/05

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2016	N.T.S	PRAVEEN	KAPIL/RJ

CHECKED BY :- R.J.

REVISION DRG. DATED	DETAILS OF REVISION
REVISION - 1	
REVISION - 2	
REVISION - 3	

DRAWING RELEASED FOR :- TENDER APPROVAL ✓ / G.F.C

CONTRACTOR :- JV - (JBM - CEIPL)

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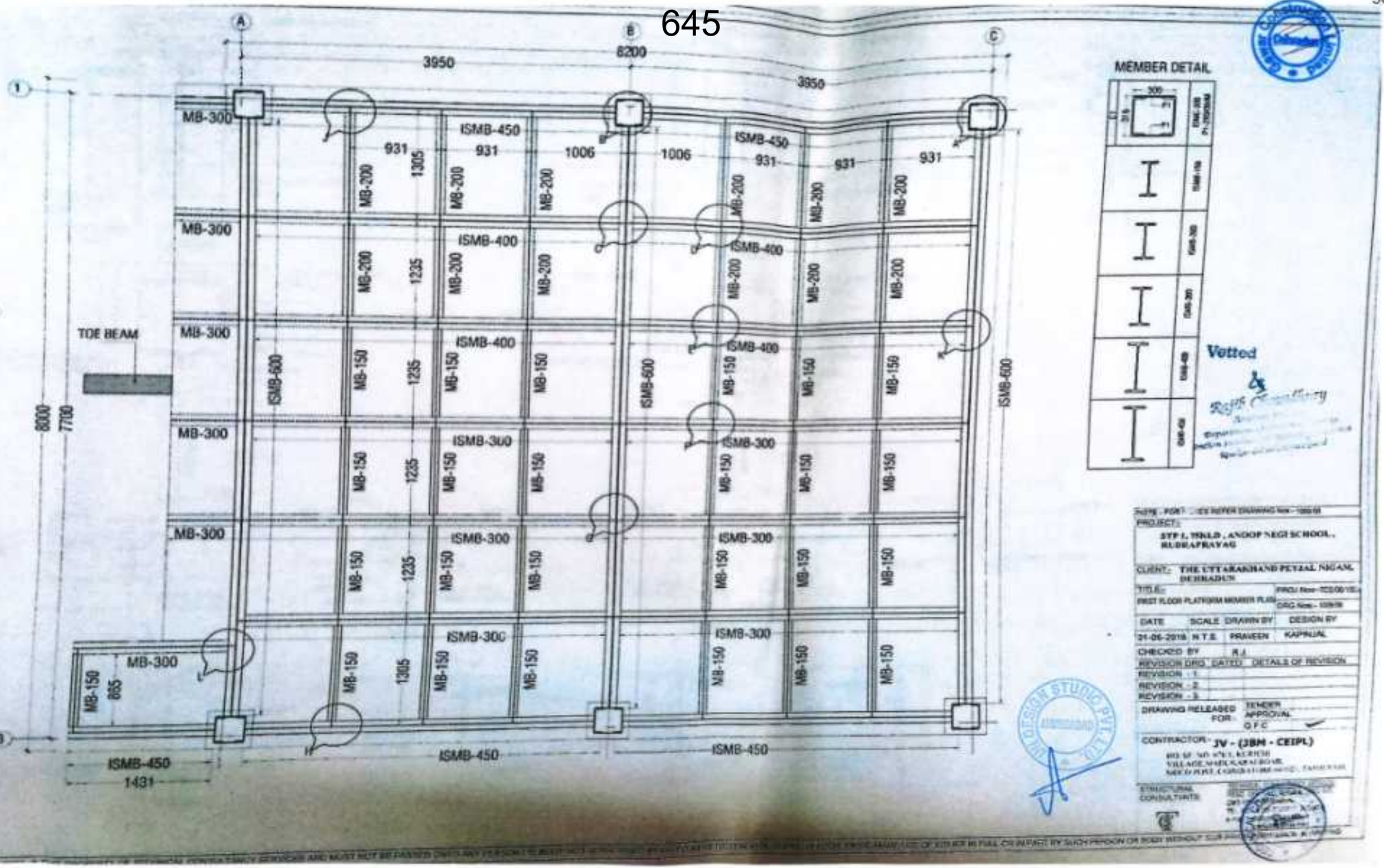
645


A
B
C
1
3
3950
6200
3950
MB-300
MB-200
MB-150
ISMB-450
ISMB-400
ISMB-300
ISMB-600
931
1006
1305
1235
865
1431
TOE BEAM
8000
7700
ISMB-450
ISMB-450
ISMB-600
MEMBER DETAIL
Vetted
DESIGN STUDIO PVT. LTD.
PROJECT:
STP I, 9MLD, ANOOP NEGI SCHOOL, RUDRAPRAYAG
CLIENT: THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN
TITLE:
FIRST FLOOR PLATFORM MEMBER PLAN
DATE
SCALE
DRAWN BY
DESIGN BY
21-06-2018
N.T.S.
PRAVEEN
KAPNIJAL
CHECKED BY
REVISION DRG. DATED
DETAILS OF REVISION
REVISION - 1
REVISION - 2
REVISION - 3
DRAWING RELEASED FOR:
TENDER
APPROVAL
G.F.C
CONTRACTOR:
JV - (JBM - CEIPL)
STRUCTURAL CONSULTANTS

ELEVATION

ELEVATION

DETAIL-C

DETAIL-A

PLAN

DETAIL-B

PLAN

DETAIL-D

DETAIL-E

DETAIL-F

DETAIL-L

DETAIL-G

DETAIL-H

DETAIL-J

DETAIL-K

Vetted

NOTE : FOR NOTES REFER DRAWING No.- DB/01

PROJECT :-

STP L 35MLD , ANOOP NEGI SCHOOL , RISHIKESH

CLIENT :- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE :- JOINT DETAIL

PROJ.Nos.- 103/37/DB

DRG Nos.- 104/37

DATE	SCALE	DRAWN BY	DESIGN BY
29-04-2016	N.T.S	PRAVEEN	KAPINJAL

CHECKED BY :- R.J.

REVISION DRG. DATED	DETAILS OF REVISION
REVISION - 1	
REVISION - 2	
REVISION - 3	

DRAWING RELEASED FOR:- TENDER APPROVAL ✓ G.F.C

CONTRACTOR :- JV - (JBM - CEIPL)

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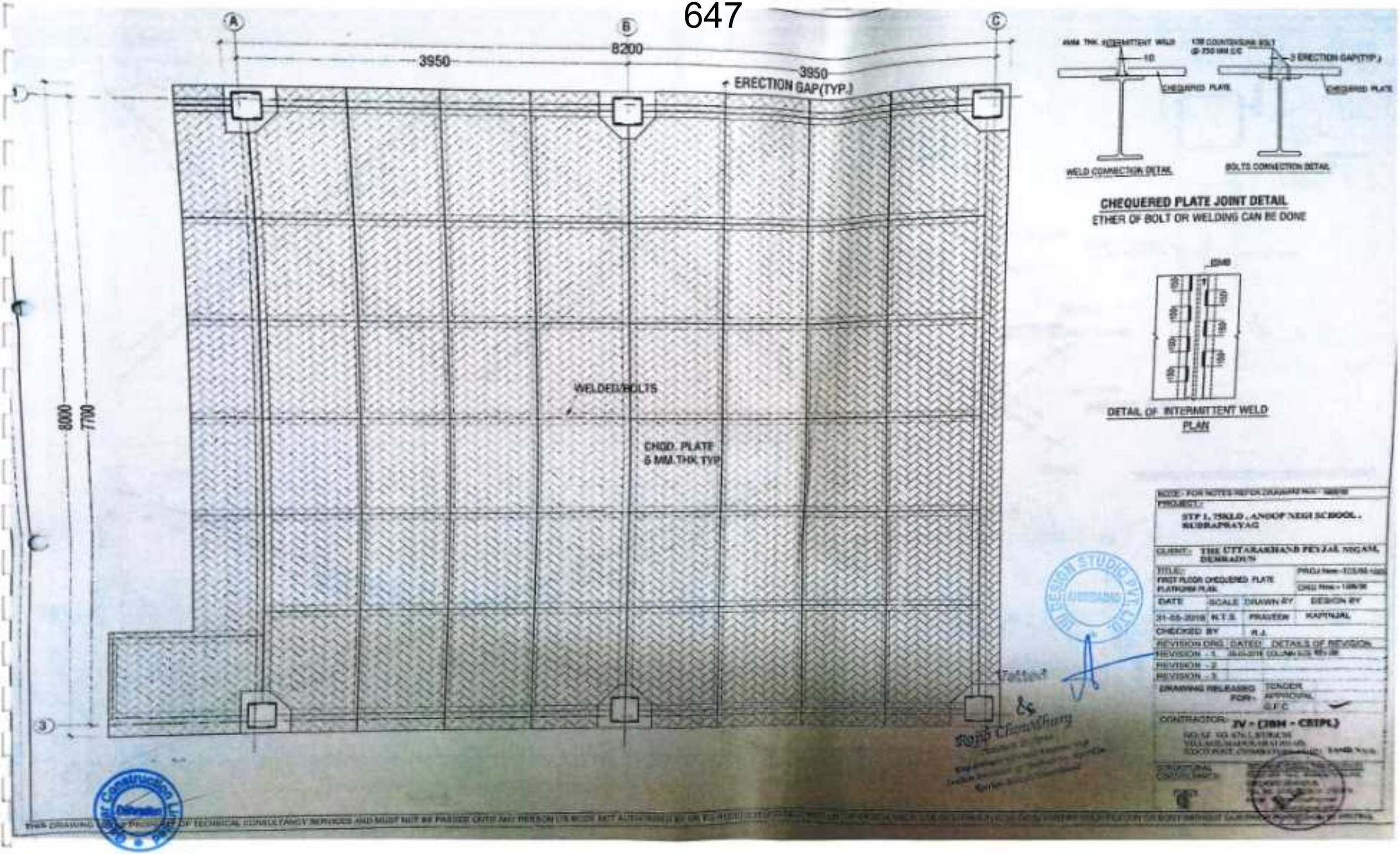
647



CHEQUERED PLATE JOINT DETAIL

ETHER OF BOLT OR WELDING CAN BE DONE

DETAIL OF INTERMITTENT WELD

PLAN

PROJECT: STP 1, 75MLD, ANDOP NEGI SCHOOL, RUDRAPRAYAG			
CLIENT: THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN			
TITLE: FIRST FLOOR CHEQUERED PLATE PLATFORM PLAN			PROJ Nos: 1335/16-1353 CHQ Nos: 1386/36
DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPIYAL
CHECKED BY	R.J.		
REVISION DRG	DATED	DETAILS OF REVISION	
REVISION - 1	26-07-2018	COLUMN C/L REVISED	
REVISION - 2			
REVISION - 3			
DRAWING RELEASED FOR:-	TENDER APPROVAL G.F.C. ✓		
CONTRACTOR: JV - (JBH - CETPL)			

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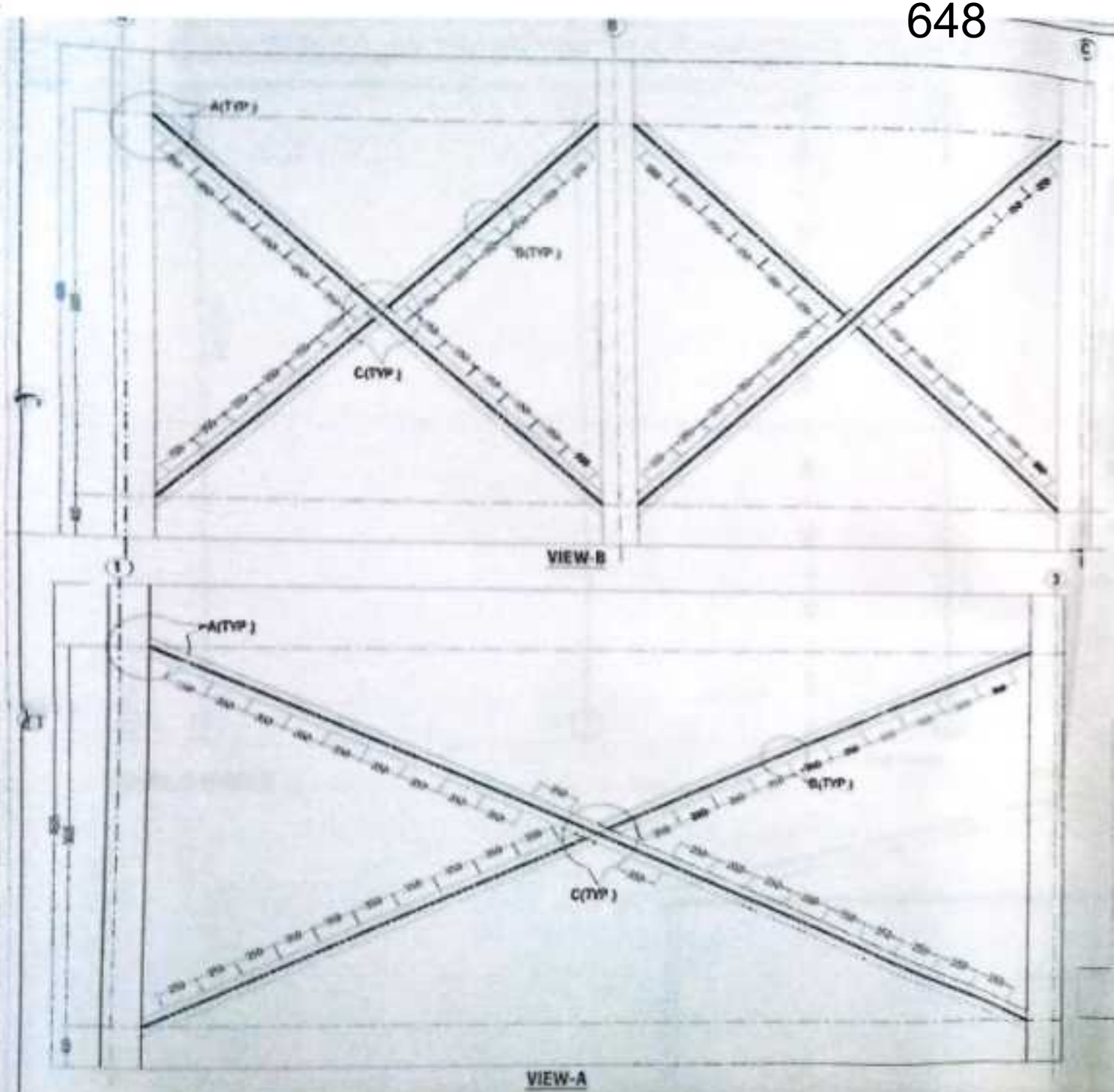

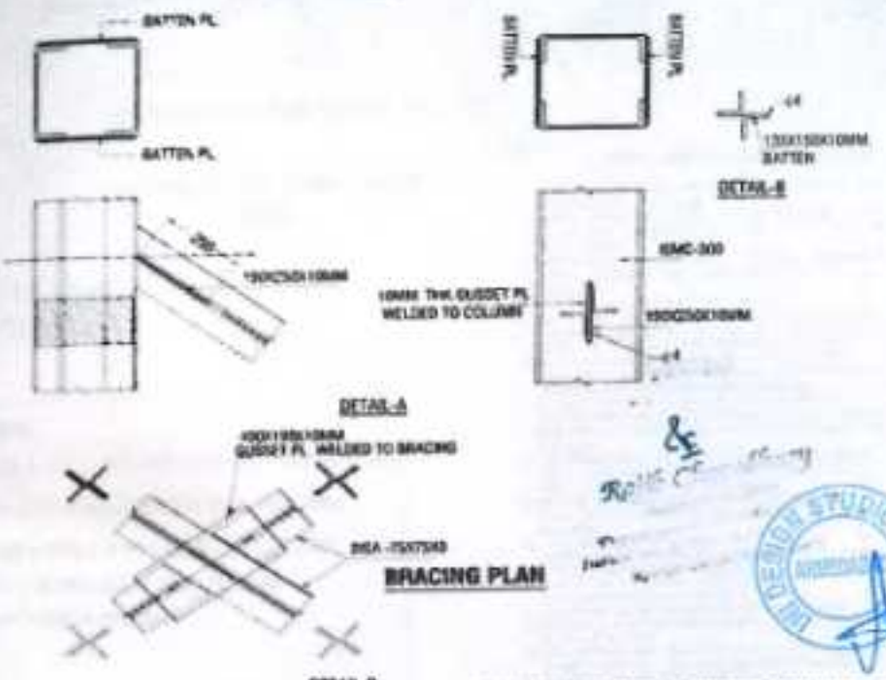

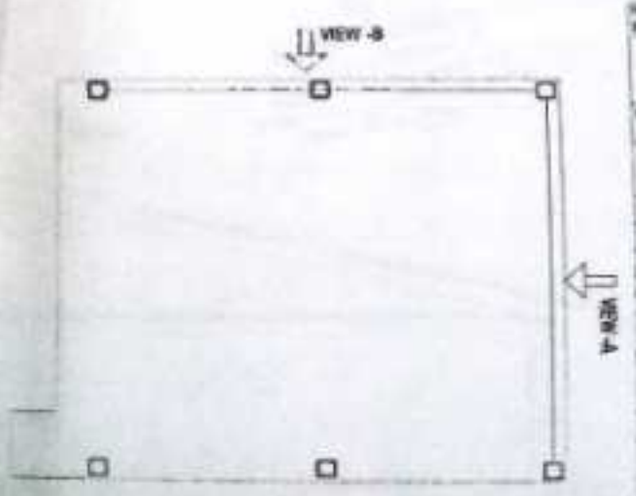

NOTE :- FOR NOTES REFER DRAWING No.- 1(R/0)

PROJECT :-
EFP 1, 75MLD., ANOOP NEGI SCHOOL, RUDRAPRAYAG

CLIENT :- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE :- BRACING DETAIL

PROJ No.- 1,2/0 1000

DRG No.- 1000

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPINJAL

CHECKED BY :- R.J.

REVISION DRG.	DATED	DETAILS OF REVISION
REVISION - 1	29-09-2018	EQUIMN SIZE REVISE
REVISION - 2		
REVISION - 3		

DRAWING RELEASED FOR :- TENDER / APPROVAL / G.F.C. ✓

CONTRACTOR :- JV - (JBM - CEIPL)

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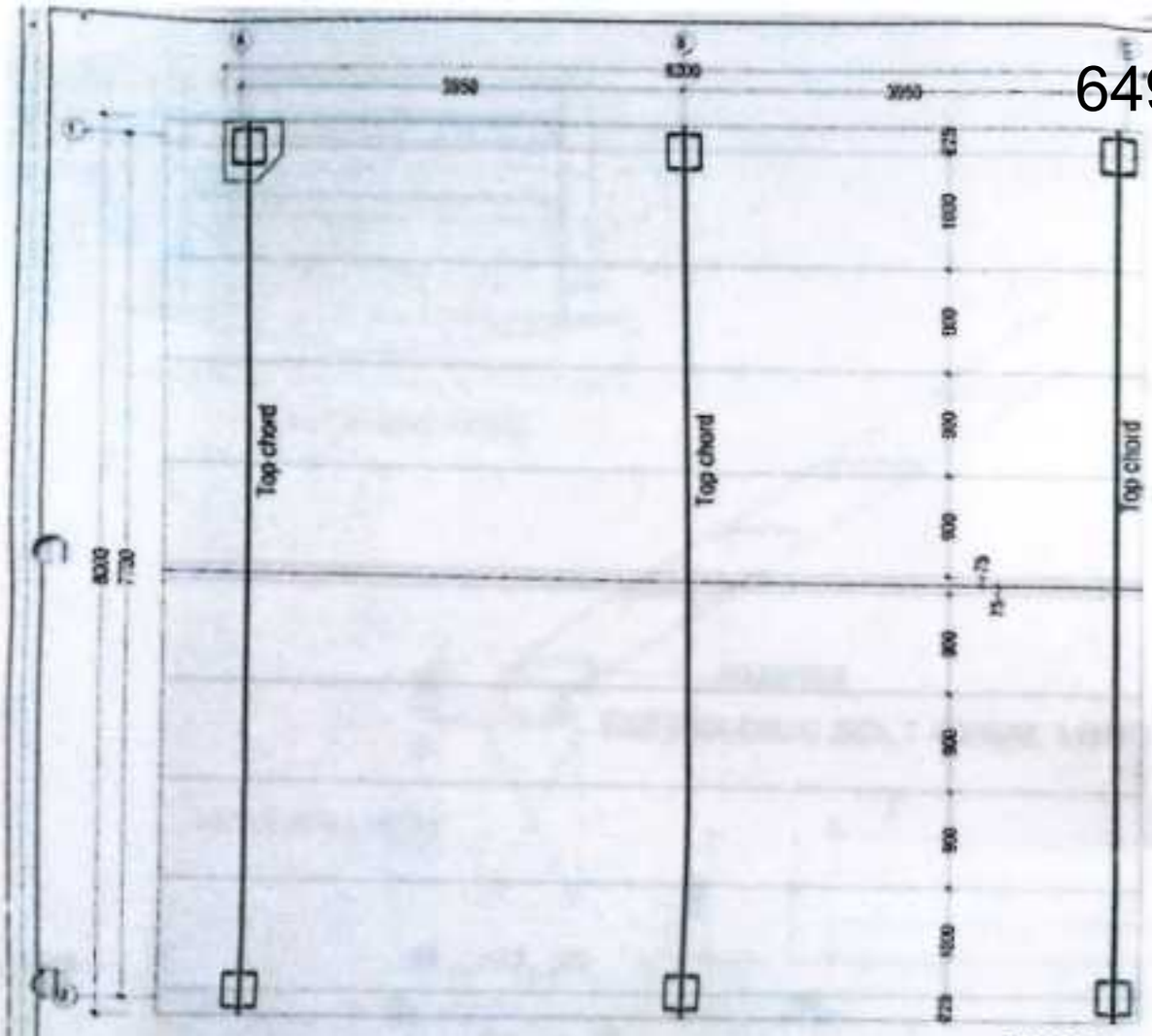
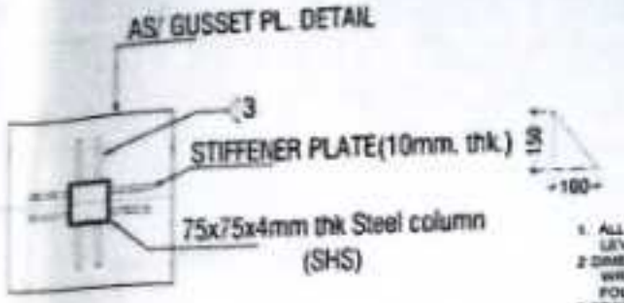




STEEL COLUMN
(TOP PLAN)

LEGENDS

1	1	125 x 125 x 4.5 mm SHS BOTTOM CHORD
2	2	75 x 75 X 4mm SHS STEEL COLUMN
3	3	100 x 100 x 4 mm SHS TOP CHORD
4	4	90 x 90 X 4.5mm SHS PURLIN

SHS-Square hollow section

(APPLICABLE TO ALL DRAWINGS)

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS.
2. DIMENSIONS ARE NOT TO BE SCALED ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. STIFFENERS & BRACING - STEEL (GRADE E -250, QUALITY-BR CONFORMING TO IS : 2062:2011
4. BOLTS SHALL BE OF GRADE 8.8
5. ALL BOLTS AND NUTS SHALL CONFORM TO LATEST VERSIONS OF IS 1363, IS 1364, IS 1367, IS 3640, IS 3757, IS 6623 AND IS 6623AS APPROPRIATE.
6. DURING WELDING POSITION OF MEMBERS AND ASSEMBLY SHOULD BE SUCH THAT OVERHEAD WELDING SHALL BE AVOIDED / MINIMISED
7. ALL ELECTRODES SHALL BE OF DESIGNATION E41XX WITH ULTIMATE STRESS OF 410-510 MPA & MIN YIELD STRESS OF 330 MPA CONFORMING TO IS 814:2004
8. WELDING SHALL BE DONE AT FABRICATION SHOP ONLY SITE WELDING SHALL BE ALLOWED ONLY FOR FIXING OF CHEQUERED PLATE
9. BEFORE FABRICATION WELDING PROCEDURE SHALL BE APPROVED BY THE ENGINEER IN CHARGE
10. ALL FABRICATED MEMBER SHALL BE THOROUGHLY WASHED WITH 5% PHOSPHORIC ACID SOLUTION TO REMOVE ALL LOOSE SCALE AND RUST WITH WIRE BRUSHING AND SUPPINGS AND BLASTING AS REQUIRED
11. WELD THK SHALL BE AS PER DETAILS GIVEN
12. FABRICATION & WELDING SHALL BE DONE AS PER IS 816 & IS 1024
13. ALL OBTUSE ANGLE CUTTING SHOULD BE DONE IN PROPER SHAPE AND WITHOUT ANY DAMAGE
14. PAINTING SHALL BE AS PER TENDER SPECIFICATIONS

NOTE :- FOR NOTES REFER DRAWING Nos.- 1001/02

PROJECT :-
STP I, TEHLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG

CLIENT :- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE :-
TRUSS DETAIL

PROJ.Nos.- TCE/12/1001
DRG Nos.- 1001/12

DATE	SCALE	DRAWN BY	DESIGN BY
21-03-2018	N.T.S.	PRAVEEN	KAPIL PAL

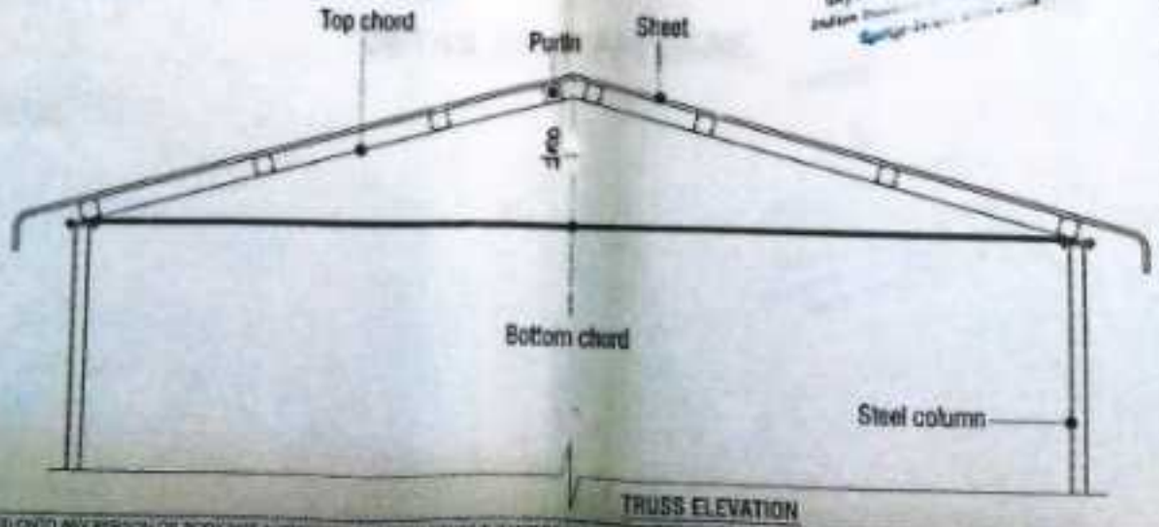
CHECKED BY R.J

REVISION DRG. DATED	DETAILS OF REVISION
REVISION - 1	05-09-2018 COLUMN SIZE REVISED
REVISION - 2	
REVISION - 3	

DRAWING RELEASED FOR:- TENDER / APPROVAL / GFC ✓

CONTRACTOR:- JV - (JBM - CEIPL)

STRUCTURAL CONSULTANTS



TRUSS ELEVATION

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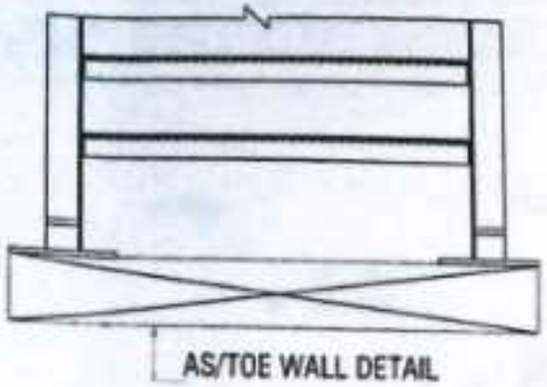
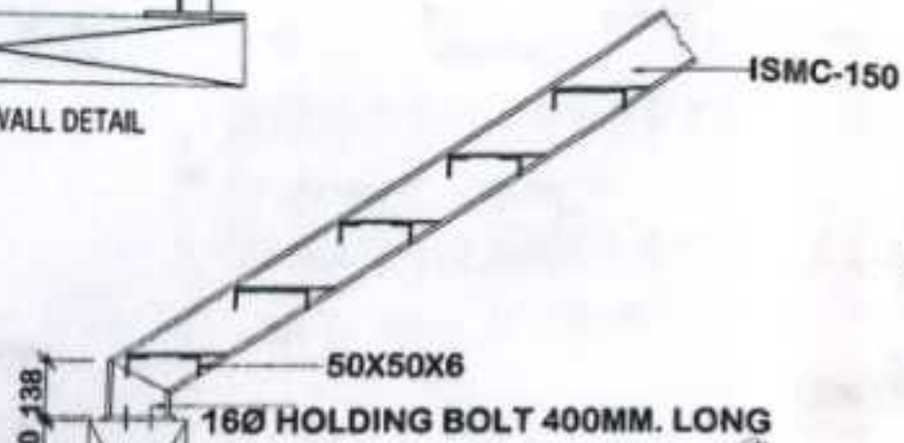
650



AS/TOE WALL DETAIL



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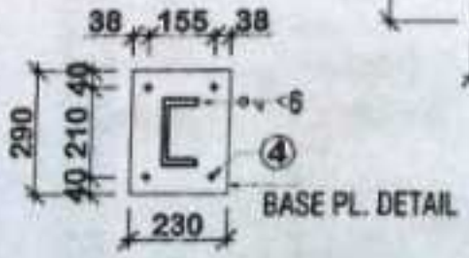
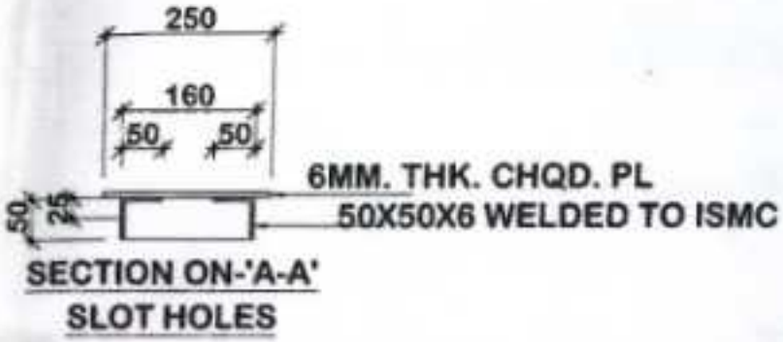
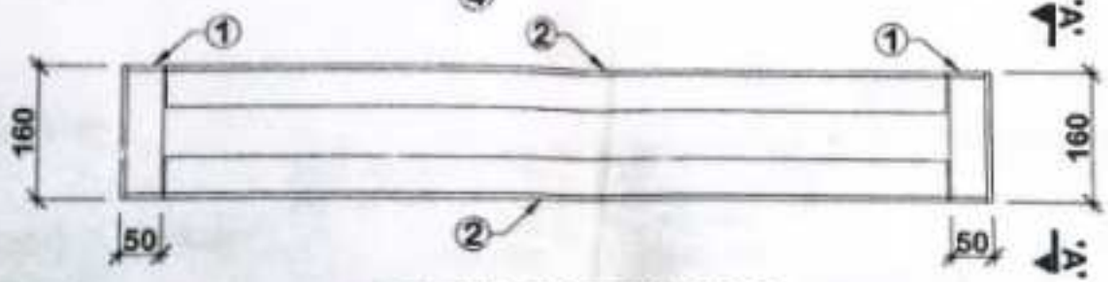


BASE PL. DETAIL



SECTION ON-'A-A'
SLOT HOLES



DETAIL OF STAIR CASE.

Vetted
&
Rajib Chowdhury

PROJECT:-	STP L.THLD., ANOOP NEGI SCHOOL., RUDRAPRAYAG		
CLIENT:-	THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN		
TITLE:-	STAIR CASE DETAIL	DRG.No.-	
DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPIL LAL
CHECKED BY	R.J.		
REVISION DRG.	DATED	DETAILS OF REVISION	
REVISION - 1			
REVISION - 2			
REVISION - 3			
DRAWING RELEASED FOR:-	TENDER APPROVAL		
	G.F.C.	✓	
CONTRACTOR:-	JV - (JBM - CEIPL)		
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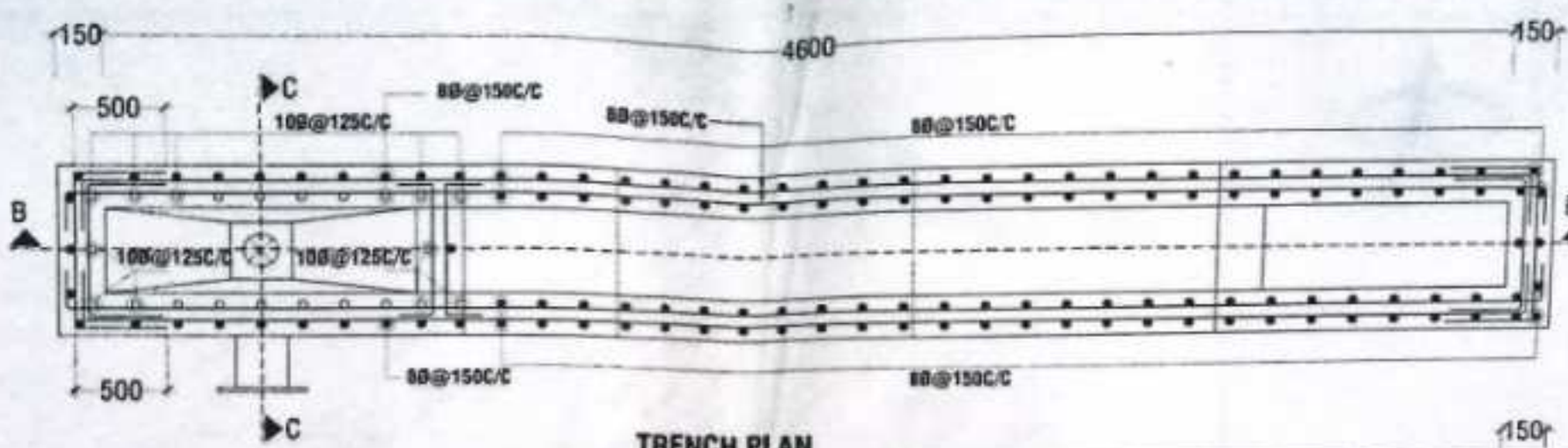
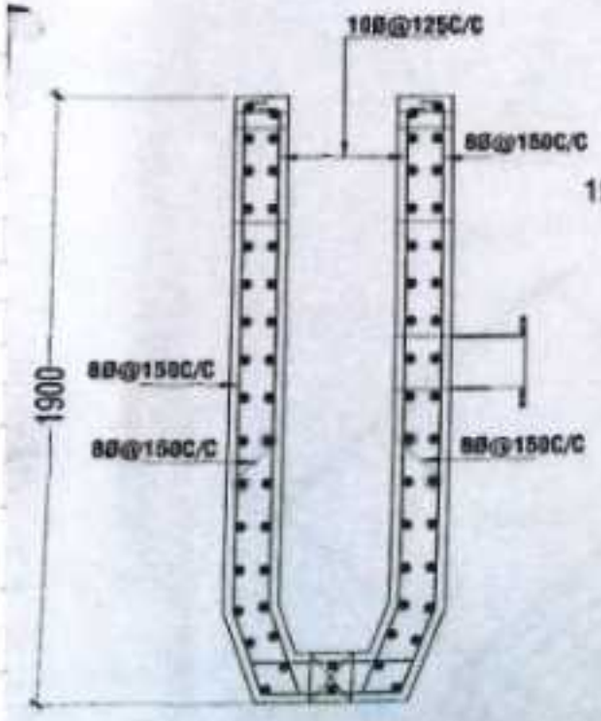
BAR DETAIL

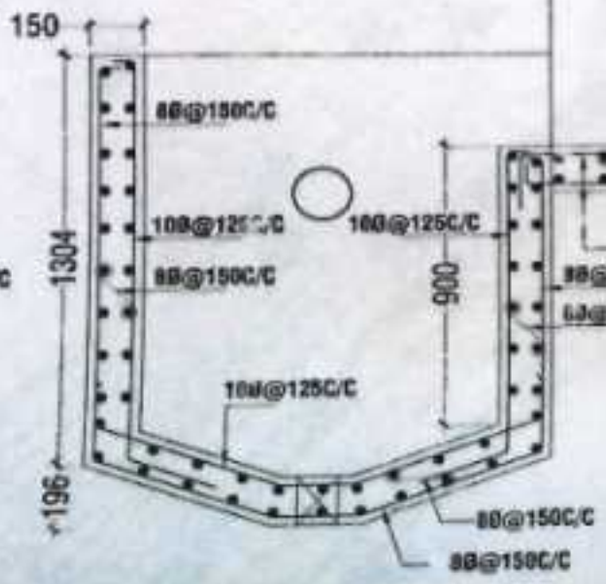
10Ø@125C/C

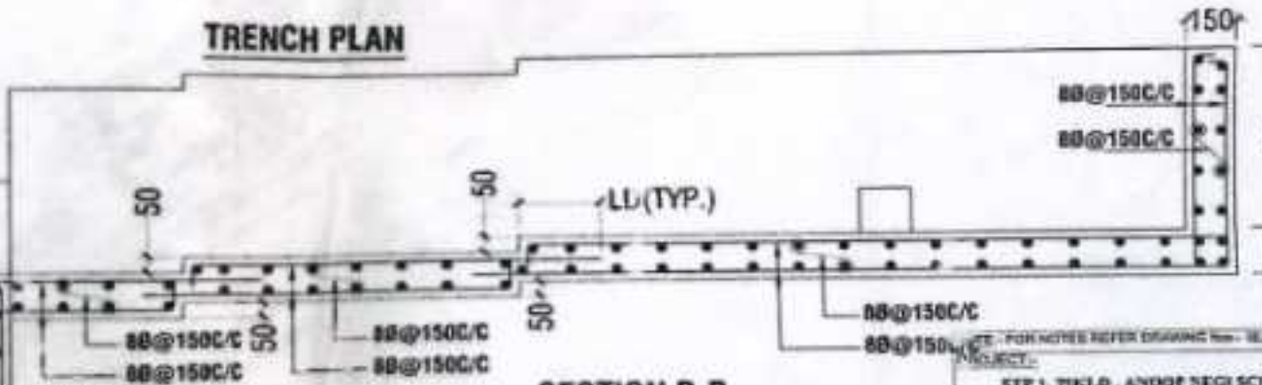
8Ø@150C/C





SECTION C-C





SECTION B-B

Vetted
&
Raja Chaudhury

Department of Civil Engineering
Indian Institute of Technology Roorkee
Roorkee-247667, Uttarakhand

DESIGN STUDIO PVT. LTD.

Owner Construction Limited
Dehradun

PROJECT:- STP 1, 75KLD , ANOOP NEGI SCHOOL, RUDRAPRAYAG

CLIENT:- THE UTTARAKHAND PEYJAL NIGAM, DEHRADUN

TITLE:- TRENCH DETAIL

PROJ No:-102/12/005

DRG No:- 005/2

DATE	SCALE	DRAWN BY	DESIGN BY
31-05-2018	N.T.S.	PRAVEEN	KAPIL/RJ
CHECKED BY		R.J.	

REVISION DRG.	DATED	DETAILS OF REVISION
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REVISION - 2.		
REVISION - 3.		

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CONTRACTOR:- JV - (JBM - CEIPL)

NO.SF.NO 67/1, 67/2/3D1
VILLAGE MADEVAMBOVIL
SIDCO (W)SO, COIMBATORE (DIST), TAMILNADU

STRUCTURAL CONSULTANTS

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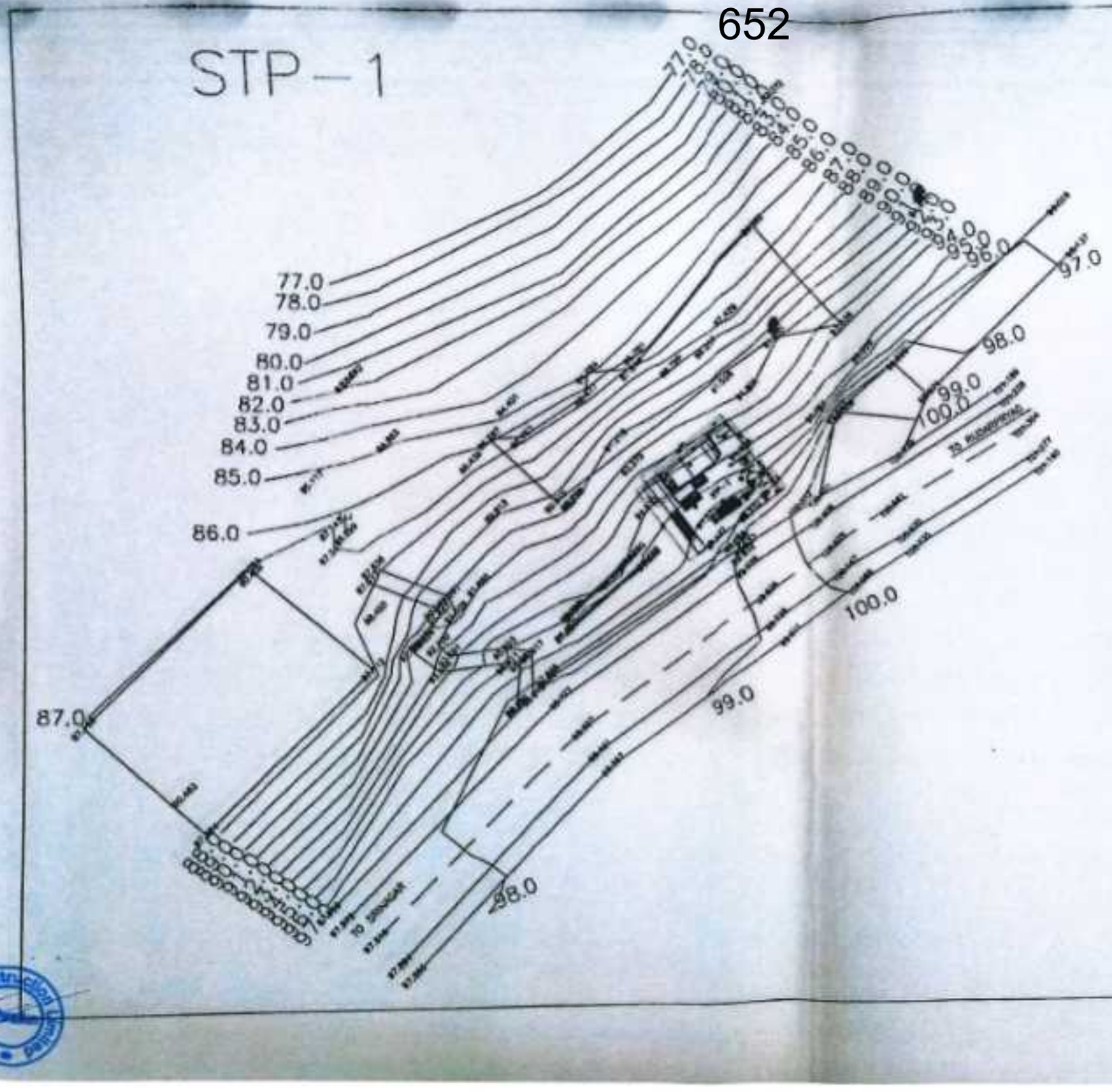
STP – 1



PROJECT:

CLIENT:

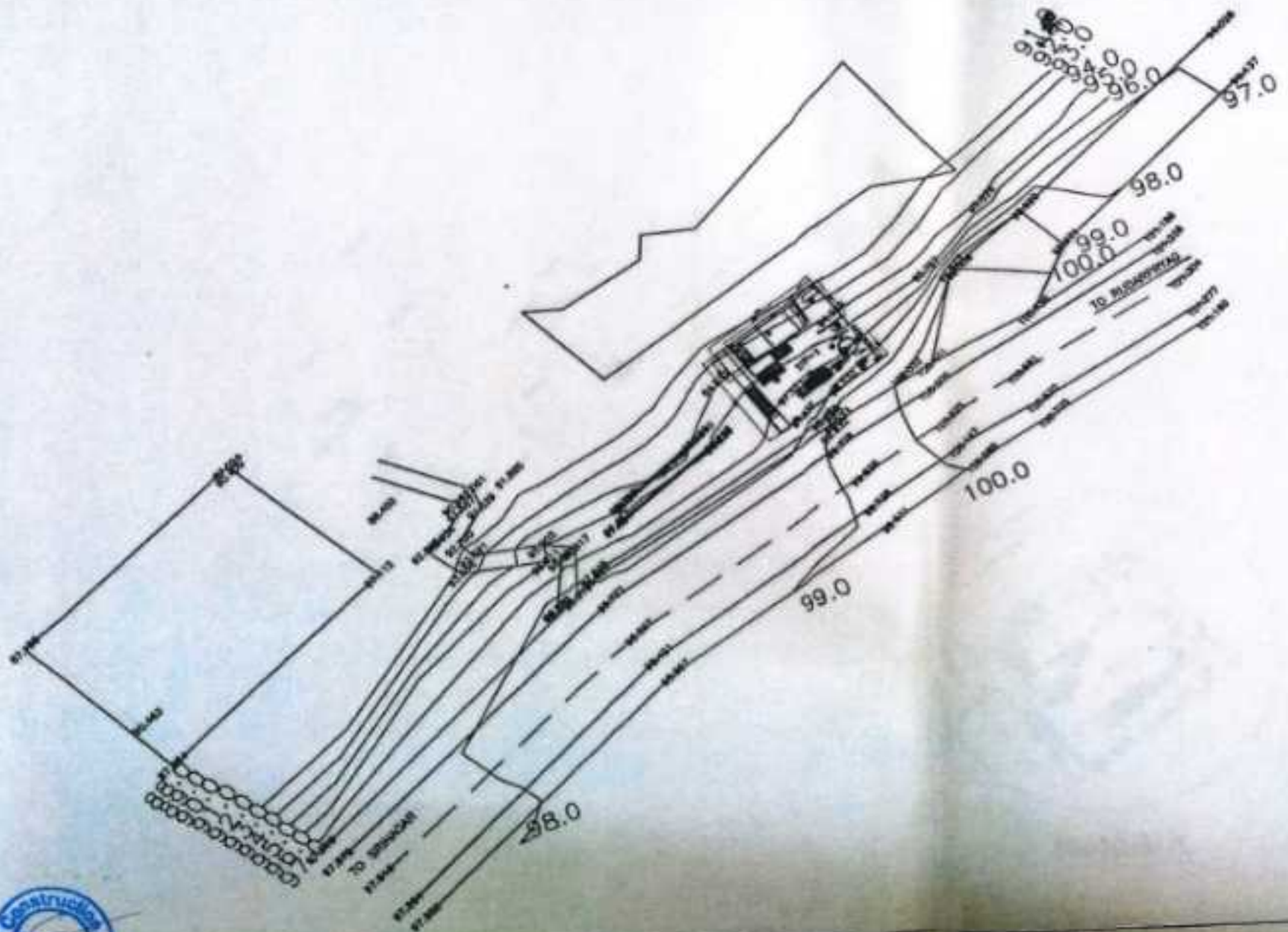
LOA NO:

REF. NO:

SHEET TITLE:
SITE LAYOUT PLAN

STRUCTURAL DESIGN
JV - (JBH - CEPL)
S.F.NO:678/1, Kuruchi Village,
Madukarai Road,

STP – 1



PROJECT:
CAPACITY (TPA) AT, NEAR ANOOP NSCI SCHOOL,

CLIENT:
THE UTTARADHARMAPRIYAL NIGAM, DEHRADUN

LOA. NO:w/93/karya-10/107 DATED 25.10.17

REF. NO: CB-15/UM/2017-2018

NO.	REVISION	DESCRIPTION	DD
	-	-	

SHEET TITLE:
KEY PLAN

DRAWN BY:

CHECKED BY:

DESIGN BY:

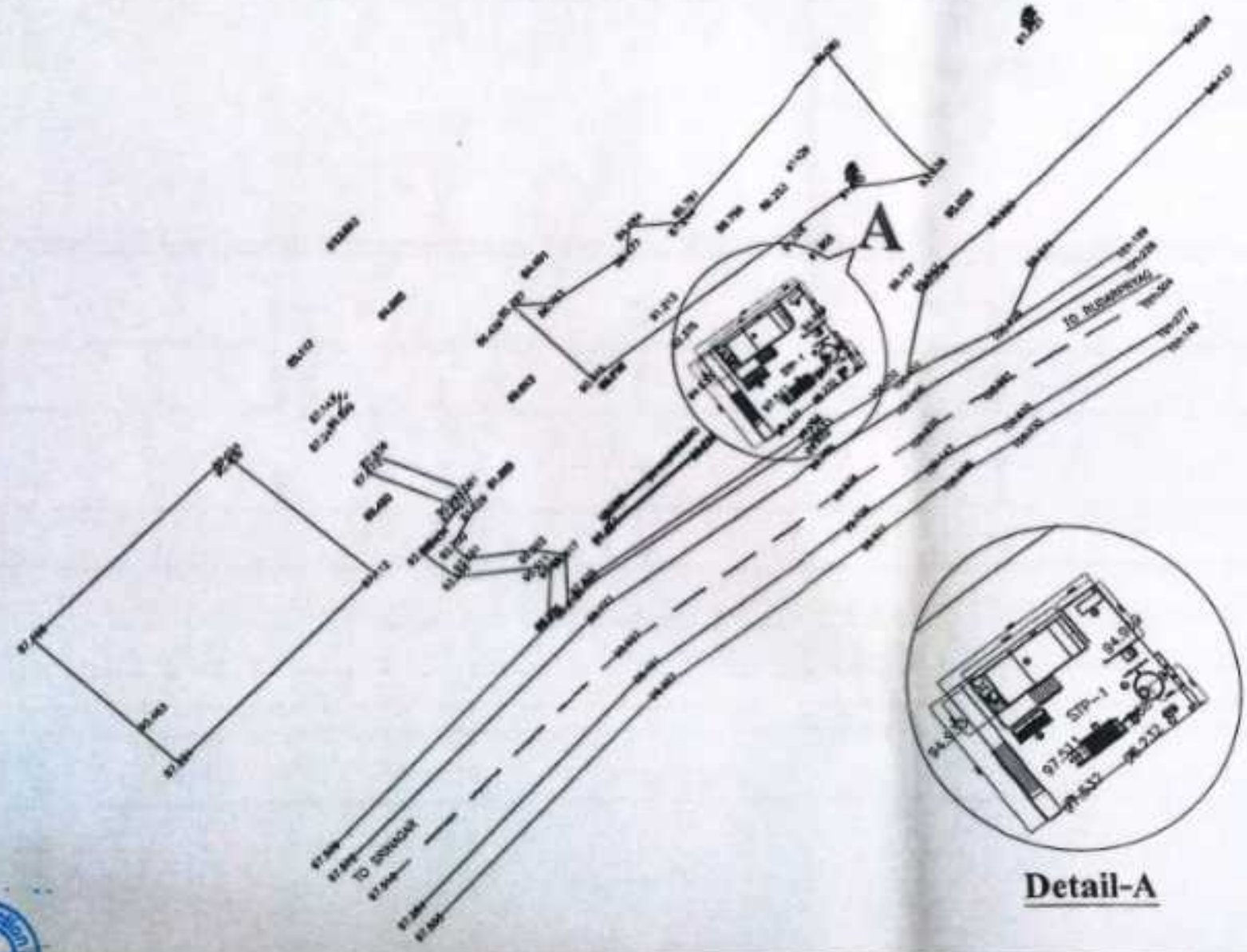
APPD BY:

SCALE:

SHEET NO:

STRUCTURAL DESIGN
JV - (JBM - CEIPL)
S.F.NO:678/1, Kurichi Village,
Madukarai Road,
Coimbatore-641 021
Phone: 0422 - 2430000

STP – 1



Detail-A

PROJECT:

CLIENT:

LOA, NO:

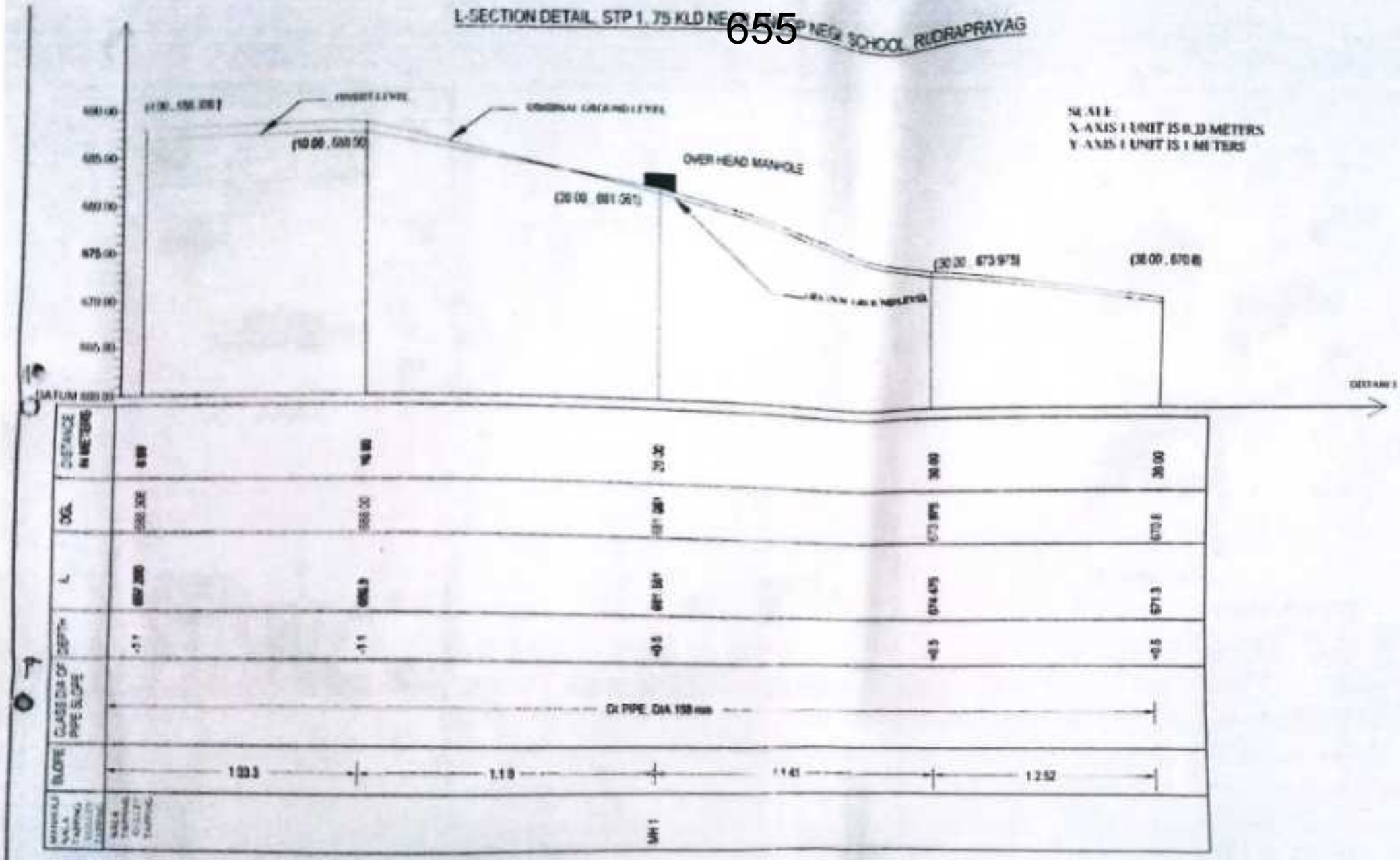
REF. NO:

SHEET TITLE:
SITE PLAN

STRUCTURAL DESIGN
JV - (JBM - CEIPL)
S.F.NO:678/1, Kurichi Village,
Madukarai Road.

655

L-SECTION DETAIL STP 1.75 KLD NE[illegible] NEAR SCHOOL RUDRAPRAYAG



M/S DESIGN STUDIO PVT. LTD.
Rishikesh Construction Limited

STP I, 75KLD , ANOOP NEGI SCHOOL, RUDRAPRAYAG

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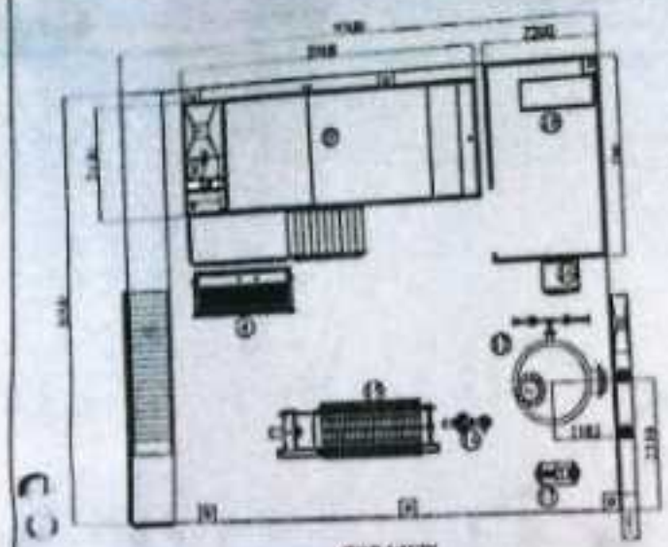
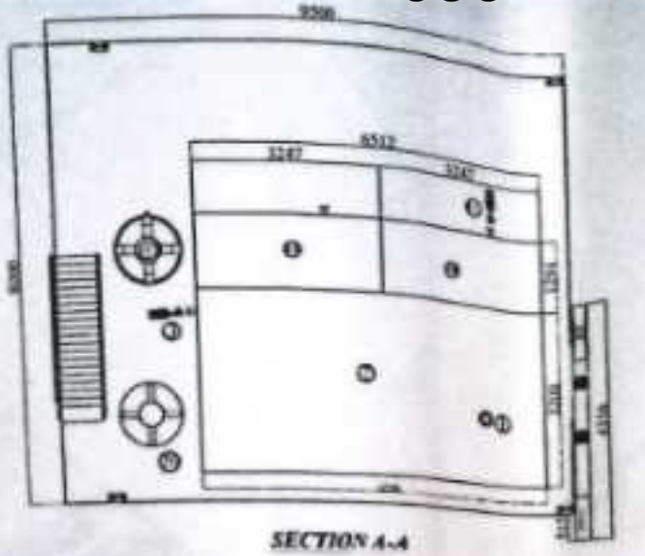
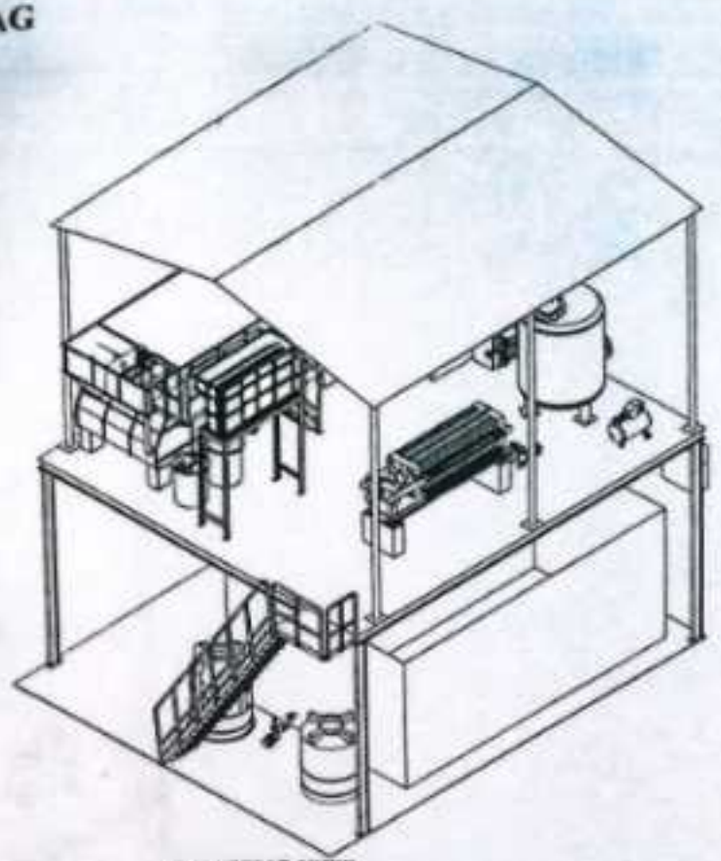


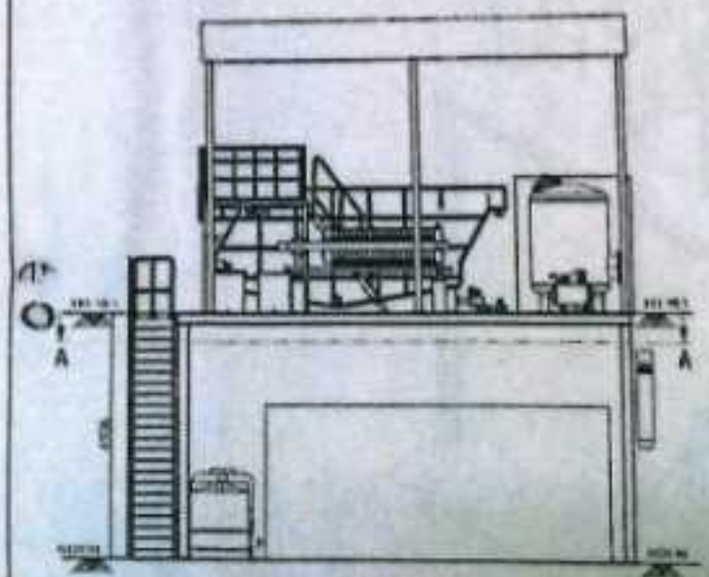
TOP VIEW



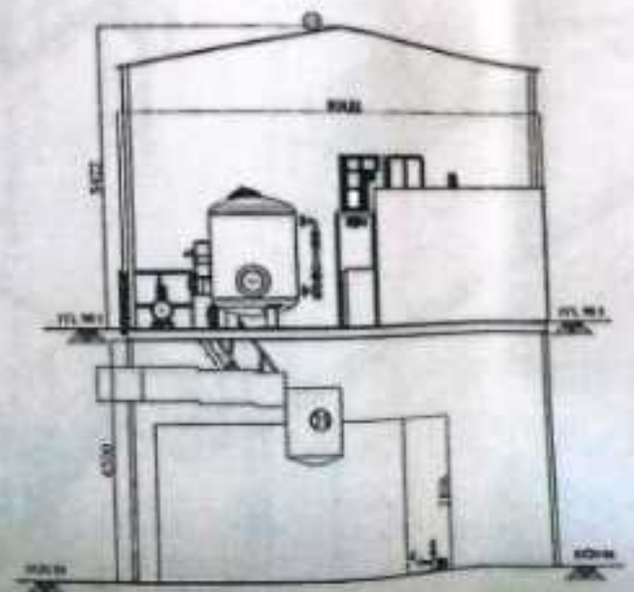
SECTION A-A



ISOMETRIC VIEW



FRONT VIEW



SIDE VIEW

NOTE:
TOTAL AREA REQUIRED: 9.5m x 8m = 76 sq.m

NOTE
Plant al Fencing work with Barbed wire, 4Nos (3x2.4m(H)) etc. & M.S Gate

TABLE OF CONTENTS:

S.No.	DESCRIPTION	PARTICULARS	QTY.	REMARKS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
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16				
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21				

TITLE :	G. A DRAWING
LOCATION :	STP I, 75KLD , ANOOP NEGI SCHOOL , RUDRAPRAYAG
CLIENT :	DEE UTTARAKHAND PEYJAL KHAND, RUDRAPRAYAG

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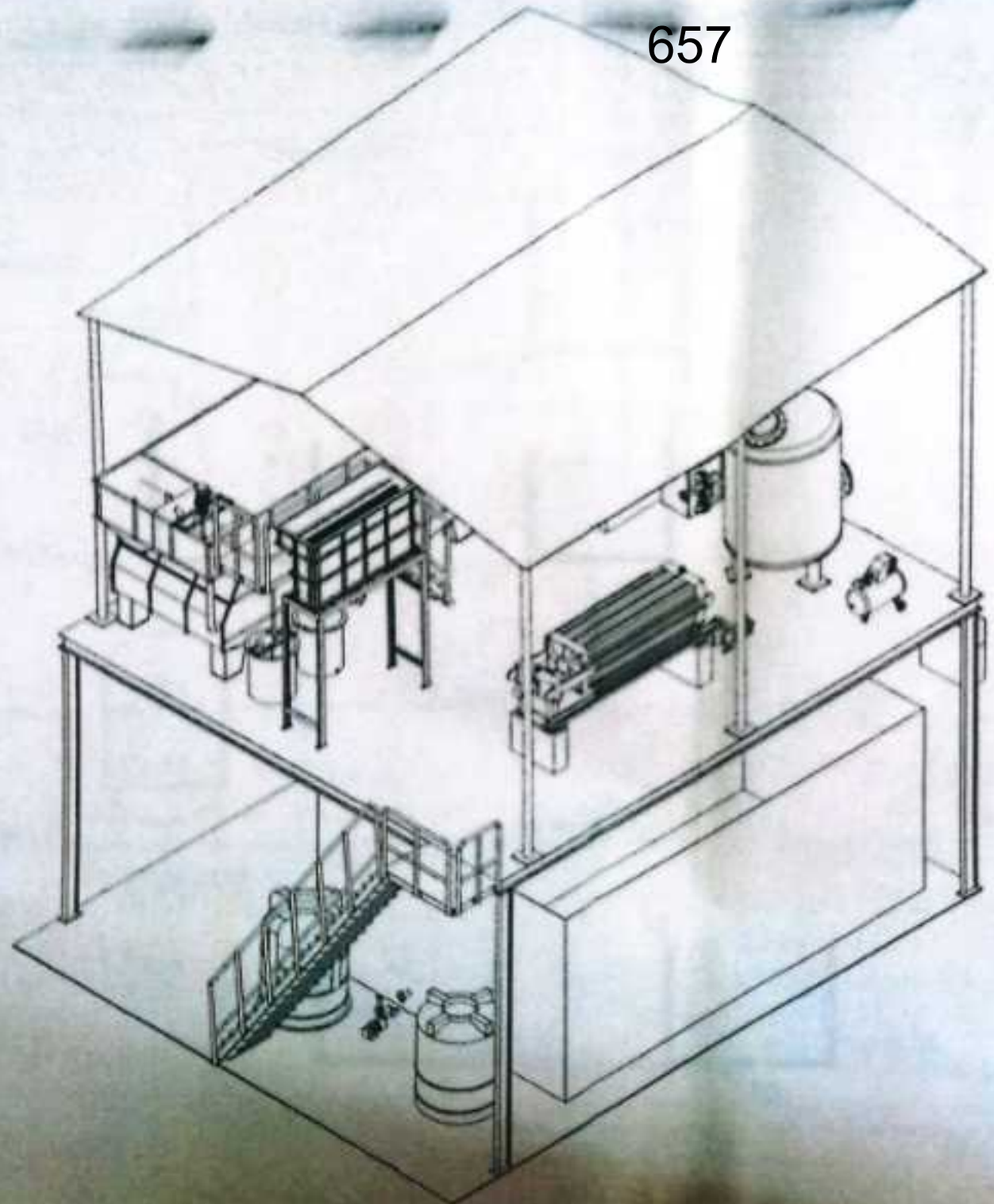

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JV - (DSK - CEIPL)

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STP 1 75 KLD NEAR ANOOP NEGI SCHOOL,RUDRAPRAYAG

LEGEND			
T-101	COLLECTION TANK	ALL LEVELS ARE IN METERS	
T-103	CLEANING TANK		DOSING PUMP
T-105	FLASH MIXER		PUMP
T-106	FILTERED TANK		SLUDGE LINE
T-107	SLUDGE FEED TANK		PROCESS LINE
	DOSING & CLEANING LINE		PERMEATE LINE

BAR SCREEN & GRIT CHAMBER

+0.50m +0.3m +0.15 +0.55 +0.25 +0.05 +0.200 +0.10 0.20 +0.50 +0.03

THROUGH GRAVITY

THROUGH PUMP

EC SKID

+3.79 +3.49 +0.696

THROUGH PUMP

-1.0 -1.3 -3.8 LVL

T-101

-3.1 -2.8 -3.8 LVL

T-103

+2.8 +3.0 +2.1

T-105

THROUGH GRAVITY

TUBE SETTLER CLARIFIER

+2.7 +3.0

THROUGH GRAVITY

+2.6

TREATED WATER OUTLET

THROUGH PUMP

+0.696 LVL

PRESSURE SAND FILTER

THROUGH GRAVITY

+0.696 LVL

-1.3 -1 -3.8LVL

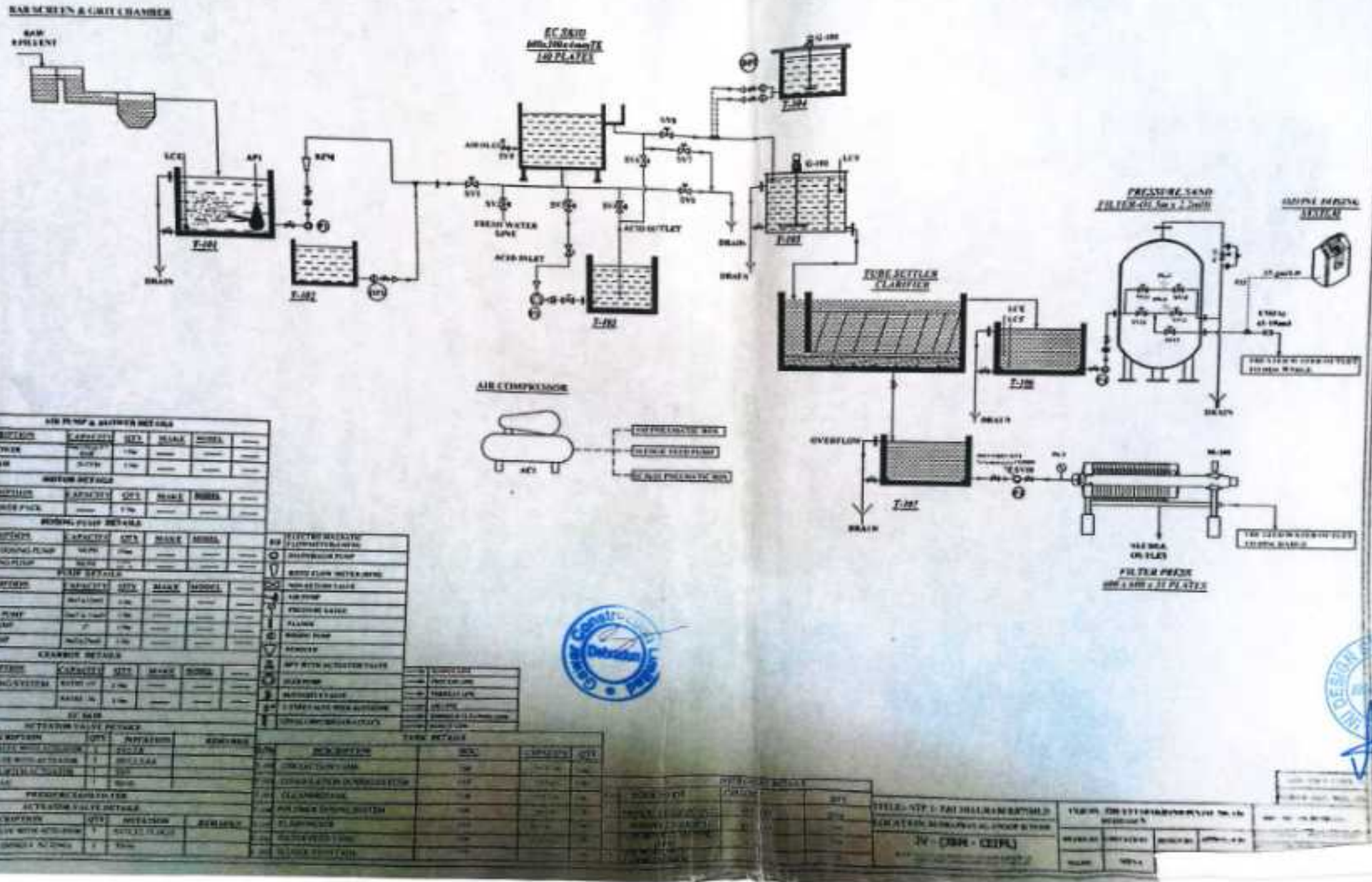
T-107

1 -1.3 -3.8LVL

T-106

TITLE:		CLIENT :THE UTTARAKHAND PEYJAL NIGAM DEHRADUN		DRG. NO.-1 S.
LOCATION:				
JV - (JBM - CEIPL)				
DRAWN BY	CHECKED BY	DESIGN BY	APPROVED BY	REV. 01
			CMA	DATE : 22.02.18

STP-1 .75 KLD NEAR ANOOP NEGI SCHOOL,RUDRAPRAYAG



SECTION IX

REFERENCE OF ELECTROCOAGULATION TECHNOLOGY

(ANNEXURE – C)

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doi:10.5004/dwt.2017.20645

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April

Electrocoagulation of municipal wastewater – a pilot-scale test

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ABSTRACT

In this study, a pilot test of electrocoagulation (*EC* with aluminium electrodes) of natural municipal wastewater was performed. In view of the obtained results and the unique and innovative nature of the proposed procedures and solutions, *EC* can be regarded not only as a preliminary purification step, but also as a comprehensive alternative to other wastewater treatment methods. Electrocoagulation was conducted at constant current, and changes in voltage were registered continuously to control and calculate energy consumption. After 2 h (7200 s of *EC* + 1800 s of additional sludge settling), initial colour (2140–2570 mg/L) was removed in 86–99.5%, turbidity (87.5–149 mg/L) – in 100%, suspended solids (250–340 mg/L) – in 88.5–91%, COD (609–737 mg/L) – in 60.8–63.5%, and phosphorus (10.0–10.7 mg/L) – in 94.5–96%. As expected, a higher electrocoagulant dose at higher energy consumption improved the efficiency of wastewater treatment, but energy consumption was not directly proportional to the treatment efficiencies of electrocoagulated municipal wastewater. The obtained results of sewage purification seem to be promising both economically and technologically. They fulfil Polish standards of effluent quality, except for COD where higher efficiency is required. *EC* poses a viable alternative to other wastewater treatment methods and should be considered as an initial step in municipal wastewater treatment.

Keywords: Electrocoagulation EC; Al-electrodes; Energy consumption; Sewage

1. Introduction

Biological treatment of wastewater, the most popular sewage treatment method, is characterized by very low efficiency at low temperatures [1–3]. At low temperatures (5–10°C), the efficiency of most biological processes decreases considerably, and the effectiveness of suspended solids, COD and phosphorus removal is reduced significantly. Therefore, a biological purification of wastewater, in cold regions, should be supported such as chemical coagulation or, alternatively, electrocoagulation, which will significantly reduce the loading to biological stages.

Electrocoagulation (*EC*) is easy to control, which is an important consideration in wastewater treatment systems for single houses and portable water treatment units [4,5]. When aluminium electrodes are used, the formation of the aluminium coagulant can be described with the use of the following equations representing the main electrode reactions:

$$2n\,Al^{\circ} - 6n\,e = 2n\,Al^{3+} \quad (1)$$

$$6(n-x)H_2O + 6(n-x)e = 6(n-x)OH^- + (n-x)H_2(\uparrow) \quad (2)$$

The formation of a positively-charged, colloidal aluminium electro-coagulant is described by the following reaction equation:

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$$2n\,Al^{3+} + 6(n-x)OH^- = \left\{Al(OH)_3\right\}_{2(n-x)} + 2x\,Al^{3+} \quad (3)$$

The above reactions are accompanied by minor oxygen polarization of the cathode (the value of n in the above equations is significantly higher than the value of x), which induces a minor increase in the pH of electrocoagulated wastewater:

$$\frac{3}{2}x\,O_2(\text{from water}) + 6x\,e + 3xH_2O = 6x\,OH^- \quad (4)$$

EC poses an alternative to chemical treatment [6,7], in particular with regard to low transportation costs of Al from Al-electrodes which is nearly 10 times lighter than Al from $Al_2(SO_4)_3{\cdot}18H_2O$. The availability of cheap electricity and/or the addition of seawater to wastewater treated by *EC* could reduce the costs associated with this method [8–10]. Such an approach has already been tested in Norway by Foyn [11]. Surprisingly, Al-Zuhair et al. [12] noted a 10–15% increase in *EC* efficiency when the temperature of treated wastewater was decreased by 15°C, which may suggest that this method is more suitable for cold climate regions. Similarly to coagulation, the main stages of *EC* are destabilization and flocculation of the colloidal system [13–15]. Electrochemical treatment of sewage [16–19] and other types of wastewater, such as baker's yeast [20], chips [21], pulp and paper [22,23], has been widely researched. Under these conditions, wastewater disinfection [24] also by chlorine evolution at the anode [10,19] may be an important part of the electrocoagulation process. During laboratory experiments, a variety of practical improvements have been suggested for the *EC* process to lower the coagulant dose, including: a) wastewater recirculation [25], b) the use of electrodes that are specifically shaped to account for the unique parameters of treated wastewater and c) changes in the direction of current flow [26] for electrode self-cleaning [27].

In this study, selected innovative solutions for sewage EC, which had been previously tested only in a laboratory setting, were analysed in semi-industrial conditions. The following unique solutions were applied in a pilot experiment: a) sewage flow during recirculating *EC* was enforced by the shape of the electrodes and the electrolyser, and the electrolyser can be easily adapted to process large quantities of wastewater, b) electrode self-cleaning was induced by changes in the direction of current flow on the electrodes, c) the optimized frequency of changes in the direction of current flow on the electrodes (every 256 s) was sufficient for electrode polarization. In view of the unique and innovative nature of the proposed procedures and solutions, *EC* can be regarded not only as a preliminary purification step, but also as a comprehensive alternative to other wastewater treatment methods.

2. Materials and methods

Sewage from Reszel (Poland, 5000pe) was used in this pilot test. Raw sewage was characterized by the following average parameters: pH = 6.89–6.97; Turbidity TU = 87.5–149 mg/L, Suspended Solids SS = 250–340 mg/L; Chemical Oxygen Demand COD = 609–737 mg/L; Total Phosphorus P = 10.0–10.7 mg/L. A pilot system for *EC* of municipal wastewater, equipped with Al-electrodes, was designed and constructed specifically for this test. The diagram of a recirculation system for sewage *EC* is shown in Fig. 1.

550 g NaCl was dissolved in 100 L of sewage to increase its specific conductance κ to $2.2{\cdot}10^{-3}$ $\Omega^{-1}{\cdot}cm^{-1}$. Then, 26 mL of concentrated HCl (36%) was added to decrease pH and dissolve the passive layer of the anode [28]. According to some researchers [10,19,24], disinfectant chlorine can be generated electrochemically under the above conditions. Next, 100 L of sewage was recirculated at 200 L/h between the small electrolyser and the large container for 1 h (Fig. 5) or 2 h (Figs. 3 and 4). Nine Al-electrodes with the width of 46 cm, height of 16 cm and thickness of 0.3 cm each, spaced at 2.3 cm, were installed in the glass chamber. This unique arrangement contributed to maximum contact between the electrodes and wastewater (Fig. 1, "6"). The pH in the container was maintained at 6.0 by adding small amounts (14–19 mL) of concentrated (36%) HCl during the process.

EC was conducted at constant current. Changes in voltage were registered continuously (Fig. 2), and the mean value of U was determined for controlling and calculating energy consumption. Programmable power supply for the electro-coagulator and the microcomputer controlling the system (10 and 11 in Fig. 1) changed the direction of the current on the electrodes every 256 seconds (based on the results of previous laboratory tests [27]) to: a) facilitate "sophisticated" self-cleaning of the cathode which became a soluble anode after every 256 s, b) minimize polarization loss. The electro-coagulant dose was proportional to the time of electrolysis according to Faraday's law,

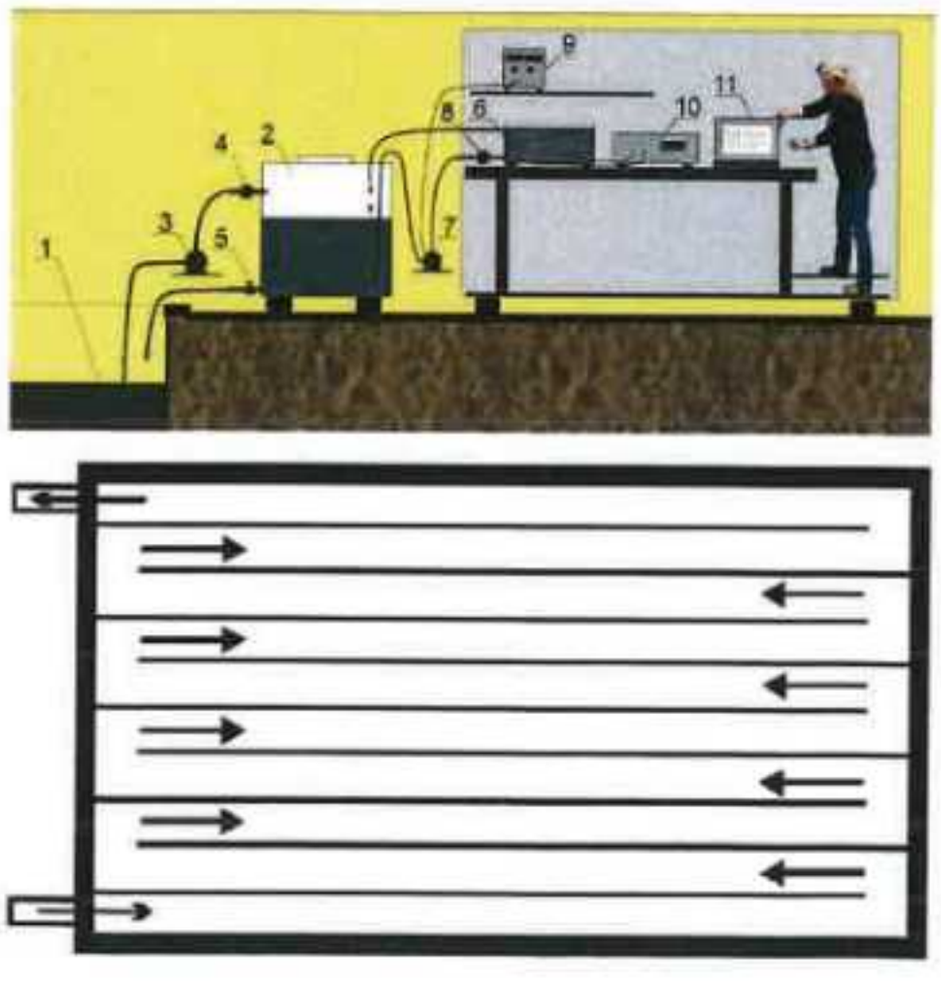

Fig. 1. Diagram of a recirculation system for sewage EC. 1 – wastewater reservoir, 2 – treated sewage tank, 3 – pump for filling the tank, 4 – volume counter, 5 – valve for draining the tank, 6 – electro-coagulator (including the top view), 7 – recirculation pump, 8 – volume counter, 9 – power supply for the recirculation pump, 10 – programmable power supply for the electro-coagulator, 11 – microcomputer controlling the system.

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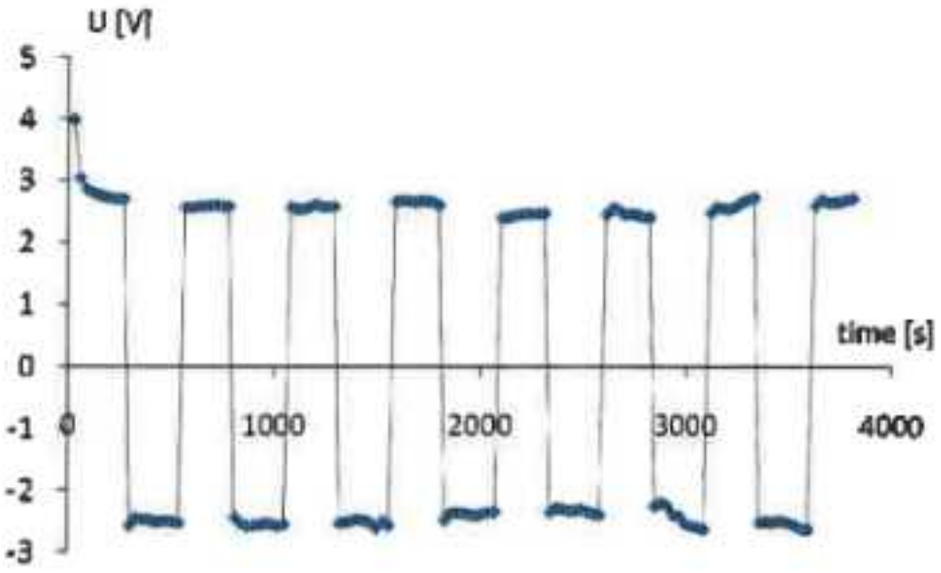

Fig. 2. Example of registration of changes in voltage.

$m = k \cdot i \cdot t$, where the electrochemical equivalent of aluminium is $k = 27/(96500 \cdot 3) = 9.3 \cdot 10^{-6}$ g·A^{-1}·s^{-1}, although previous research [29] demonstrated that it could be higher. Samples for analysis were collected from the supernatant every 10 min. Colour, turbidity (TU), suspended solids (SS), total phosphorus and COD were measured in the DR 2800 HACH-Dr Lange system, and pH was controlled with the Hanna Instruments HI 8424 pH-meter. After *EC*, treated sewage was sedimented for 30 min, and three final samples were collected from the supernatant for analysis. The mean values of parameters describing treated wastewater are given in Figs. 3–5, and the percent error (± %) of SS, P and COD values is presented in Table 1. In Polish wastewater treatment plants, the maximum concentration of phosphorus in purified wastewater is 5 mg/L. Initial phosphorus concentration in the analysed sewage was close to 10 mg/L. Therefore, the common denominator for comparing the obtained purification results was the removal of 50% P.

3. Results and discussion

The purification of re-circulated sewage treated by *EC* with Al-electrodes is shown in Figs. 3–6 as the following relationship:

$$\textit{impurity removal [\%]} = f(\textit{time of electrolysis})$$

The first run of *EC* was performed at I = 10A during t = 2 h (Fig. 3).

During *EC*, aluminium ions formed by electrolytic dissolution of the aluminium anode are transferred to wastewater [Eq. (1)]. Positively-charged colloidal [$Al(OH)_3$] in sewage [Eq. (3)] is gradually bound to wastewater impurities (responsible for the values of TU, SS, P and COD). After aggregation, agglomeration, flocculation and sedimentation of the sewage sludge, the liquid phase of treated wastewater is gradually separated from impurities expressed by the values of TU, SS, P and COD. After 2 h of *EC*, the initial colour (2520) was finally removed in 70.2%, turbidity (148) – in 98%, suspended solids (350) – in 74.3%, and phosphorus (10.0 mg/L) – in 79.1%. The electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5} g \cdot A^{-1} \cdot s^{-1} \cdot 10\ \text{A} \cdot 7200\ \text{s} = 6.7 g\ \text{Al} / 100\ \text{L} \quad (5)$$

According to the data in Fig. 3, less Al (approx. 62.5 mg Al/L) was required (t = 6720 s) to meet the Polish sewage treatment standards with regard to (–50%) phosphorus removal. Unfortunately, the final COD of 289 mg/L (up to 60.8%) did not conform to the Polish requirements, i.e. 150 mg/L. The energy consumption associated with the introduction of 6.7 g of Al to 100 L of treated sewage was:

$$E = 2.65\text{V} \cdot 10\text{A} \cdot 2\text{h} = 53\text{Wh} / 100\text{L} = 0.53\ \text{kWh per tonne of sewage} \quad (6)$$

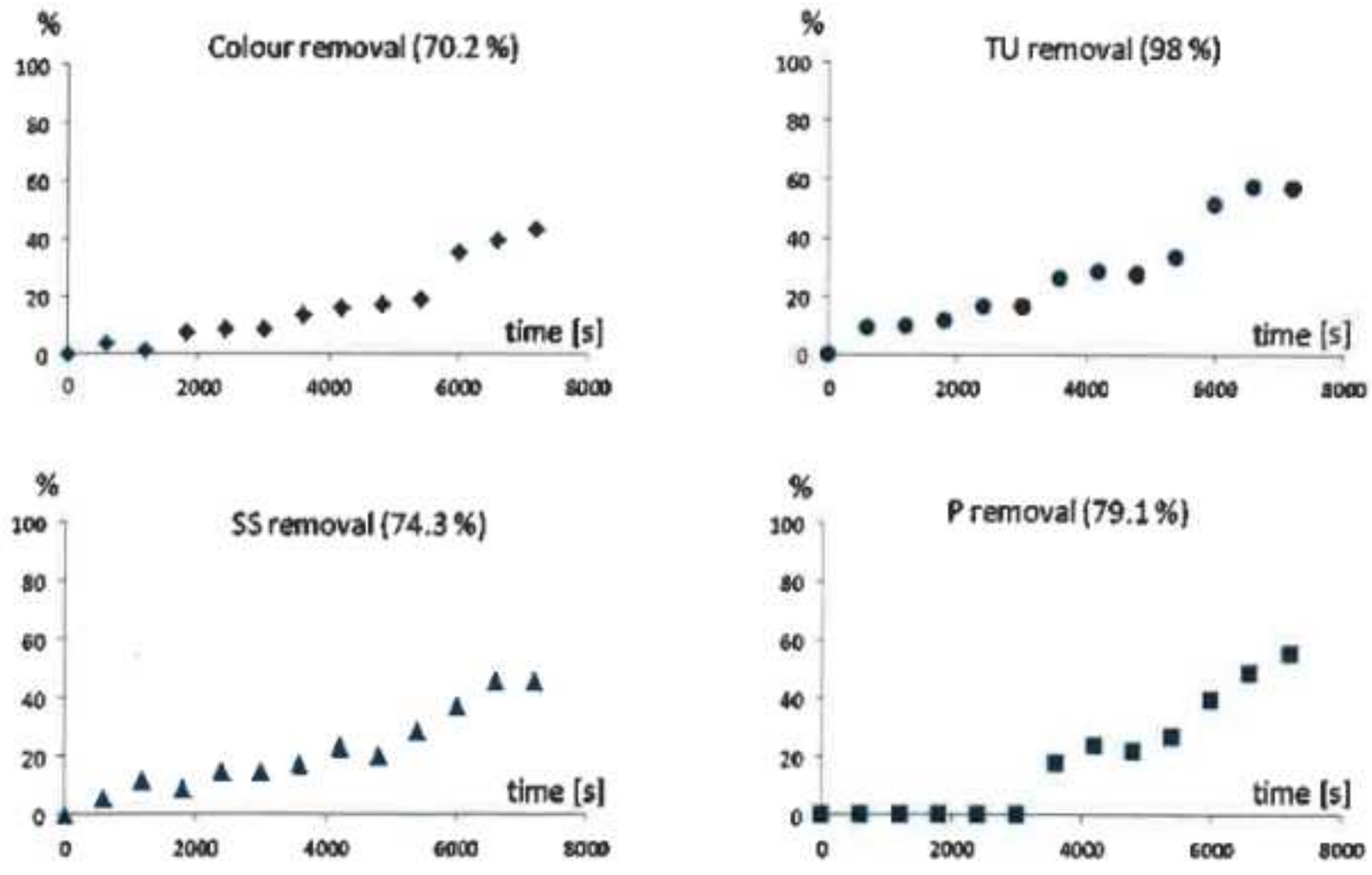

Fig. 3. Purification of sewage treated by *EC* at I = 10 A, U = 2.65 V, t = 7200 s, pH_o = 6.93 + 15 mL HCl, P_o = 10.0, $Colour_o$ = 2520, TU_o = 148, SS_o = 350, $COD_o \rightarrow COD_t$ = 609 → 326 mg/L (–46.5%).

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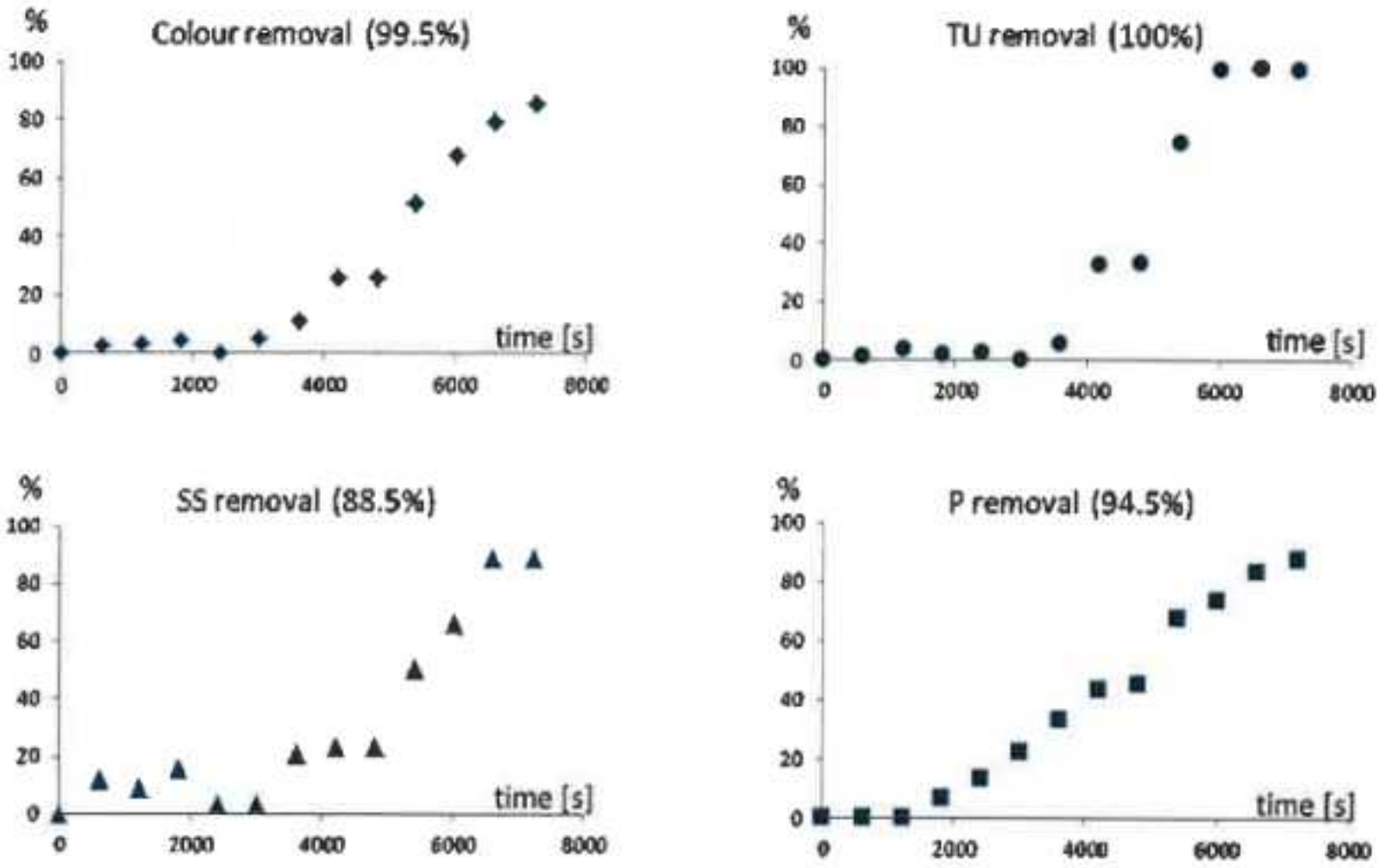

Fig. 4. Purification of sewage treated by EC at I = 13 A, U = 2.8 V, t = 7200 s, pH_o = 6.92 + 14 mL HCl, P_o = 10.7, $Colour_o$ = 2140, TU_o = 87.5, SS_o = 260, $COD_o \rightarrow COD_t$ = 737 → 289 mg/L (–60.8%).

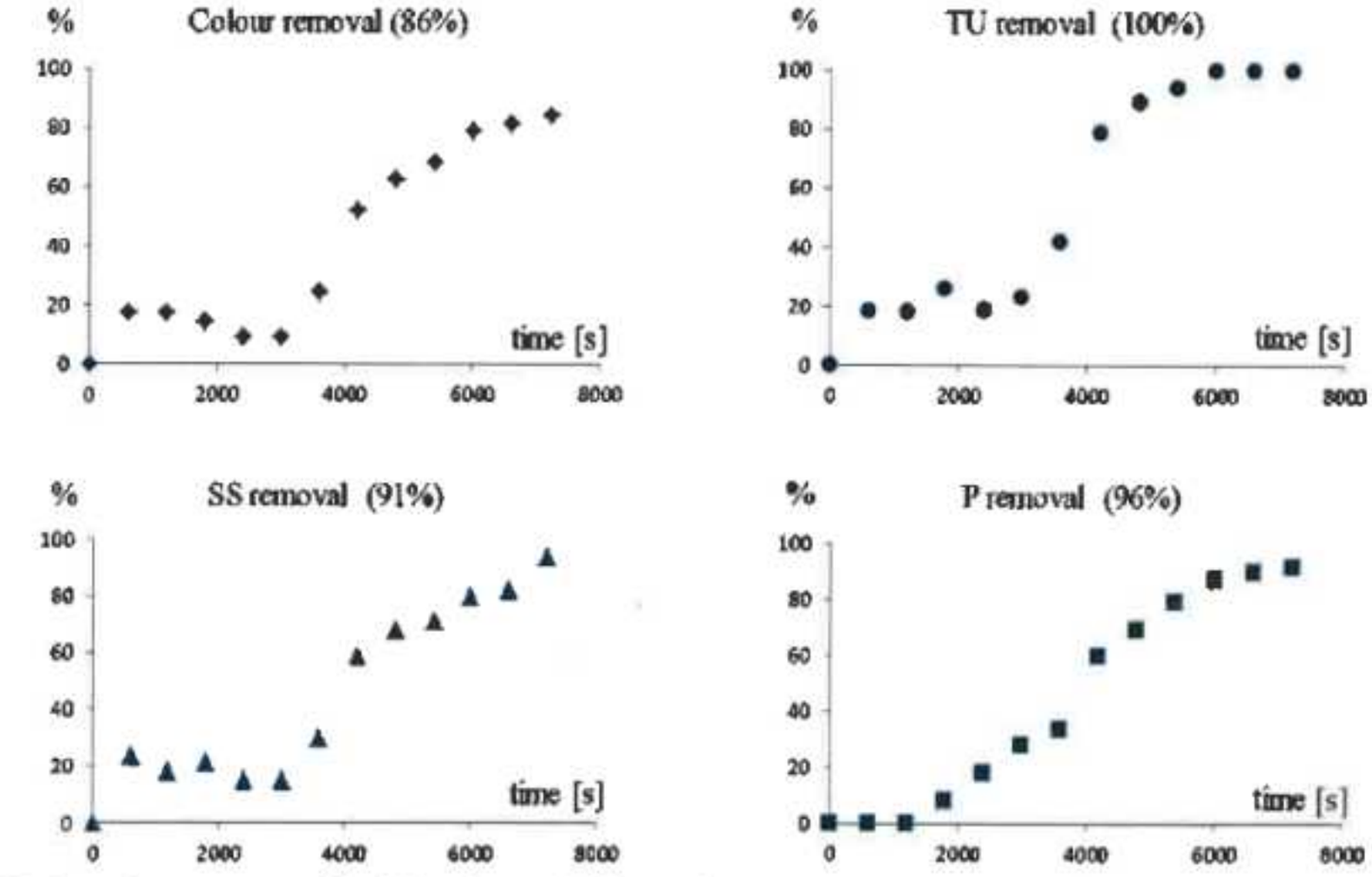

Fig. 5. Purification of sewage treated by EC at I = 15 A, U = 3.2 V, t = 7200 s, pH_o = 6.89 + 15 mL HCl, P_o = 10.7, $Colour_o$ = 2570, TU_o = 149, SS_o = 340, $COD_o \rightarrow COD_t$ = 737 → 269 mg/L (–63.5%).

Table 1
Parameters and results of pilot EC of municipal wastewater

No. of run	Al-dose	Energy consumption	SS	P	COD
	g/tonne	kWh/tonne	[%] removal		
1	67	0.530	74.3 ± 1.2	79.1 ± 4.4	46.5 ± 5.0
2	87	0.728	88.5 ± 1.5	94.5 ± 4.5	60.8 ± 5.5
3	100	0.960	91.0 ± 1.7	96.0 ± 4.3	63.5 ± 1.6

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Therefore, energy consumption required to remove 50% of P was 0.49 kWh per tonne of sewage (62.5 mg Al/L was consumed). Al-anode dissolution and energy consumption are the main costs associated with *EC* maintenance.

The second run of *EC* was performed at $I = 13$ A during $t = 2$ h (Fig. 4). Those parameters (I and t) were selected based on numerous laboratory experiments and trials [29–31].

After 2 h of *EC*, the initial colour (2140) was removed in 99.5%, turbidity (87.5) in 100%, suspended solids (250)– in 88.5%, and phosphorus (10.7 mg/L) in 94.5%. The electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5}\, g \cdot A^{-1} \cdot s^{-1} \cdot 13\ \text{A} \cdot 7200\ \text{s} = 8.7 g\ \text{Al} / 100\ \text{L} \quad (7)$$

According to the data in Fig. 4, less Al (approx. 58.6 mg Al/L) was required ($t = 4850$ s) to meet the Polish sewage treatment standards with regard to (–50%) phosphorus removal. Unfortunately, the final COD = 289 mg/L (60.8% removal) did not conform to the requirements, i.e. 150 mg/L. The energy consumption associated with the introduction of 8.7 g of Al to 100 L of treated sewage was:

$$E = 2.8\ \text{V} \cdot 13\ \text{A} \cdot 2\ \text{h} = 72.8\ \text{Wh} / 100\ \text{L} = 0.728\ \text{kWh per tonne of sewage} \quad (8)$$

Therefore, energy consumption required to remove 50% of *P* at 58.6 mg Al/L was 0.49 kWh per tonne of sewage. It means that energy consumption required to remove 50% of *P* is the same at $I = 13$ A and $I = 10$ A, although less Al was consumed at $I = 13$ A.

In the third run of *EC* (Fig. 5), current was increased to $I = 15$ A.

After 2 h of *EC*, the initial colour (2570) was removed in 86%, turbidity (149) – in 100%, suspended solids (340) – in 91%, and phosphorus (10.4 mg/L) – in 96%. Due to higher $I = 15$ A, the electro-coagulant dose required to achieve the above results was:

$$m = 9.3 \cdot 10^{-5}\, g \cdot A^{-1} \cdot s^{-1} \cdot 15\ \text{A} \cdot 7200\ \text{s} = 10 g\ \text{Al} / 100\ \text{L} \quad (9)$$

According to the data in Fig. 5 and according to expectations (Figs. 3 and 4), less Al (approx. 55.5 mg Al/L) was required to meet the sewage treatment standards with regard to (–50%) phosphorus removal. However, the final COD of 269 mg/L (up to 63.5% removal after EC) did not fulfil the Polish requirements. Similar or even worse results were obtained in numerous laboratory experiments and trials [29–31]. The energy consumption associated with the introduction of 10 g of Al to 100 L of treated sewage was:

$$E = 3.2\text{V} \cdot 15\text{A} \cdot 2\text{h} = 96\text{Wh} / 100\text{L} = 0.96\ \text{kWh per tonne of sewage} \quad (10)$$

Therefore, energy consumption required to remove 50% of *P* (at 55.5 mg Al/L) was 0.53 kWh per tonne of sewage. It means that energy consumption required to remove 50% of *P* at $I = 15$ A was slightly higher than at $I = 10$ A and $I = 13$, but less Al was consumed at $I = 15$ A. Considering the final results of purification (final removal of Colour, TU, SS and *P*, Fig. 5), a compromise between Al-anode dissolution and energy consumption has to be reached.

As expected, a higher electrocoagulant dose at higher energy consumption improved the efficiency of wastewater purification. The data presented in Table 1 indicate that the improvement in the purification degree of electrocoagulated waste may not be cost-effective in practice. When energy consumption is increased by 45% and aluminium consumption (Al electrodes) is increased by 33%, the corresponding increase in removal efficiency (SS, P and COD) is only around 17%. However, operating costs (consumption of Al electrodes and energy) can be adapted to local needs and requirements. One of the greatest advantages of the proposed *EC* method is that it is easy to control by changing the current flowing through the electrolyser.

As mentioned in the Introduction, *EC* and chemical coagulation involve the aggregation, agglomeration and flocculation of impurities with colloidal particles of aluminium hydroxide and other aluminium compounds in the system after the hydrolysis of aluminium cations [32].

The diagram in Fig. 6 presents a simple model for the aggregation and flocculation of phosphates and COD with colloidal $\{Al(OH)_3\}_n$. From the physicochemical point of view, this process involves bridging of positively-charged, colloidal $\{Al(OH)_3\}_n$ adsorbents by negatively-charged sewage impurities, and the adsorption of other wastewater impurities (such as phosphate anions) by colloidal $\{Al(OH)_3\}_n$ adsorbents [30]. In industrial practice, this aggregation mechanism is known as sweep flocculation [15,32]. Sewage impurities are agglomerated in sludge, and sludge is separated to produce treated wastewater.

In the fourth run (Fig. 7), in order to validate the data from purification trials 1, 2 and 3, the duration of the experiment was reduced to 1 h of *EC* at the current of $I = 15$ A (Fig. 5).

After 1 h of *EC*, the initial colour (2170) was removed in 63%, turbidity (102) – in 100%, suspended solids (270) – in 71%, and phosphorus (10.7 mg/L) – in 51%. Since the fourth run of *EC* was twice shorter, the electro-coagulant dose required to achieve the above results was also twofold lower (50 mg Al/L). In such conditions purification results were not satisfactory, except for the final removal of P after 0.5 h of additional sludge settling. Therefore, *EC* has to last longer under practical conditions.

The results obtained during *EC* of municipal wastewater indicate that *EC* can pose a viable alternative to other wastewater treatment methods and can be seriously considered as an initial process of municipal wastewater purification.

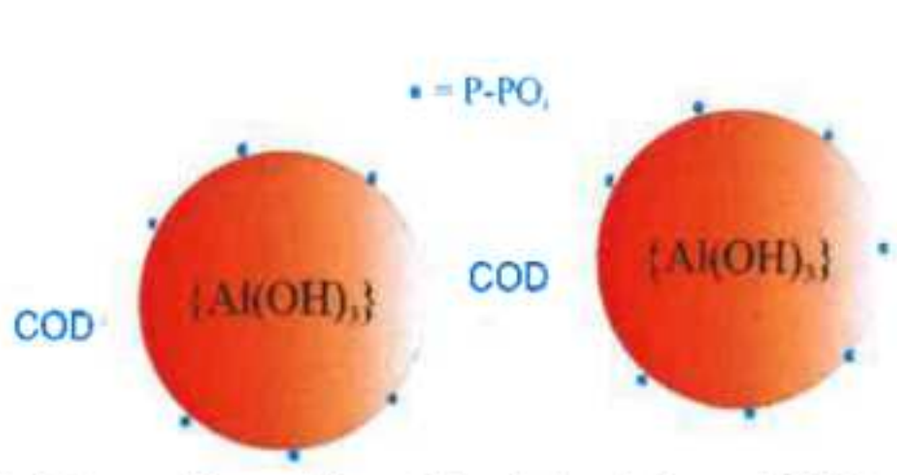

Fig. 6. Aggregation and flocculation of phosphates and COD in wastewater electrocoagulated with Al electrodes.

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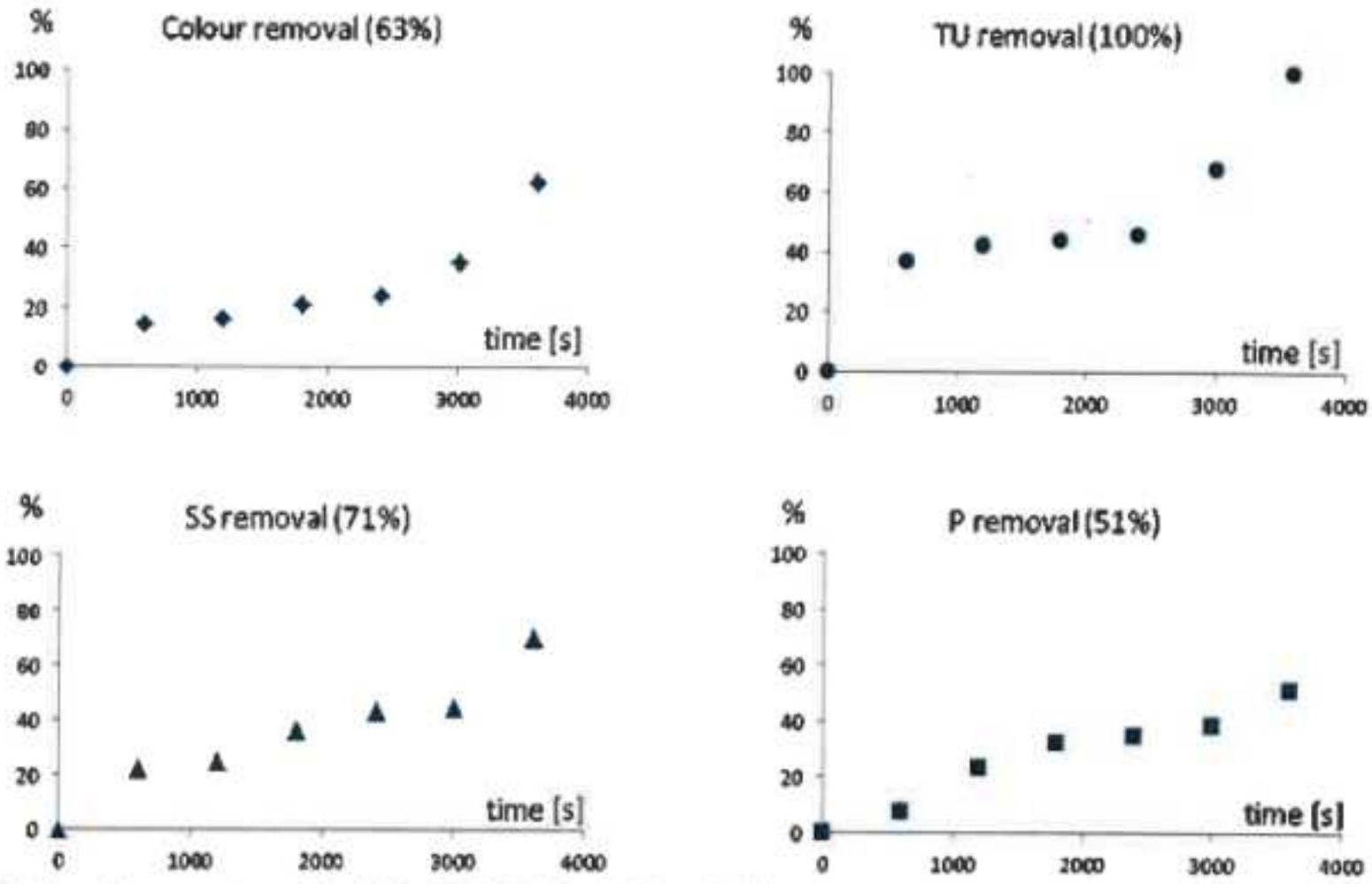

Fig. 7. Purification of sewage treated by *EC* at $I = 15$ A, $U = 3.0$ V, $t = 3600$ s, $pH_o = 6.97 + 19$ mL HCl, $P_o = 10.7$, $Colour_o = 2170$, $TU_o = 102$, $SS_o = 270$, $COD_o \rightarrow COD_f = 737 \rightarrow 304$ mg/L (–58.7%).

4. Conclusions

Municipal wastewater treated by the pilot electrocoagulation method (*EC*) is purified equally or more effectively than sewage treated in a laboratory. The costs of the main components of the *EC* system are determined by the prices of aluminium and energy. Therefore, a certain compromise has to be reached to match the specific requirements of a wastewater treatment plant. In the described pilot test: a) the maximum energy consumption associated with 55.5 mg Al/L was 0.53 kWh per tonne of sewage and b) the minimum energy consumption associated with 62.5 mg Al/L was 0.49 kWh per tonne of sewage. Sewage purification results seem promising, and they fulfil Polish effluent quality standards, excluding COD where higher efficiency is required, which is caused by the dissolved fractions. Electrocoagulation alone can pose a viable alternative to other wastewater treatment methods in most cases and will be an important initial step, where biological processes are required to remove dissolved COD during municipal wastewater purification.

Acknowledgement

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Electrocoagulation -A Promising Technology for Sewage Treatment

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Abstract — Treatment of sewage wastewater has become an absolute necessity because sewage is main point source pollutant on global scale. An innovative, cheap and effective method of purifying and cleaning wastewater before discharging into any other water system is needed. Wide ranges of wastewater treatment techniques are known which include biological process and physicochemical process. Study has been made to replace the biological treatment of sewage by electrochemical process with consideration to achieve desired water quality. Present study was conducted to investigate the applicability of the electro-coagulation technique for the treatment of sewage wastewater. In this study lab-scale electro-coagulation was carried out for the treatment of raw sewage wastewater at different operating time i.e 15min, 20min, 25min, 30min using Aluminum as Cathode and Mild steel as a Anode, with 15mm and 10 mm electrode spacing, supplying 24v and 10amp. It is observed that the batch which is operated at 10Amp for 30 min has maximum removal efficiency of COD & S.S i.e. 95% & 86% respectively at optimum pH 8.3.

Keywords: Sewage, Electro-Coagulation, COD removal

I. INTRODUCTION

Sewage is the main point source pollutant on a global scale [5]. So, direct discharge of raw or improperly treated sewage into the water body is one of the main sources of pollution [5]. Sewage normally consists of biological, chemical and physical constituents which usually high in Bio-chemical Oxygen demand (BOD), Chemical Oxygen Demand (COD) and Suspended Solids (SS). There are two main objectives of wastewater treatment, one is protecting the environment and other is conserving fresh water resources [1].

Nowadays, many treatment plants use the biological process in treating sewage water but there are also disadvantages for that process. Besides, this Conventional biological treatment needs aeration for days and growth of bacteria. To enhance the removal efficiency of Suspended Solids (SS) in conventional treatment, chemical coagulant such as alum, ferric chloride, ferric sulfate and lime are usually used resulting in suspended solid removal efficiency ranging between 80% to 90%. The major disadvantages of chemical precipitation process for the removal of SS and COD are that it involves the addition of chemicals which can be costly and result in the increase of Total Dissolve solids (TDS). Research in the past few decades, have shown that the Electro-Coagulation is a promising treatment method and have potential to treat variety type of wastewater including sewage.

Electro-coagulation treatment offers an alternative to the use of chemical coagulant such as metal salts or polymer for breaking the pollutants because during the Electro-coagulation process, the electrode can generate the metal hydroxides that destabilized and aggregate the suspended particles and precipitates. It is a complex process involving chemical and physical mechanism operating simultaneously to remove the organics from the sewage wastewater. It involves 3 successive stages

1) Formation of coagulants by Electrolytic oxidation of the sacrificial electrode such as mild steel.
2) Destabilization of contaminants, particulate suspension and breaking of emulsion.
3) Aggregation of destabilized phase to floc formation. (Mollah et al., 2014)

Main aim of the study is to investigate the potential of Electro-Coagulation process using Mild Steel electrodes in the removal of COD and SS from Domestic wastewater. The effect of electrolysis time, inter electrode distance for the removal of parameters are discussed.

II. MATERIALS AND METHODS

A. Sewage Water Samples

Raw sewage wastewater samples were collected from the Pirana 106 MLD sewage treatment plant located in Ahmedabad, Gujarat. The composition of sewage wastewater then characterized to identify the pH, SS, COD, TDS.

B. Experimental Set-up

The batch experimental set-up shown in Fig. 1. The Electrochemical unit consists of an Electrocoagulation cell, a DC power supply and the electrodes (4 Aluminum as cathode and 3 Mild Steel as anode). A Monopolar electrode having same dimensions (230mm X 170 mm X 3mm) as an anode and cathode which spacing of 10mm and 15 mm (depending on the experiment) between each other. The total effective area of electrode was 78200 mm2. All the electrodes were washed with dilute HCl before every experiment conducted.

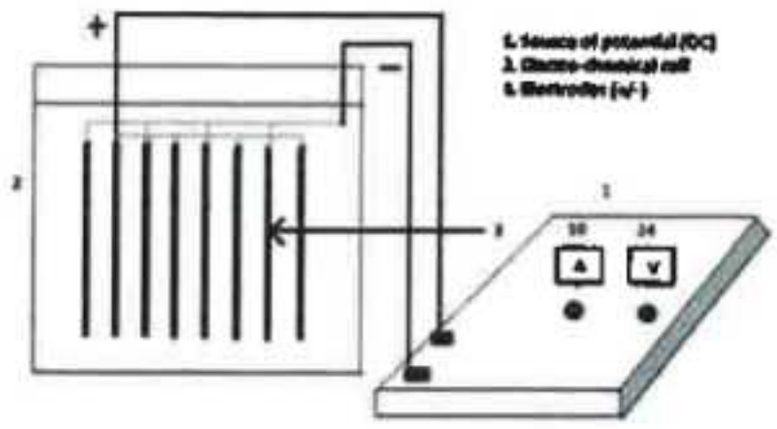

Fig. 1: Schematic diagram of experimental set-up

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C. Specifications of lab-scale model

Sr No	Physical Features	Dimensions
1	Reactor Dimensions	380 X 235 X 255 mm^3
2	Liquid Depth	210mm
3	Width of Baffle	50mm
4	Volume of Reactor	22L
5	No of Electrode	4 Al + 3 MS
6	Electrode Dimensions	230mm x 170mm
7	Electrode Area	78200mm^2
8	Thickness of Electrode	3mm
9	Distance between Electrode	15 mm & 10mm

Table 1: SPECIFICATION OF LAB-SCALE REACTOR

D. Electrodes for Lab-scale Model

In the present work Aluminum used as Cathode and Mild steel used as Anode. Electrode design is one of the most important factor that affects the Electro-coagulation process. Electrode design affects the release of coagulants in the solution and the bubble type.

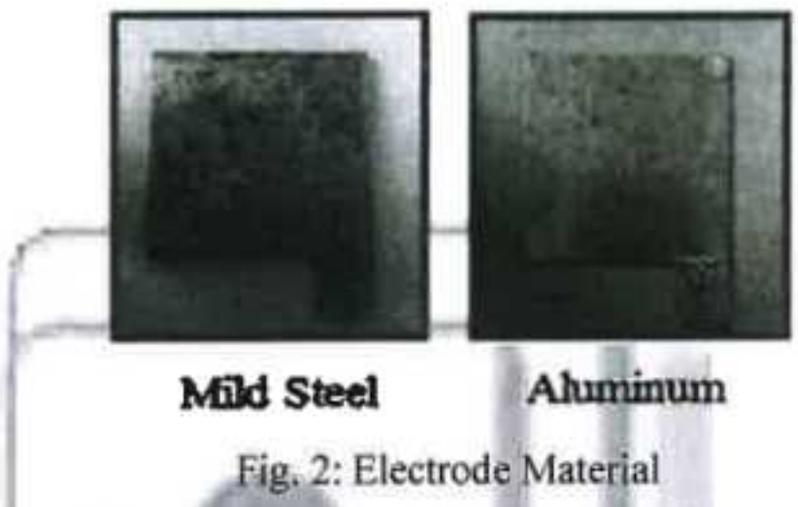
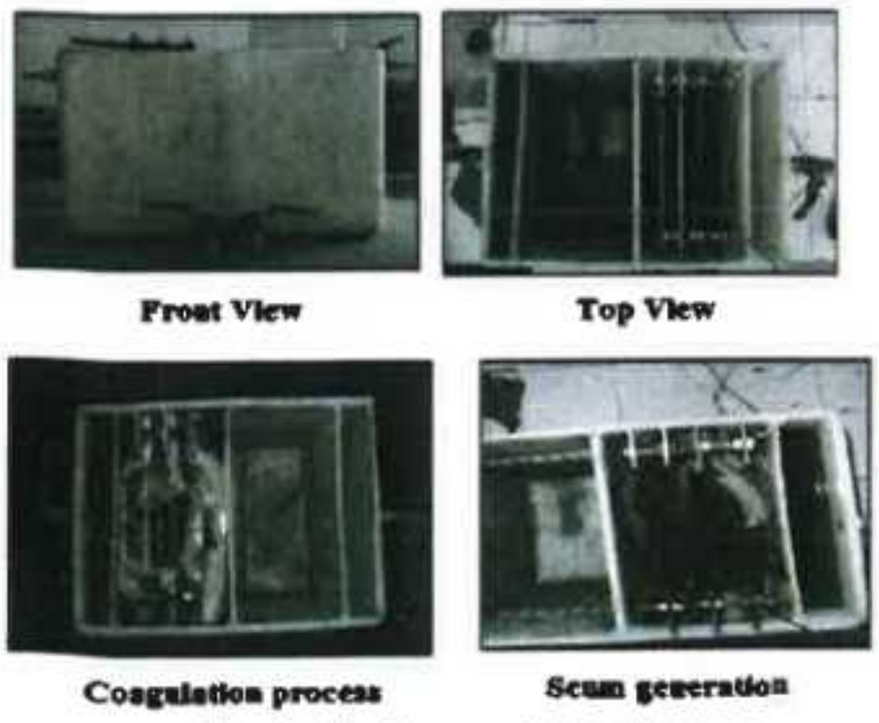


Fig. 2: Electrode Material

E. Experimental procedure

The experiments were carried out in a batch mode. Monopolar electrodes used with electrode distance 15mm and 10 mm. 10 Ampere and 24 volt are fixed in power supply unit. Each run was carried out at time interval of 15min, 20min, 25 min, and 30 min, once the DC power supply was started. Experiments were carried out to Determine the effect of electrode material, Electrocoagulation time, interelectrode distance and initial pH. After the experiment 500ml treated sample was taken from each plate and then kept undistributed for 60 min in order to allow the flocs to settle. Subsequently after settling the sample of supernatant was collected to perform the analysis of TDS, SS and COD.



. Fig. 3: Electrocoagulation Process

III. RESULTS AND CONCLUSION

A. Characteristics of raw sewage water

Parameter	Avg Value
COD(mg/L)	506
SS(mg/L)	182
TDS(mg/L)	847
pH	7.1

Table 2: Average raw sewage characteristics of 106 MLD, Pirana, Ahmedabad

Parameter	Avg Value
COD(mg/L)	506
SS(mg/L)	182
TDS(mg/L)	847
pH	7.1

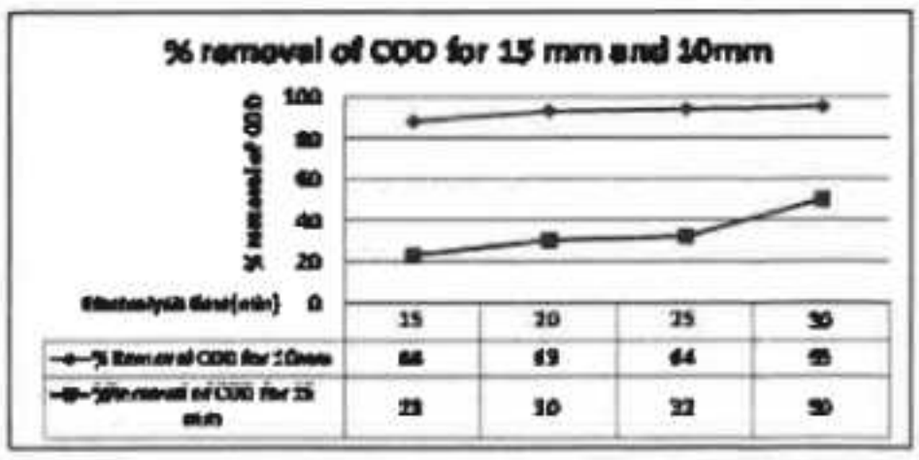
B. Effect of electrolysis time

As shown in fig 4 as the time of electrolysis increase comparable changes in the removal efficiency of COD, SS, TDS and pH are observed. Reactive time also influence the treatment efficiency of Electrocoagulation Process because the more time consume the more production rate of hydroxyle and metal ions are produced on the electrodes.

Parameter	Raw	15 min	20min	25min	30min
COD(Mg/L)	457.6	52	31.2	26	20.8
% removal	-	88	93	94	95
SS(Mg/L)	440	120	120	60	60
% removal	-	72	72	86	86
TDS(Mg/L)	790	755	748	742	734
% removal	-	44	53	60	70
pH	7.6	8.0	8.1	8.1	8.3
Energy consumption(kwh/m^3)		6.31	8.42	10.52	12.6

Table 3: Effect of Electrocoagulation time on parameters

C. Effect of interelectrode distance



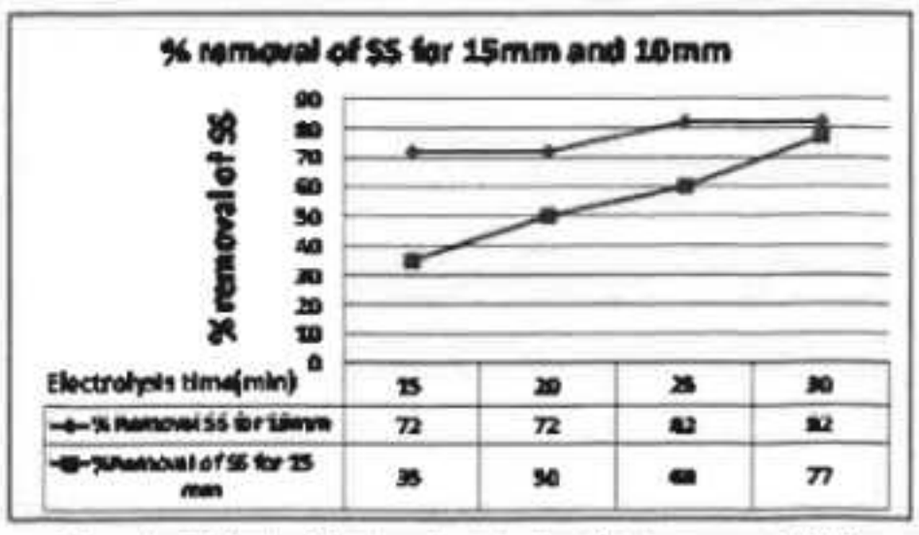


Fig. 4: Effect of inter electrode distance on COD

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and SS removal using MS and Al electrode, current density 42A/m2 and for 15 min, 20min, 25min, 30min Ec time.

The effect of interelectrode distance shows a significant result in this experiment.

Electrolysis time(min)	COD(% removal)		SS(%removal)	
	15mm	10mm	15mm	10mm
15	23	88	35	72
20	30	93	50	72
25	32	94	60	86
30	50	95	77	86

Table 4: Effect of electrolysis time on COD and SS removal

As shown in fig 4, when interelectrode distance increases the efficiency of COD and SS removal decreases slightly because the rate of electron transfer is become slower. Variations of the percentage removal with inter electrode distance is shown in figure below.

IV. CONCLUSION

In this study the EC process was found to be an effective method for the treatment of Domestic wastewater. The effect of operational conditions such as electrolysis time, pH and inter electrode distance on removal of COD and SS was examined. The result showed that the removal of COD and SS increase with increase electrolysis time except for pH and inter electrode distance. The highest removal efficiency of COD by 95%, SS by 82% occurred at 42A/m2 current density, 10mm electrode distance and pH 8.3 in 30min of operating time by Mild Steel electrode.

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Studying the effectiveness of treating waste water using the electro coagulation process at Sewage Treatment Plants

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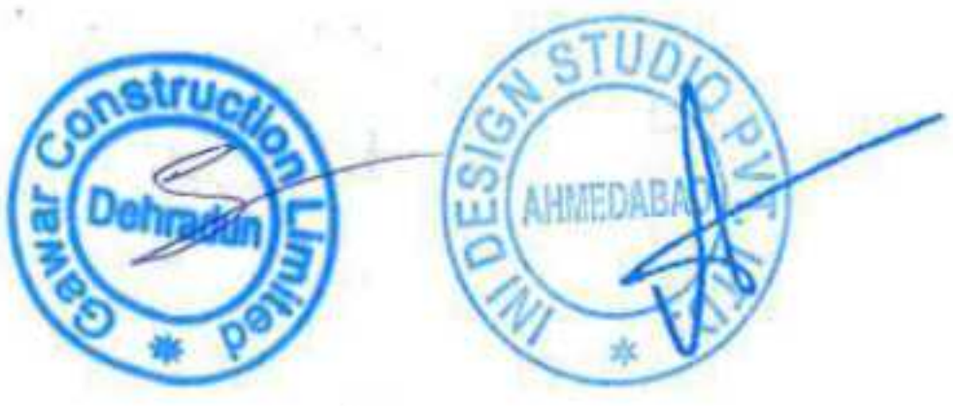
Abstract

Sewage has become a major point-source pollutant on a global scale. The management and treatment of wastewater is important to ensure that it is processed to a safe quality before re-use or disposal. The purpose of this study is to investigate the effectiveness of the electrocoagulation process in treating wastewater as an alternative to conventional methods to treat sewage. A 2 litre batch electrocoagulation unit was set up consisting of 4 monopolar electrodes connected to a DC power supply and the process was investigated for chemical oxygen demand, ammonia, and phosphates reduction. Iron and aluminium were comparatively used as the treatment electrodes, and effects of operating conditions like applied voltage and treatment time were investigated. Voltage was varied from 5V, 10V and 15V for 30 and 60 minutes treatment duration and aluminium gave better results than iron. The optimum conditions were experimentally determined to be 15V at 30 minutes treatment using aluminium, to give 92% COD removal, 100% phosphate removal and 61% ammonia removal using DC current converted to alternating pulse current by use of a circuit. The experimental results showed electrocoagulation to be a feasible process in the treatment of wastewater.

Keywords: electrocoagulation; wastewater treatment; applied voltage; COD removal; phosphate removal; ammonia removal; monopolar electrodes.



INTRODUCTION

Sewage is the main point-source pollutant on a global scale [1]. The biological and chemical composition of sewage is usually high in Biological Oxygen Demand (BOD), Suspended Solid (SS) and Chemical Oxygen Demand (COD). So, direct discharge of raw or improper treated sewage into the water body is one of the main sources of pollution on a global scale [1]. Wastewater treatment serves two main objectives, protecting the environment and conserving fresh water resources [2].

Treated municipal wastewater is considered, in many major cities of the world, as a supplementary water source for several uses such as agricultural irrigation, landscaping, industrial activities (cooling and process needs), groundwater recharge, recreational and other uses. The continued dependence on treated municipal wastewater for the previously mentioned uses coupled with emerging stricter policies/guidelines for such uses prompted scientists and researchers to concentrate in improving current treatment technologies and to come up with innovative ideas to treat municipal wastewater in an efficient and cost effective manner [3].

The most common conventional methods of treating sewage include Activated Sludge Process, Aerated Lagoons (Oxidation Ponds), Biological Trickle Filtration systems and Anaerobic Digesters. The major disadvantages of most of the conventional methods is that they consume a lot of space and require long periods to process sewage. Simple and efficient sewage water treatment systems are urgently needed in developing countries [4].

Electrocoagulation is one of a simple method to treat wastewater efficiently [5]. Electrocoagulation (EC) is an emerging technology that combines the functions and advantages of conventional coagulation, flotation, and electrochemistry in water and wastewater treatment [6]. It is a complex process involving chemical and physical mechanisms operating simultaneously to remove pollutants from wastewaters [2]. Therefore the potential of electrocoagulation to treat multiple contaminants must be studied. Wastewater is the main cause for irreversible damages to the environment and also contributes to the reduction of fresh water reserves, creating threats to the next generation [7]. Sewage treatment plants are then setup to manage wastewater disposal from the sewer systems and processing this wastewater to safe quality before re-use or disposal.

The purpose of this study is to investigate the treatment of wastewater using electrocoagulation and study its effectiveness as an alternative treatment system to already existing methods. Eyvaz et al. (2014) states that electrocoagulation (EC) has gained many interest due to providing simple, reliable and cost effective operation for the treatment of wastewaters without and need for additional chemicals, and thus the secondary pollution [8].

Research, in the past few decades, have shown that electrocoagulation is a promising

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treatment method and effectively potential to treat variety type of wastewaters including dyes wastewater, tannery wastewater, restaurant wastewater, palm oil mill effluent, food wastewater, potato chip manufacturing wastewater, urban wastewater, and removing heavy metals [9-10]. Hence a multiple contaminant treatment system could prove very beneficial for municipalities and this could lead to advancement in water treatment technology.

METHODS AND MATERIALS

A schematic diagram of the experimental set-up is depicted in Figure 1. The electrochemical circuit unit consists of an electrocoagulation cell, a D.C power supply and the electrodes (aluminum and iron) and is shown in Figure 2. A magnetic stirrer was put in place to keep the composition the sample homogeneous throughout the treatment and set at 100 rpm. All the electrodes were washed with 5% HCl before every experiments conducted. At the beginning of each experiment, 2000 mL of Municipal wastewater was fed into the electrocoagulation cell and current was applied to the circuit for 60 min. The amount of voltage that were applied to the system were 5, 10 and 15 V with maximum treatment time of 60 minutes. Every experiment was performed at room temperature and experimental samples were taken at 5 minute intervals of each run for COD, phosphate and ammonia measurements. Reagent grade of chemicals were used without further purification in every experiment. The pH value was determined by a pH meter (HACH HQ11d). The COD values were measured using a Double Beam UV/VIS Spectrophotometer (PERKIN – ELMER). Conductivity measurements were obtained using a Conductivity meter (Eutech CON 5100). Phosphates and ammonia measurements were obtained using a Single Beam Ultra-Violet Visible Spectrophotometer (HACH-LANGE DR 6000). The system's current was provided by a regulated D.C power with maximum 30V and 3A output volume and current respectively with a 2cm gap between them.

Figure 1: Electrocoagulation unit setup

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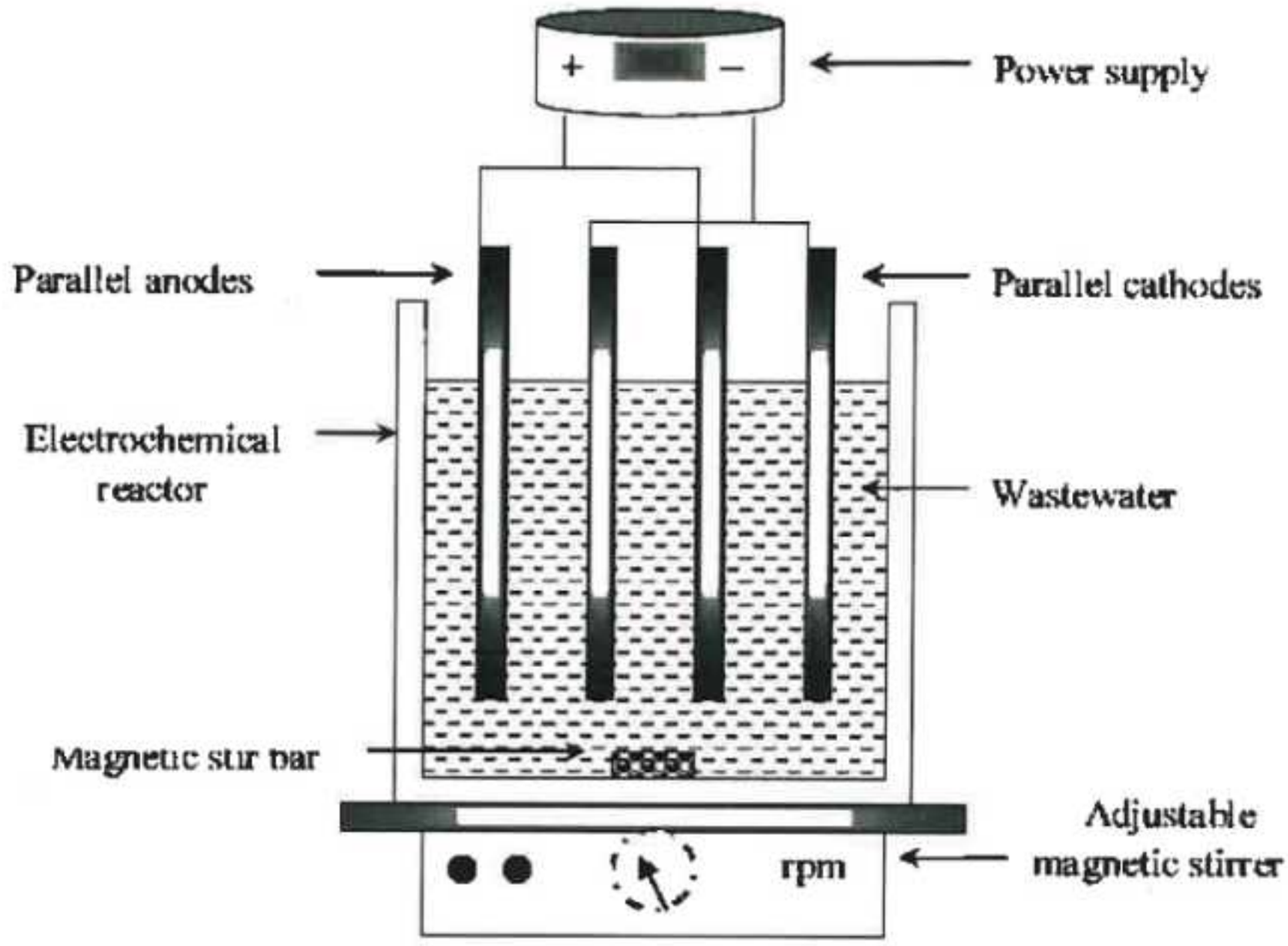

Figure 2: Circuit diagram of electrocoagulation reactor setup

Effect of electrode material

Aluminium and iron were compared for their treatment efficiency. The varied parameters were voltage and treatment time for each electrode.

Effect of Applied Voltage

Voltage was varied from 5V, 10V to 15V. Each voltage was run on a fresh sewage sample. The electrodes were washed with 5% HCl and rinsed with water before and after each treatment in order to remove all dirt from the electrodes [11-12].

Effect of treatment time

50 ml samples were taken after 30 minutes and 60 minutes treatment time. These were filtered and preserved with concentrated H_2SO_4 at 4°C for analysis. The amount of electrode material used up in the treatment was determined using Faraday's Law

$$W = \frac{itM}{zF}$$

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RESULTS AND DISCUSSION

pH and conductivity

The effect of pH and conductivity were not subjects of this study, but were analyzed before treatment was carried out to ensure that their values could suffice electrocoagulation. From literature near neutral pH and conductivity in the range >50mS/cm was adequate for electrocoagulation. Domestic wastewater has a fairly good concentration of dissolved salts like NaCl which enable the conduction of current.

Treatment using iron

The EC process was first applied using iron electrodes and the results shown in Table 1.

Table 1: Characteristics of raw and treated wastewater for iron at 5, 10 and 15 volts

5 VOLTS	Pre-Treatment	30-Minutes	60-Minutes
COD (mg/L)	346	242.2	215
Phosphates (mg/L)	10.8	1.3	0.11
Ammonia (mg/L)	56.4	50.1	49.3
10 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	470	222	153
Phosphates (mg/L)	7.51	0.12	0.00
Ammonia (mg/L)	58.6	37.4	30.8
15 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	481	154	96.1
Phosphates (mg/L)	10.33	0.00	0.00
Ammonia (mg/L)	41.7	23.2	19.13

Removal Efficiency was calculated from equation 1:

Taking COD at 5 Volts, Removal efficiency (R %) was calculated from equation 1:

$$R\%\,(30\text{minutes}) = \frac{346-242.2}{346}\times 100 \qquad (1)$$

$$= 30\%$$

(Tables showing Removal efficiencies are in the Appendix)

Effect of Time :

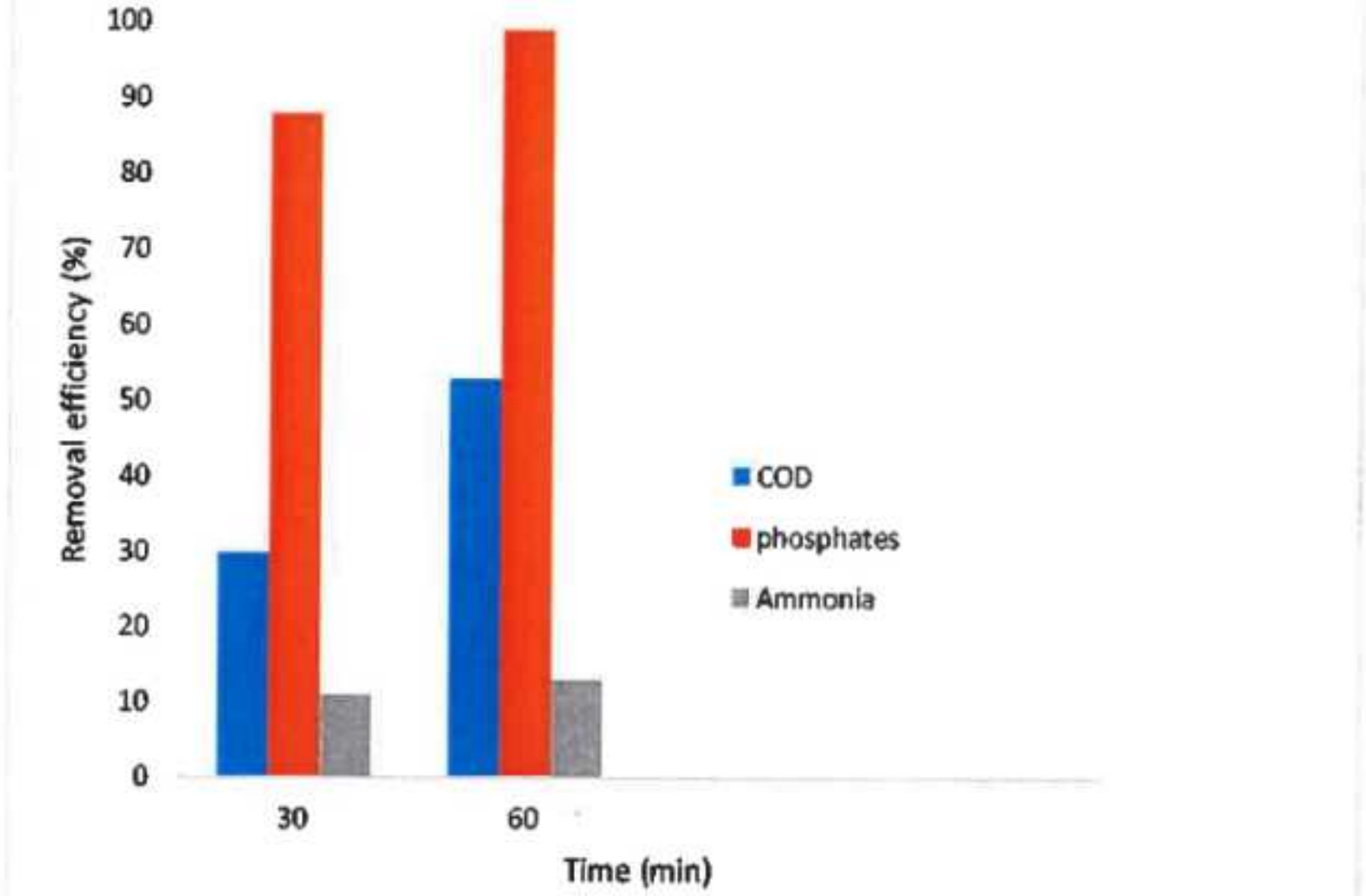

Figure 3: Effect of time at on removal efficiency at 5 volts

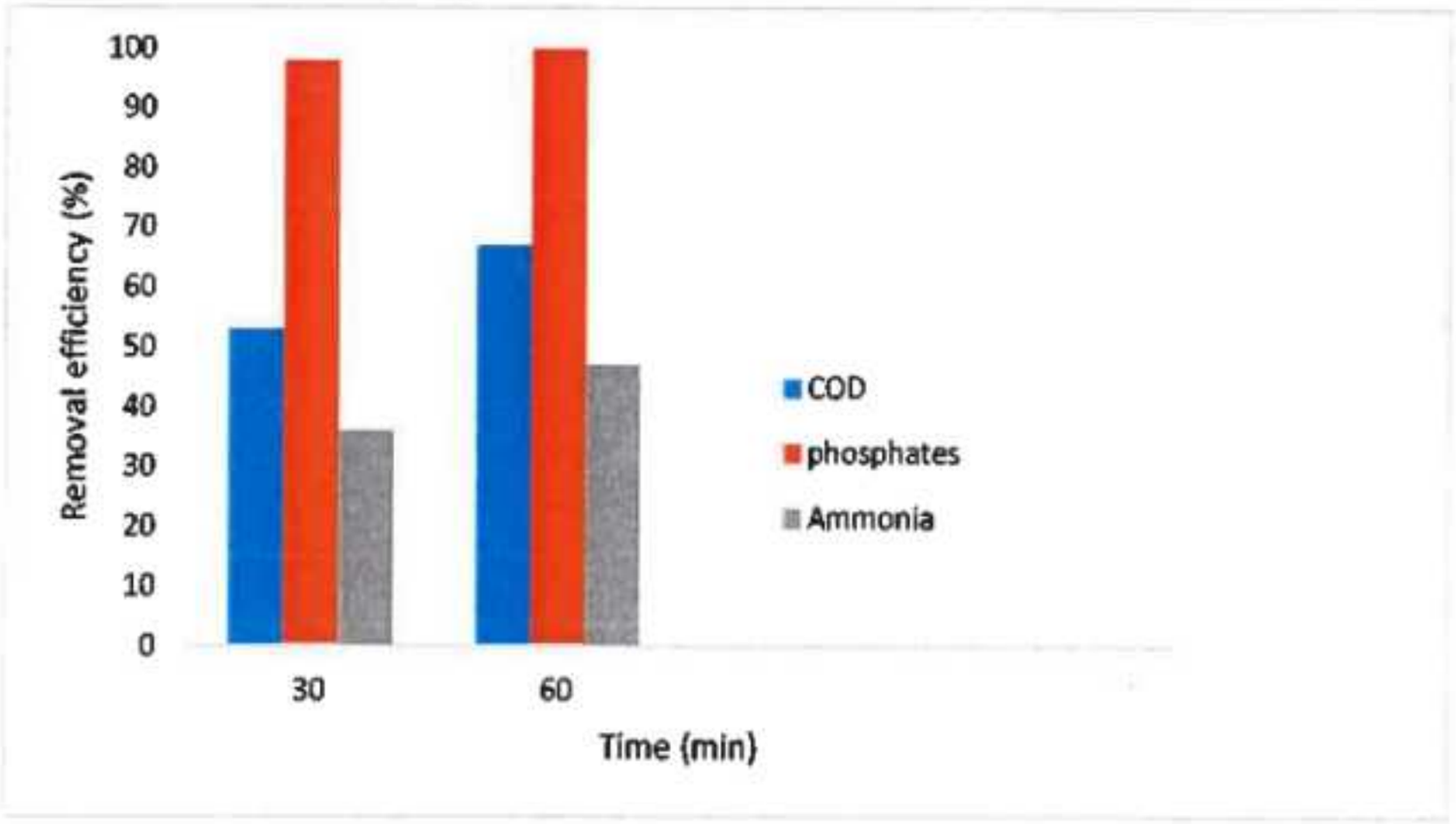

Figure 4: Effect of time on removal efficiency at 10 volts

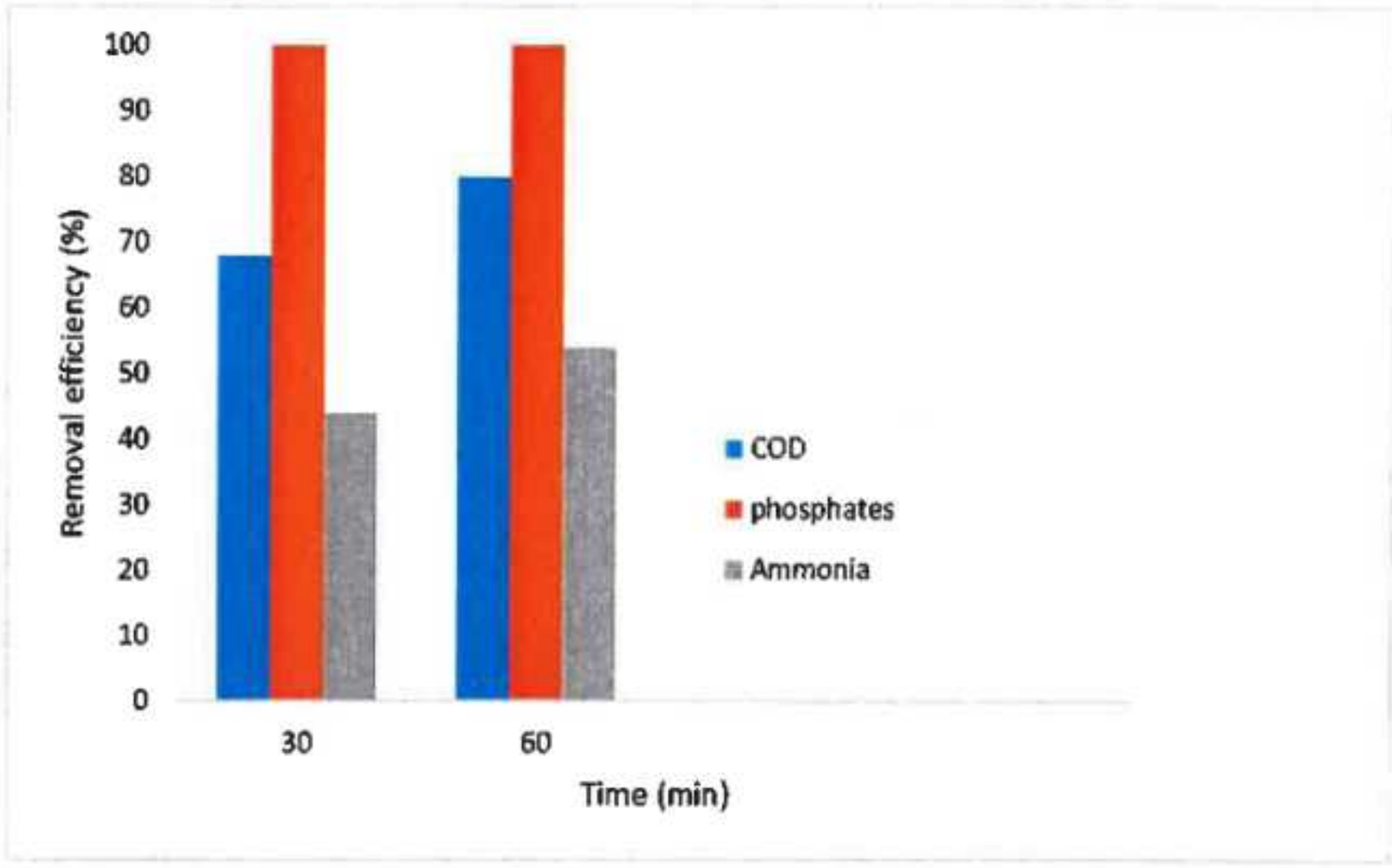

Figure 5: Effect of time on removal efficiency at 15 volts

Effect of Applied Voltage :

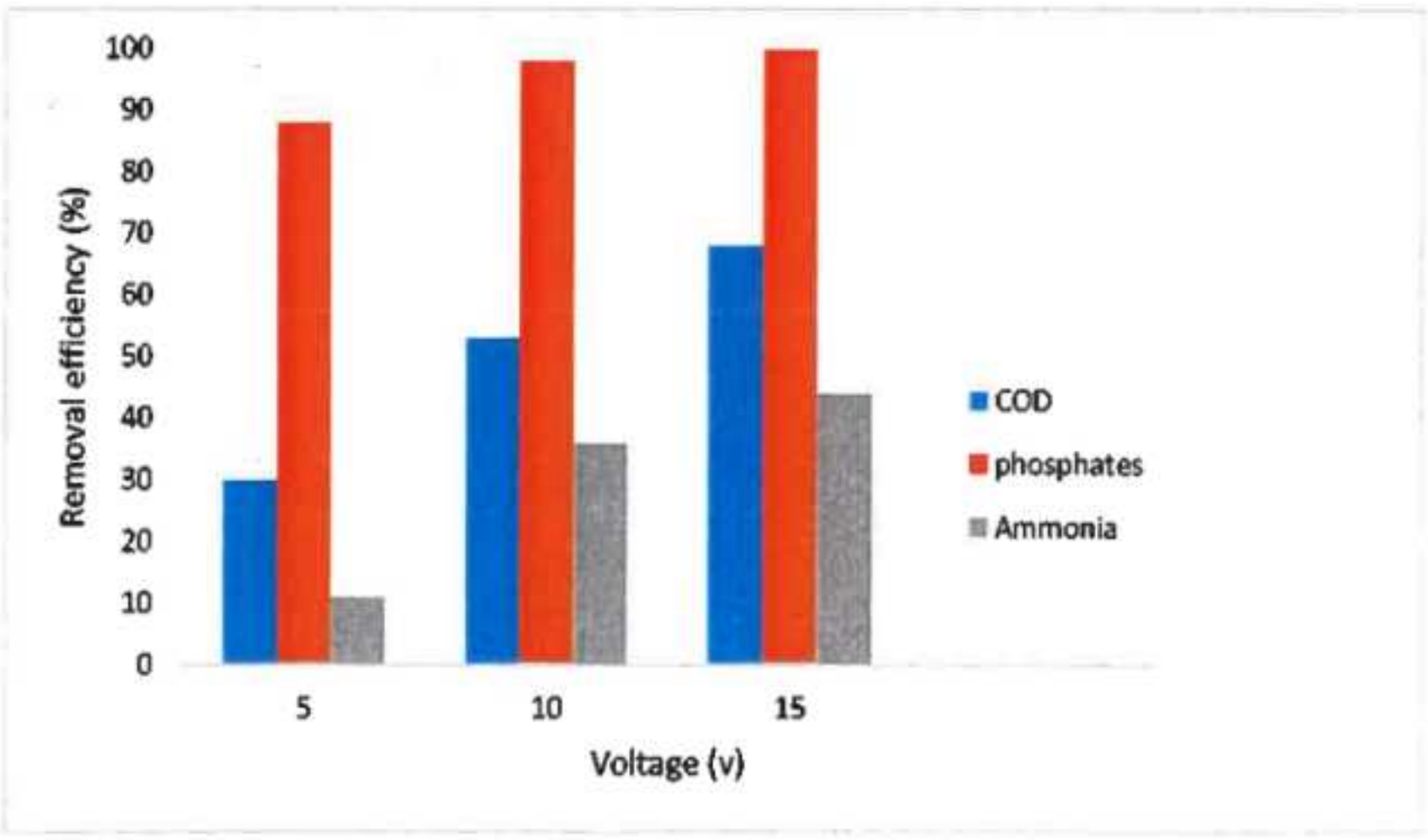

Figure 6: Effect of applied voltage on removal efficiency after 30 minutes treatment

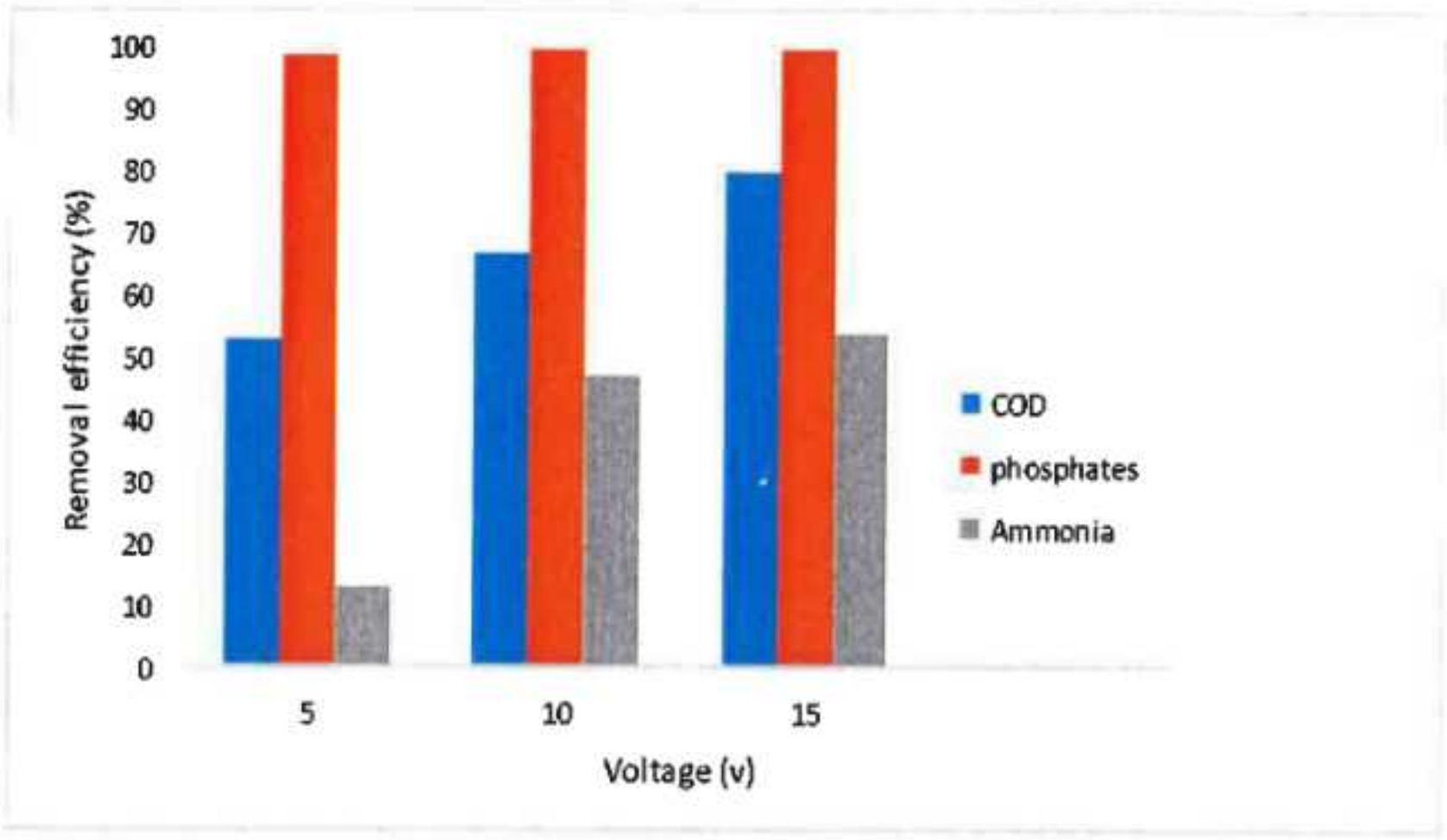

Figure 7: Effect of applied voltage on removal efficiency after 60 minutes treatment

Table 1 shows the results obtained for iron at different voltages and different treatment times. The best result was obtained at 15 volts after 60 minutes treatment. COD, phosphates and ammonia were reduced from 481 mg/L, 10.33 mg/L, and 41.7 mg/L to 96 mg/L, 0.00 mg/L and 19.13 mg/L. Conversely, the lowest result was obtained at 5 volts. Figures 3 to 5 show that increasing treatment time increases removal and Figures 6 and 7 show that increasing voltage had a positive effect on removal efficiency of all pollutants because of the increase in anode dissolution per unit time. 80%, 100% and 54% removal efficiencies were obtained for COD, phosphates and ammonia respectively.

Using iron electrodes, the treating solution began to change into a greenish color after 5 minutes and then switched into brownish color a few minutes later during treatment. These particles are extremely fine and very hard to precipitate, the color was also hard to wash from the vessels. Therefore all subsequent treatments were carried out using aluminum.

TREATMENT USING ALUMINUM

Because of the problems associated with using iron, the results are associated with aluminium

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Table 2: Characteristics of raw and treated water at 5 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	431	243.3	231.7
Phosphates(mg/L)	5.82	0.33	0.01
Ammonia (mg/L)	41.82	32.46	32.10
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	300	178	162
Phosphates(mg/L)	15.3	0.8	0.01
Ammonia (mg/L)	59.9	48	46
Experiment 3	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	365	207	197
Phosphates(mg/L)	6.71	0.3	0.02
Ammonia (mg/L)	41.34	32.35	31.20

Table 3: Characteristics of raw and treated water at 10 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	315.1	98.3	52.7
Phosphates(mg/L)	5.65	0.13	0.00
Ammonia (mg/L)	6.37	3.81	2.35
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	537	197	95.4
Phosphates(mg/L)	10.34	0.00	0.00
Ammonia (mg/L)	3.99	2.47	1.56
COD (mg/L)	481	168.3	60.2
Phosphates(mg/L)	7.6	0.00	0.00
Ammonia (mg/L)	45.7	27.42	20.15

Table 4: Characteristics raw and treated wastewater at 15 volts

Experiment 1	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	360	21.6	2.2
Phosphates(mg/L)	3.70	0.00	0.00
Ammonia(mg/L)	2.75	2.11	1
Experiment 2	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	438	24.6	14.6
Phosphates(mg/L)	8.60	0.00	0.00
Ammonia (mg/L)	38.2	22.50	15.10
Experiment 3	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	273.3	17.3	0.00
Phosphates(mg/L)	13.1	0.00	0.00
Ammonia (mg/L)	11.4	6.56	4.22

The tables show that initial concentration is also an important factor to be considered in electrocoagulation. From Table 2, comparing COD removal, it can be seen that a higher initial COD loading meant a relatively higher COD loading in the final treated

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solution. The same is true with ammonia, which exhibits the same trend as COD. Phosphate conversely did not seem to be affected by this factor. COD was in the blue zone, ammonia red and phosphate blue according after 60 minutes treatment at 15 volts. 30 minutes treatment produced similar results.

Effect of Time:

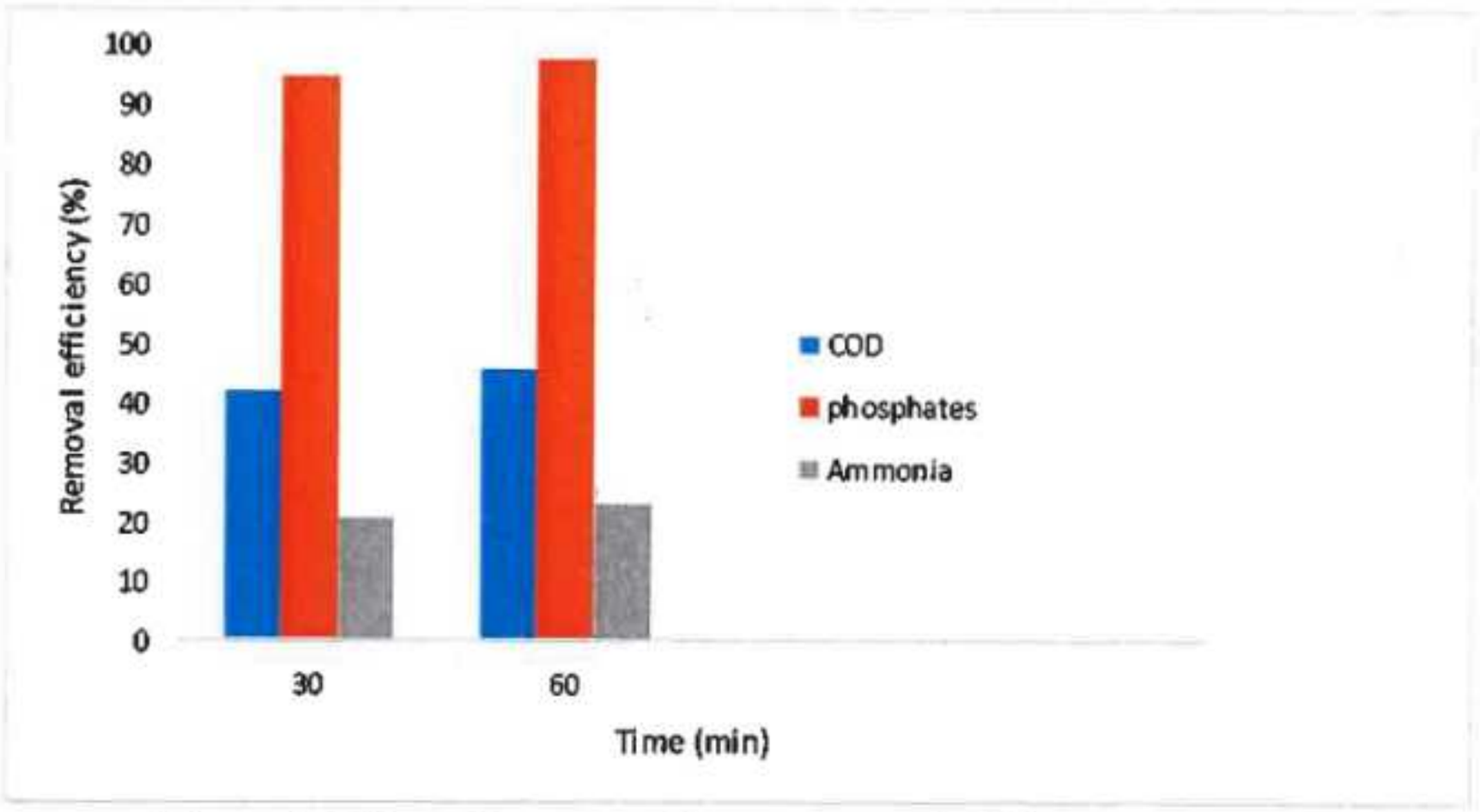

Figure 8: Effect of treatment time on removal efficiency at 5 volts

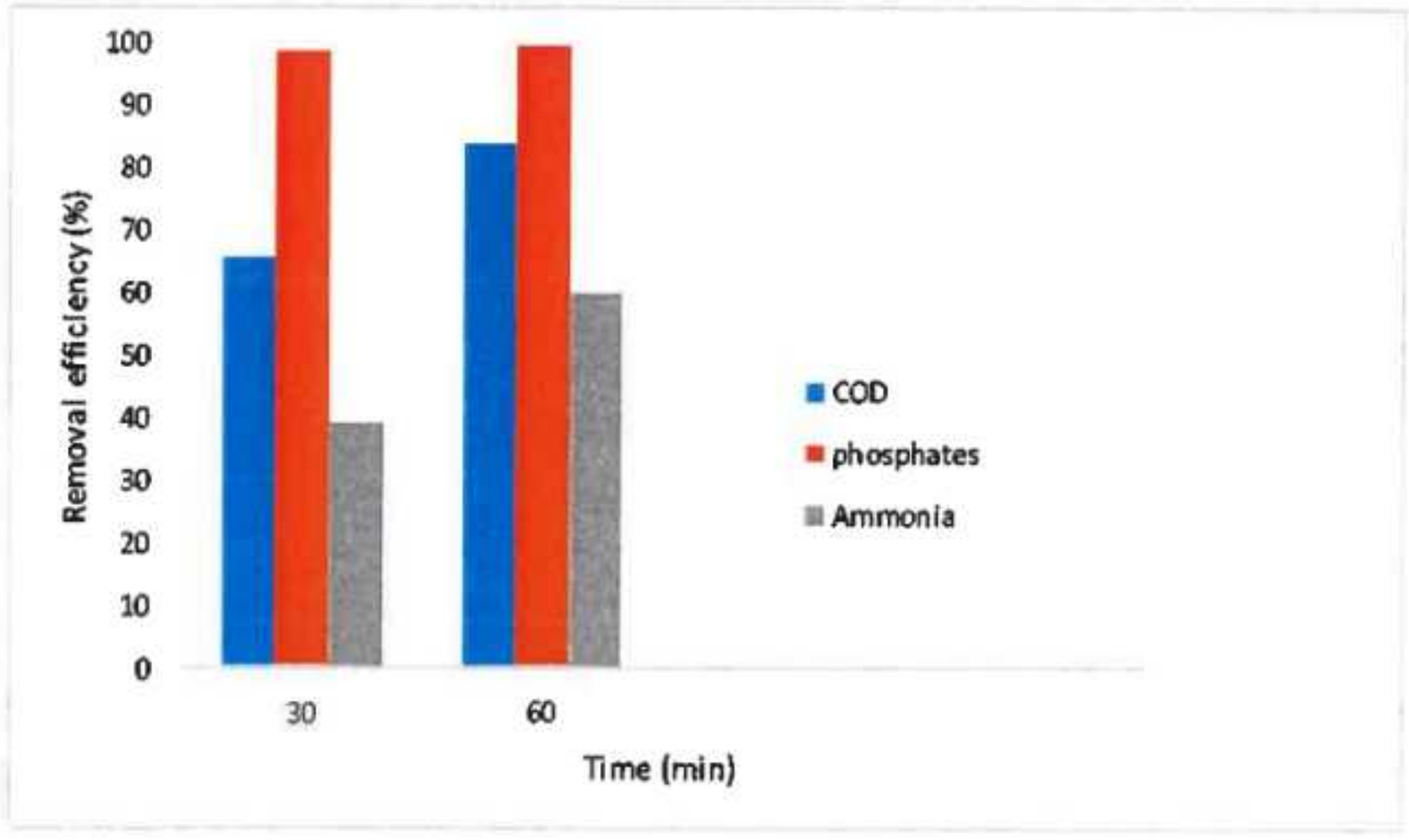

Figure 9: Effect of treatment time on removal efficiency at 10 volts

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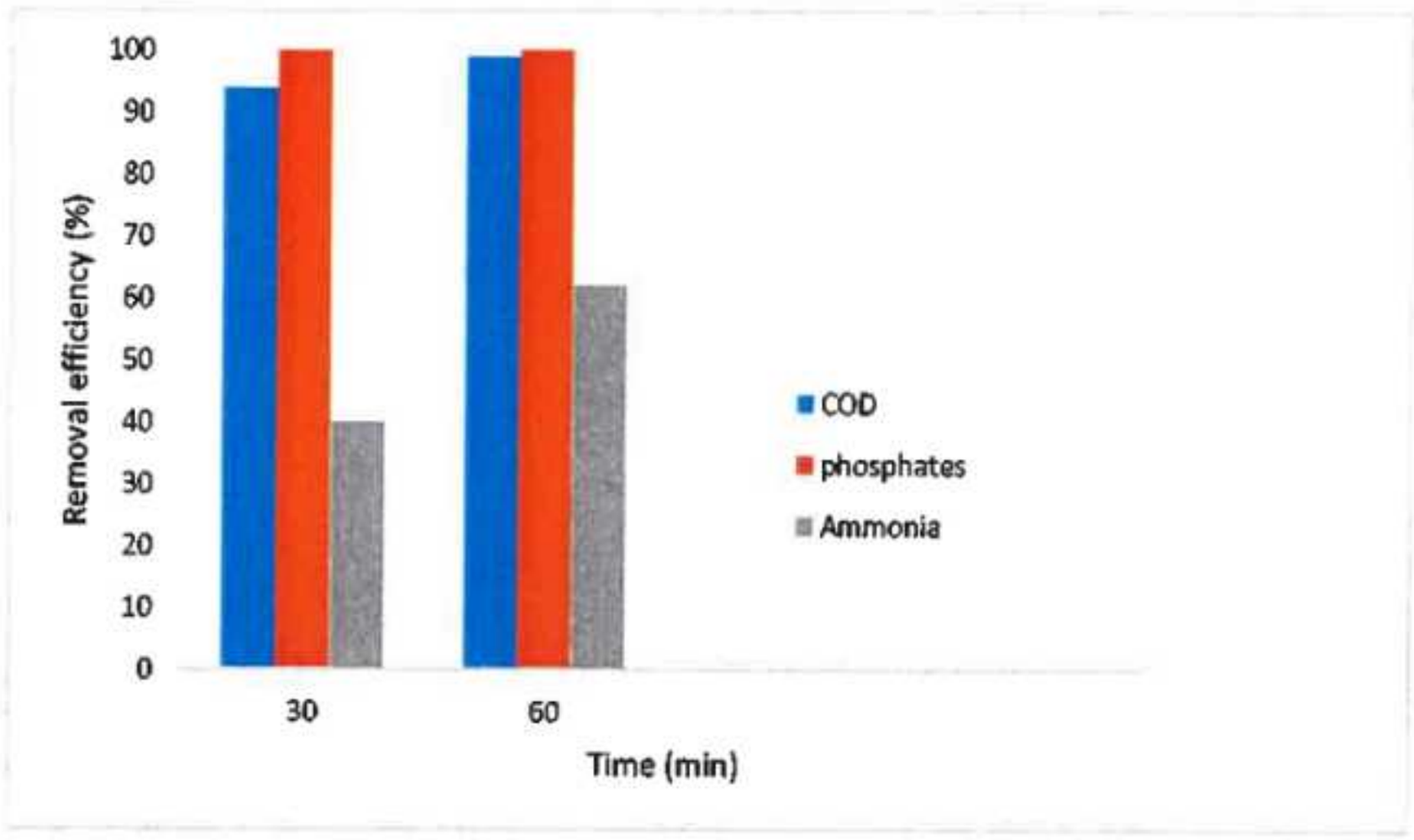

Figure 10: Effect of treatment time on removal efficiency at 15 volts

Figures 8-10 show pollutant reduction to be a function of time. An increase in treatment time results in a subsequent increase in removal efficiency. The best COD reduction was observed after 60 minutes. The same is true with ammonia. 100% phosphate removal efficiency just after 30 minutes at 15 volts, and at all voltages, excellent phosphate removal was observed after 30 minutes.

Effect of Applied Voltage

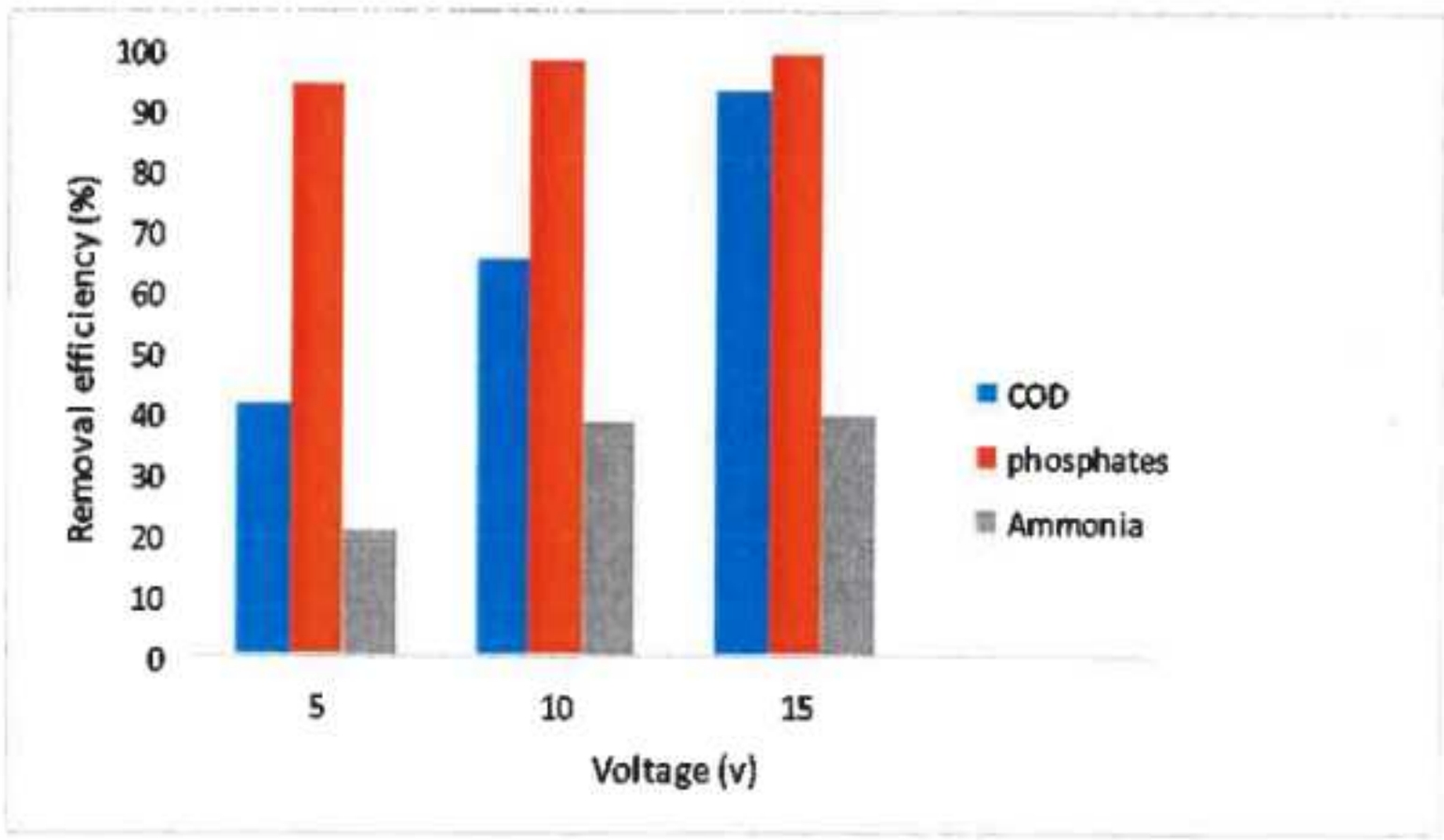

Figure 11: Effect of applied voltage after on removal efficiency 30 minutes treatment

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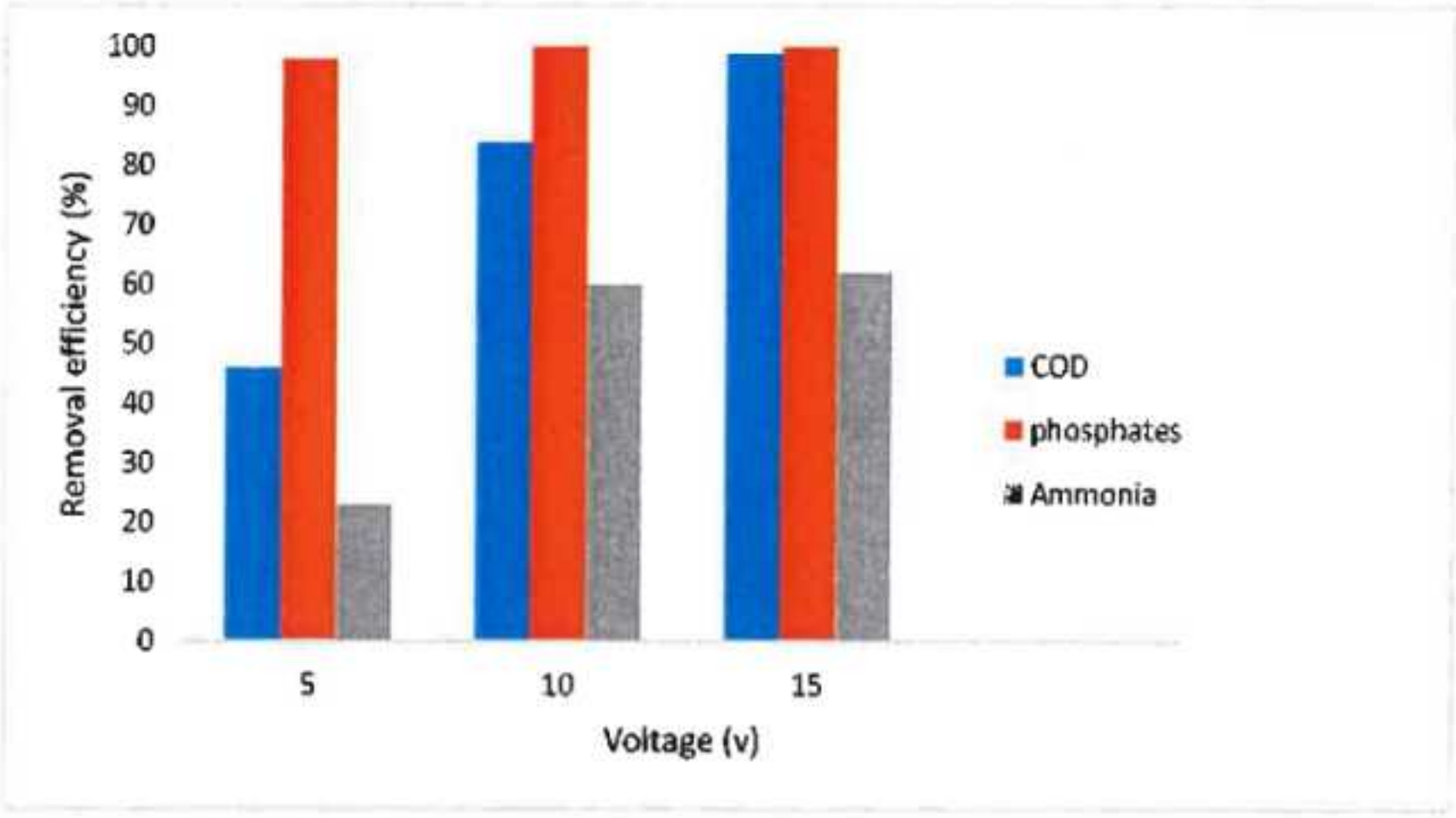

Figure 12: Effect of applied voltage on removal efficiency after 60 minutes treatment

Pollutant removal is observed to also be in accordance with Faraday's law in terms of increase in voltage. Removal efficiencies reached 46%, 84%, 99% for COD at 15 Volts in 60 minutes respectively. High removal efficiency for phosphate was obtained at 5 volts reaching 98% in 60 minutes and 100% at 10 and 15 volts respectively. 23%, 60% and 63% removal efficiencies were obtained for ammonia at 5, 10 and 15 volts.

Effect of passivation

The effects of electrode passivation started developing after the electrodes were used for several different treatments. The effect of the formation of a passive layer was not initially considered but was only noted as after repeating the experiments three or more times.

Table 5: Characteristics of wastewater before and after treatment using passivized aluminium electrodes

5 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	631.7	554.9	534.9
Phosphates(mg/L)	5.72	0.34	0.10
Ammonia (mg/L)	40.5	39.3	36.2
10 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	691	550.9	500.1
Phosphates(mg/L)	5.53	0.13	0.00

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Ammonia (mg/L)	39.2	36.5	34.5
15 VOLTS	**Pre-Treatment**	**30-Minutes**	**60-Minutes**
COD (mg/L)	722.7	543.5	466.7
Phosphates(mg/L)	6.82	0.06	0.00
Ammonia (mg/L)	41.3	32.2	31.4

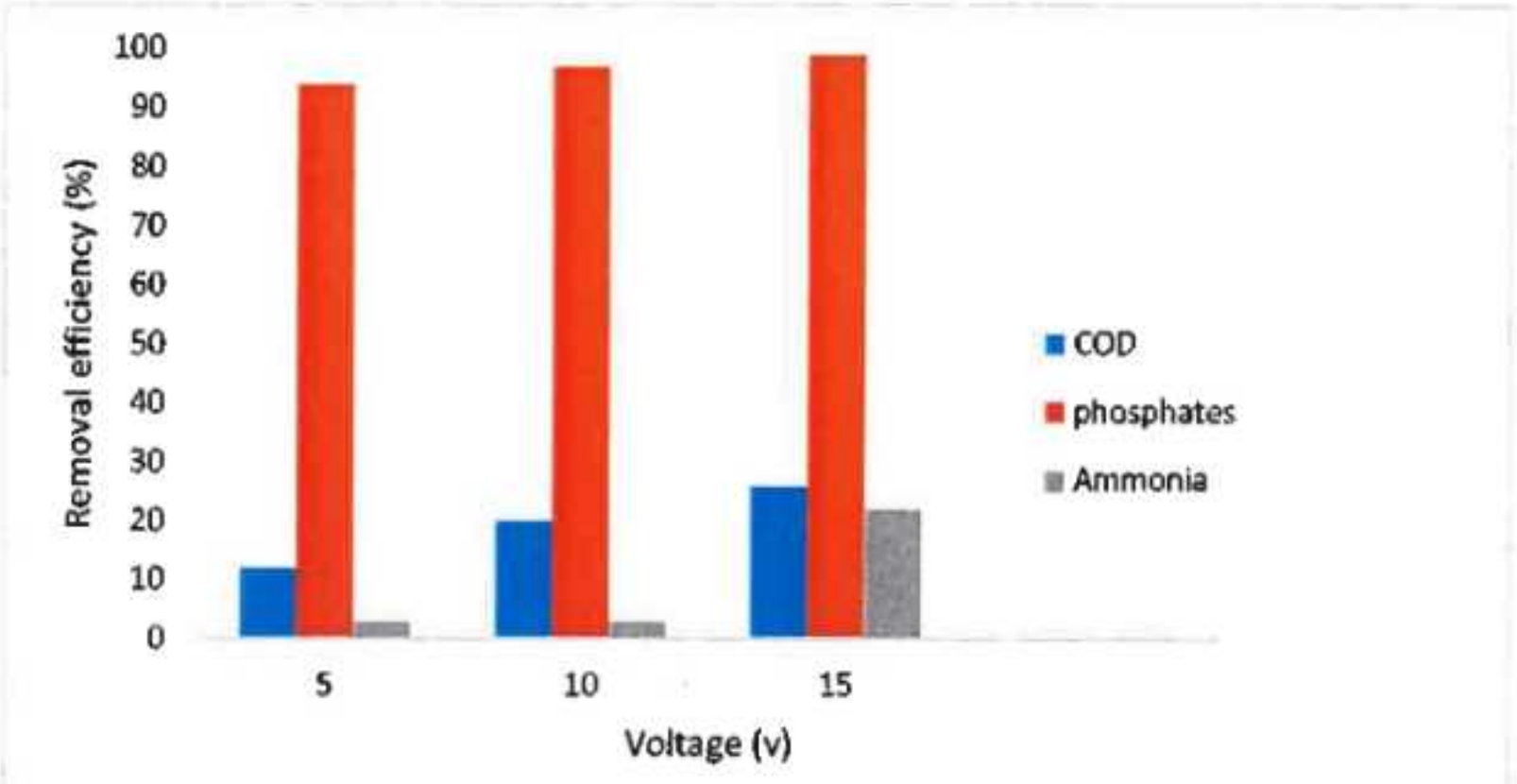

Figure 13: Effect of passivation on removal efficiency after 30 minutes with varying voltage

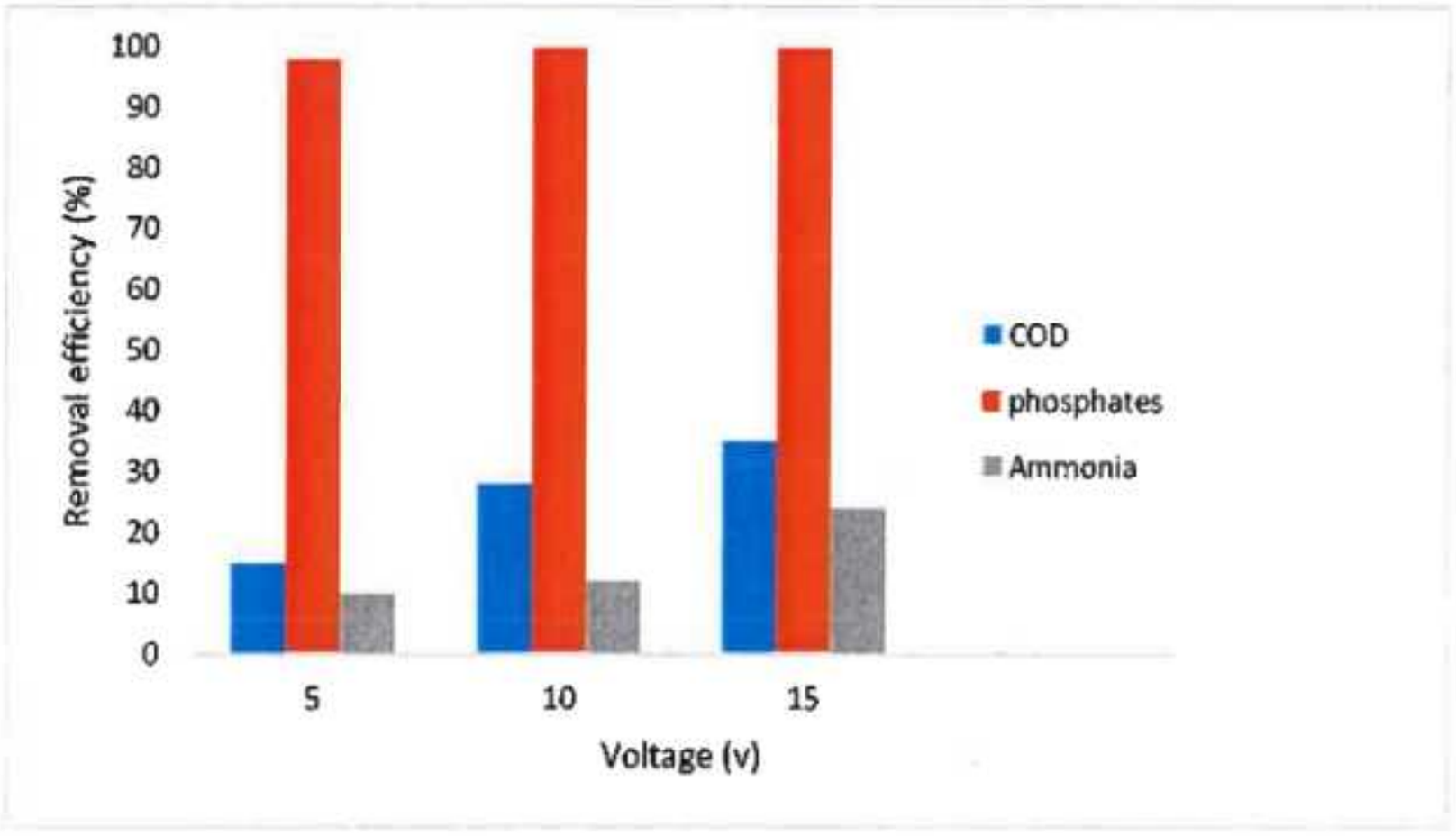

Figure 14: Effect of passivation on removal efficiency after 60 minutes with varying voltage

A decrease in removal efficiency was observed over time as seen in Table 5 and represents the final results using the passivized electrodes. Figures 13 and 14 show that the lowest removal for COD was 12% at 5 volts after 30 minutes treatment and the highest was 24% after 60 minutes treatment for COD. Ammonia removal reduction was also significantly affected by passivation recording such low removal efficiencies as 22% at 5 volts after 30 minutes and 24% was the highest at 15 volts after 60 minutes. Phosphate removal was unaffected by passivation and high removal of 100% was still maintained.

This passivation phenomenon occurred during the process and impeded the oxidation/reduction reactions. The oxide layer reduced the ionic transfer between the anode and the cathode directly, hindering the metal dissolution and indirectly preventing metal hydroxide formation [8].

Application of alternating pulse current

Note should be taken that this method of analyzing the effects of passivation is a novel process. Conductivity of the electrodes is decreased by the formation of the oxide layer, which increases the resistance to the flow of current in the cell.

Table 6: Analysis of conductivity of aluminium before and after treatment using an APC system

Before Treatment		After Treatment	
VOLTAGE	CURRENT	VOLTAGE	CURRENT
2	0.01	2	0.1
3	0.03	3	0.3
4	0.04	4	0.4
5	0.05	5	0.5

The notion of application of alternating pulsed current was brought about to reverse the effects of passivation. At first, manual changing of polarity of electrodes was done after 30 minutes of treatment. From literature passivation must decrease the electrodes' current conductivity, and this is observed in Table 6, the electrodes used had lower conductivity before APC was applied to them. They had a little passivation owing to the treatments they had performed. However, after electrocoagulation with APC their conductivity was observed to increase.

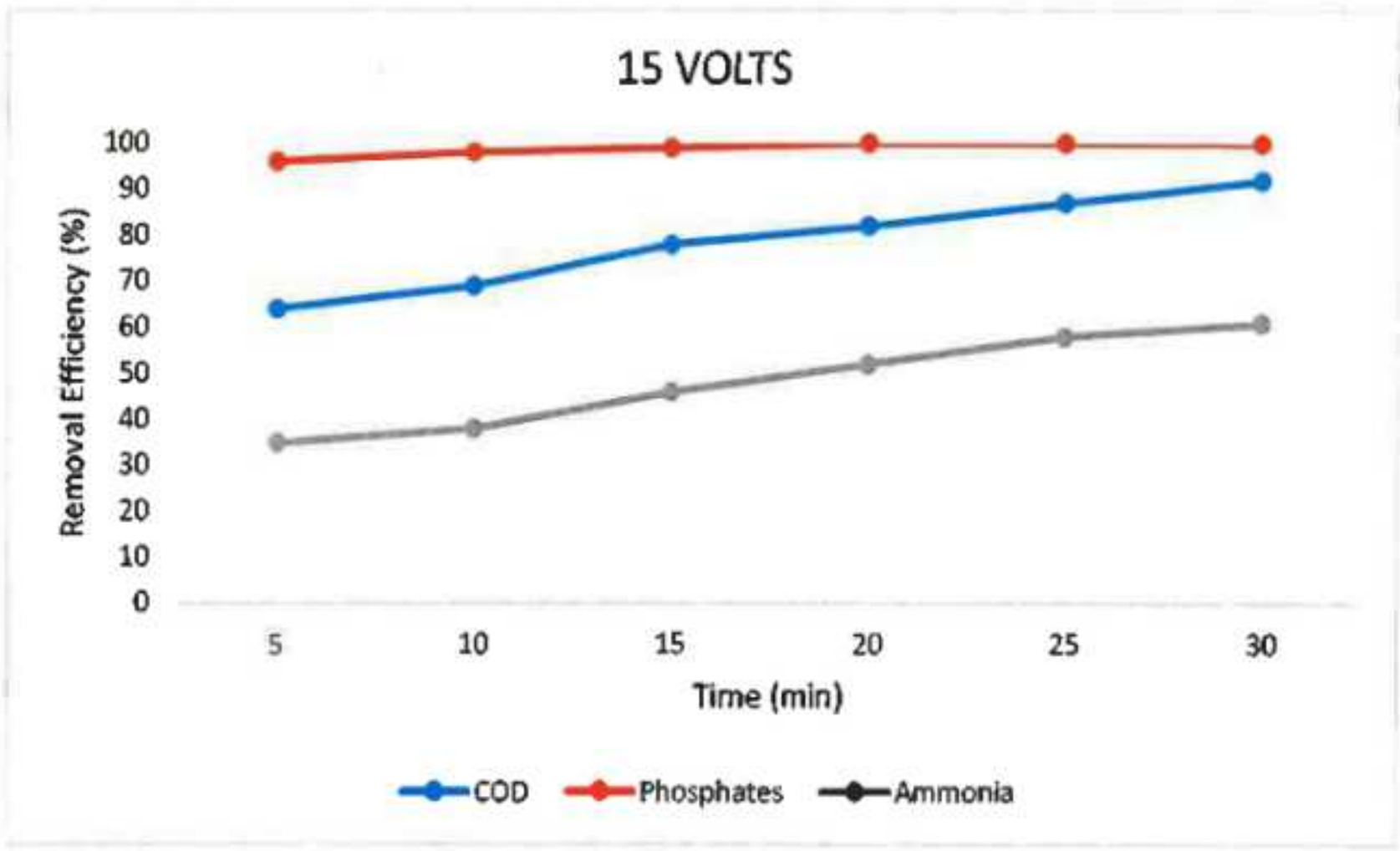

Figure 15: Effect of electrocoagulation on wastewater at 15 volts for 30 minutes using alternating pulse current

According to Figure 15 the rate of pollutant removal is high in the first 5 minutes and the rate decreases as time progresses. As time approaches 30 minutes, rate of pollutant removal decreases and reaches a monotonic state. This may be due to existence of excess colloids for adsorption

CONCLUSION

Electro coagulation was successfully applied for the treatment of municipal wastewater. The study was performed to evaluate the influence of different operational parameters on the reduction of COD, phosphates and ammonia in wastewater. Effects of type of electrode material, treatment time and applied voltage were investigated and the following observations were made:

- Aluminium and Iron were compared and Aluminium gave better results. Aluminium gave 99%, 100% and 62% removal efficiencies for COD, ammonia and phosphates respectively while Iron gave 80%, 100% and 54% removal efficiencies for the same parameters after 60 minutes treatment at 15 volts.
- Applied voltage was varied between 5, 10, 15 Volts. Pollutant removal increased with increasing voltage because of the increased coagulant generation per unit time.15 Volts gave the best results
- Application of alternating pulsed current was effective in reducing the effects

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passivation, with the conductivity of the already passivised electrodes increasing after applying alternated pulsed current. This also had the effect of increasing ammonia removal. At 15 volts, 30 minutes without the automated alternating pulsed gave 40% removal while after alternating pulsed current system gave 62% removal at the same time

- Phosphate was the most efficiently reduced pollutant, with 100% reduction being recorded at all voltages, then COD 99% and ammonia 63% at 15 volts.

ACKNOWLEDGEMENTS

Gratitude is extended to the Bulawayo City Council especially to the Technical staff at Thorngrove/Criterion Laboratory were most of the experimental work was carried out.

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APPENDIX

Removal Efficiency Tables:

A1: Removal efficiencies of COD, phosphates and ammonia using Iron at 5, 10, 15 volts

IRON		5 VOLTS	10 VOLTS	15 VOLTS
30 Minutes	COD	30	53	68
	Phosphates	88	98	100
	Ammonia	11	36	44
60 Minutes	COD	53	67	80
	Phosphates	99	100	100
	Ammonia	13	47	54

A2: Removal efficiencies of COD, phosphates and ammonia at 5 volts with varying treatment time

5 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	43	41	43	42
	Phosphates	94	95	96	95
	Ammonia	22	20	21	21
60 Minutes	COD	46	46	46	46
	Phosphates	99	95	100	98
	Ammonia	23	23	24	23

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A3: Removal efficiencies of COD, phosphates and ammonia at 10 volts with varying treatment time

10 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	69	63	65	66
	Phosphates	98	100	100	99
	Ammonia	40	38	40	39
60 Minutes	COD	83	82	87	84
	Phosphates	100	100	100	100
	Ammonia	63	60	56	60

A4: Removal efficiencies of COD, phosphates and ammonia at 15 volts with varying treatment time

15 VOLTS		Experiment 1	Experiment 2	Experiment 3	Average
30 Minutes	COD	94	94	94	94
	Phosphates	100	100	100	100
	Ammonia	38	41	42	40
60 Minutes	COD	99	97	100	99
	Phosphates	100	100	100	100
	Ammonia	63	60	63	62

A5: Removal efficiencies of COD, phosphates and ammonia after treatment using passivized electrodes

		5 VOLTS	10 VOLTS	15 VOLTS
30 Minutes	COD	12	20	26
	Phosphates	94	97	99
	Ammonia	3	3	22
60 Minutes	COD	15	28	35
	Phosphates	98	100	100
	Ammonia	10	12	24

A6: Removal efficiencies of COD, phosphates and ammonia with varying time during time optimization experiment

	5Minutes	10Minutes	15Minutes	20Minutes	25Minutes	30Minutes
COD	64	69	78	82	87	92
Phosphates	96	98	99	100	100	100
Ammonia	35	38	46	52	58	61

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PROJECT: KEDARNATH RESTORATION AND REDEVELOPMENT
DOCUMENT: WATER DEMAND & SEWAGE GENERATION

Sr No.	Description	Total Population	Diversity Factor	Diversified Population	Water Requirement per person per Day as per NBC (LTR) Floating Population: (NBC PART-9 TABLE-1) Permanennt Population: (NBC PART-9 Clause no. 4.1.1)			Total Water Requirement per Day (KL)			Total Sewage Generation per Day in KLD (80% of Domestic+ Flushing)	STP Capacity (KLD)		Total Recycle water Generation (90%) (KLD)	Solid Waste Generation as per NBC	
					Domestic	Flushing	Total	Domestic	Flushing	Total		Diversity			Solid Waste/ Person/ Day (KG)	Total Solid Waste Generation (Kg/day)
1	Floating Population - Pilgrims	25000	85%	17000	5	10	15	85.00	170.00	255.00	238.00				0.15	2,550.00
2	Permanent Staff Including Hospital	5000		5000	60	30	90	300.00	150.00	450.00	360.00				0.30	1,500.00
3	Hospital Nos of Bed			35	230	110	340	8.98	2.86	8.84	7.64				0.30	7.80
	Total KLD							**390.98**	**322.86**	**713.84**	**635.64**					**4,058**
	Say KLD							**391**	**323**	**714**	**635**	**95%**	**600**	**540**		**4058**
1	**Summary**		Unit													
a	Total Water Demand	714	KLD													
b	Total Domestic Water Demand	391	KLD													
c	Total Flushing Water Demand	323	KLD													
d	Total Waste Water Generation	635	KLD													
F	**Total Solid Waste Generation**	**4,058**	**KG/DAY**													
G	**Total Organic Solid Waste Generation (approximate 40% of Total Solid Waste)**	**1,502**	**KG/DAY**													

Certified that structural design & Drawing has been checked & found safe Execution/implementation of the same rests with the client/owner.

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(मनीष जोशी)

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MRF (Material Recovery Facility)

Plastic bailing machine, Kedarnath

(Photograph -02)

DRS project stablished RVM machine in Kedarnath.

Plastic bottle collection at Kedar triples from last year

Tanmayee Tyagi@timesgroup.com

Dehradun: Plastic waste management has continued to plague Char Dhum shrines, but officials in Kedarnath have made a significant improvement in PET bottle collection this year compared to 2023. They attributed the success to increased awareness campaigns. The Digital Refund System, initiated last year, allows consumers to claim a Rs 10 refund by scanning a QR code on the wrapper of a plastic bottle.

This system was implemented by the Rudraprayag administration with a Hyderabad-based cleantech startup Recykal.

The campaign was also launched in Chopta in September last year and then in Yamunotri and Gangotri this year. According to data obtained by TOI, the distribution of codes at Kedarnath increased from 3.15 lakh in 2023 to 5.35 lakh this year. The number of bottles collected also rose from 1.63 lakh to 4.1 lakh.

SDM Jitendra Verma said, "When we include the non-DRS bottles, the amount of plastic collected has almost tripled in this one year. We have had tremendous support from the locals along the trek route and the goal is to decentralise the whole process, do away with the need for collection centres and make it a no-waste shrine. In the next phase of the project, we will move on to multi-layered plastics like food wrappers and packets." Local hoteliers and business owners are being engaged to install compacting machines along the yatra route to facilitate responsible waste management. This strategy aims to reduce the need for transportation and preserve resources.

Abhay Deshpande, founder and CEO of Recykal, said, "Our goal is to target 100% collection and ensure zero environmental impact while promoting sustainable tourism in the region. The success of DRS and its expansion has been remarkable and made possible with the support of natives, shopkeepers, distributors, and the local administrations."

A company spokesperson mentioned that a total of 16 lakh codes were distributed this year, resulting in the collection of 11.5 lakh bottles across Gangotri, Yamunotri, Kedarnath, and Chopta. The ultimate goal is 100% collection with zero environmental impact, promoting sustainable tourism in the region.

The success of the Digital Refund System and its expansion has been attributed to the support of natives, shopkeepers, distributors, and local administrations. With a record 54.2 lakh pilgrims visiting the Char Dham shrines this year, waste generation has increased significantly, emphasising the need for large-scale initiatives for source segregation of plastic waste.

According to data obtained by TOI, the distribution of codes at Kedarnath increased from 3.15 lakh in 2022 to 5.35 lakh this year. The number of bottles collected also rose from 1.63 lakh to 4.1 lakh

Solid Waste Management Action Plan/ Detailed Project Report of Sri Kedarnath/Nagar Panchayat Kedarnath

Solid Waste Management

Cost of DPR: Rs. ₹ 309.46 Lakhs

Urban Development Directorate, Uttarakhand

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Introduction:

Waste Management in Kedarnath

Kedarnath, a renowned pilgrimage site nestled in the Himalayan region of Uttarakhand, attracts millions of devotees and tourists annually. With its resident population of 612 (Census 2011) and a floating population averaging 9,334 per day (2024), the town faces significant challenges in managing municipal solid waste. The influx of visitors during peak pilgrimage seasons increases daily waste generation, necessitating robust and sustainable waste management systems.

Currently, the total waste generated in Kedarnath is estimated at 0.147 TPD on average basis while on the basis of highest footfall of 38682 on a single day it may reach upto 1.191 TPD in 2024, projected to rise to 3.049 TPD by 2050 due to population growth and increasing tourist activity. Approximately 60% of the waste is wet (organic), while 40% is dry (recyclables and inert), with varying moisture content impacting processing efficiency.

To address these challenges, a Material Recovery Facility (MRF) has been designed, optimized for the region's limited space and hilly terrain. This facility, spread across 160 m^2 of ground area incorporates advanced waste segregation and processing systems to handle the wet and dry waste streams effectively. The MRF aims to process wet waste through composting and potential biogas generation, while dry waste is segregated into recyclables like plastics, paper, metals, and glass for further recycling.

This initiative represents a critical step towards sustainable waste management in Kedarnath, promoting environmental conservation and enhancing the town's capacity to handle the demands of its growing population and tourism. The facility's design ensures scalability and integration of innovative waste-to-energy solutions for a cleaner and greener Kedarnath.

General Information

- ULB - Nagar Panchayat - Kedarnath
- Current Population - **612**
- Floating Population - **9334** Per day average (Total **1652076** tourist visited till 03-11-2024 in current tourism session with highest footfall of **38682 on 21-05-2024**)

Status of Human Resource

- Total number of Paryavaran Mitra - 50
- Permanent Paryavaran Mitra - 0 1
- Environment Supervisor - 01

Status of SWM/PWM

- Total processed plastic waste - 8.6 tonne(approx.)
- Total income by selling plastic - Rs. 0.51 Lacs
- Solid Wast Collection Vehicle - 01 (mini tractor with trolly)
- Processing Facility - 01 MRF and 01 Bailing machine (for segregation of dry waste)

Status of Sanitation/Toilets

- 22 (20 + 02 Smart Toilets Newly Constructed)
- 02 smart toilets (6 female seat and 6 male seat) have been constructed by Kedarnath Development Authority within Nagar Panchayat Kedarnath area.
- Construction work of 20-Seater and 22-seater public toilets is also in progress.

- Disposal Mechanism- 20 toilets with Soak Pits and 02 Toilets with Soak pit as well as with septic tank.
- Operation and Maintenance- All toilets are maintained by Sulabh International and 04 Paryavaranmitra are deployed for thecleaning of all 20 toilets in 04 location/cluster.

Status of New Initiatives Deposit Refund System (DRS)

The town is a famous tourist spot with high footfall every year. The demographic consists of a significant number of tourists and local businesses, making it an ideal location for implementing innovative waste management solutions like the digital DRS.

Focusing on this urban locality, digital DRS aims to address the waste management challenges in a rapidly growing city. It ensures efficient collection and recycling of PET bottles and other recyclable materials. The initiative also engages the local community, promoting responsible waste disposal practices and environmental awareness.

DRS Progress Status –

- Total QR provided on plastic bottle/tetra pack is 172100
- Out of above 139838 Bottles/Tetra Pack (81%) with QR returned for recycling.
-

Population Growth

- Considering Annual Population Growth Rates:
  - Resident Population: 1.2% per year.
  - Floating Population: Estimate not directly available; assumed proportional to user-provided 2024 data (9,334 for 2024, 3% annual growth).

$$P_t = P_0 \times (1+r)^n$$

Where:

P_t: Population in the target year

P_0: Current population

r: Growth rate (decimal)

n: Number of years

Year	Resident Population	Floating Population (Average)
2011	612	~6,774
2024	735	9334
2034	$735\times(1.012)^{10}=687$	$9{,}334\times(1.03)^{10}=12{,}556$
2044	$735\times(1.012)^{20}=772$	$9{,}334\times(1.03)^{20}=16{,}887$
2050	$735\times(1.012)^{26}=878$	$9{,}334\times(1.03)^{26}=20{,}246$

Waste Generation

- Resident: 0.35 kg/person/day in 2024, increasing by 1% annually.
- Tourist: 0.10 kg/person/day in 2024, increasing by 1% annually.

$$W_t = W_0 \times (1+r)^n$$

Where:

W_t : Waste generation rate in the target year

W_0: Current waste generation rate

r : Growth rate (decimal)

n : Number of years

Year	Resident Waste Generation Rate (kg/person/day)	Tourist Waste Generation Rate (kg/person/day)
2011	0.30	0.05
2024	0.35	0.10
2034	$0.35 \times (1.01)^{10} = 0.386$	$0.10 \times (1.01)^{10} = 0.110$
2044	$0.35 \times (1.01)^{20} = 0.427$	$0.10 \times (1.01)^{20} = 0.122$
2050	$0.35 \times (1.01)^{26} = 0.444$	$0.10 \times (1.01)^{26} = 0.129$

Total Waste Generation

The formula for total waste is:

Total Waste = Population × Waste Generation Rate

Year	Resident Waste (TPD)	Floating Waste (TPD)	Total Waste (TPD)
2011	612×0.30=183.6kg= 0.184TPD	6,774×0.05=1,693.5kg= 0.3387 TPD	0.184+0.3387= **0.5227 TPD**
2024	735×0.35=257.25kg= 0.257TPD	9,334×0.10=2,800.2kg= 0.9334 TPD	0.257+0.9334= **1.1904 TPD**
2034	822×0.386=317.29kg= 0.317TPD	12,556×0.110=4,155.03kg= 1.3811 TPD	0.317+1.3811= **1.6981 TPD**
2044	919×0.427=392.91kg= 0.393TPD	16,887×0.122=6,183.64kg= 2.0602 TPD	0.393+2.0602= **2.4532 TPD**
2050	985×0.444=437.34kg= 0.437TPD	20,246×0.129=7,716.73kg= 2.6117 TPD	0.437+2.6117= **3.0487 TPD**

Final Summary:

Year	Resident Population	Floating Population	Resident Waste (TPD)	Floating Waste (TPD)	Total Waste (TPD)
2011	612	6,774	0.184	0.338	0.522
2024	**735**	**9,334**	**0.257**	**0.934**	**1.191**
2034	822	12,556	0.317	1.381	1.698
2044	919	16,887	0.393	2.060	2.453
2050	985	20,246	0.437	2.612	3.049

Waste Composition:

- Wet Waste: 60% of total waste (kitchen waste, food scraps, etc.).
- Dry Waste: 40% of total waste (plastics, paper, metals, etc.).

Moisture Content:

- Wet Waste: 70% moisture.
- Dry Waste: 10% moisture.

Dry Waste Segregation:

- Plastics: 40%
- Paper/Cardboard: 30%
- Metals: 10%
- Glass: 10%
- Other (Rubber, textiles, etc.): 10%

Wet and Dry Waste with Moisture Content

Year	Total Waste (TPD)	Wet Waste (60%) (TPD)	Dry Waste (40%) (TPD)	Wet Waste (After Moisture) (TPD)	Dry Waste (After Moisture) (TPD)
2011	0.522	0.313	0.209	0.313×(1−0.7)=0.094	0.209×(1−0.1)= 0.188
2024	**1.191**	**0.715**	**0.476**	**0.715×(1−0.7)=0.215**	**0.476×(1−0.1)=0.429**
2034	1.698	1.019	0.679	1.019×(1−0.7)=0.306	0.679×(1−0.1)=0.611
2044	2.453	1.472	0.981	1.472×(1−0.7)=0.442	0.981×(1−0.1)=0.883
2050	3.049	1.829	1.220	1.829×(1−0.7)=0.549	1.220×(1−0.1)=1.098

Dry Waste Partwise Segregation

Year	Total Dry Waste (After Moisture) (TPD)	Plastics (40%)	Paper/Cardboard (30%)	Metals (10%)	Glass (10%)	Other (10%)
2011	0.188	0.188×0.4 =0.075	0.188×0.3=0.056	0.188×0.1 =0.019	0.188×0.1= 0.019	0.188×0.1=0.019
2024	**0.429**	**0.429×0.4 =0.172**	**0.429×0.3=0.129**	**0.429×0.1 =0.043**	**0.429×0.1= 0.043**	**0.429×0.1=0.043**
2034	0.611	0.611×0.4 =0.244	0.611×0.3=0.183	0.611×0.1 =0.061	0.611×0.1= 0.061	0.611×0.1=0.061
2044	0.883	0.883×0.4 =0.353	0.883×0.3=0.265	0.883×0.1 =0.088	0.883×0.1= 0.088	0.883×0.1=0.088
2050	1.098	1.098×0.4 =0.439	1.098×0.3=0.329	1.098×0.1 =0.110	1.098×0.1= 0.110	1.098×0.1=0.110

- Objective: Design a facility capable of handling **1 TPD** (including future scalability).
- Available Area: Total Area 0.30 hectare

Proposed Design

The facility will adopt a compact and efficient layout tailored for hilly terrain with modular machinery.

Wet Waste Processing:

- Organic Waste Composter: Suitable for food and organic waste
  (1 Nos. of 500 Kgs in MRF and 8 Nos. of 50 Kgs in Route to Kedarnath)
- Biogas Generation: Option for future integration.

Dry Waste Processing:

- Segregation: Focus on plastics, paper, metals, glass, and other materials.
- Baling/compactor: Compact packaging for recyclables.
- Magnetic Separator: For metal waste.
- Manual Sorting: For finer segregation where needed.

Dry Waste Segregation Process (Partwise Breakdown)

- Plastics (40%): Recyclable plastics processed, sorted, and sent for baling or direct sale.
- Paper/Cardboard (30%): Sorted, compacted into bales for recycling.
- Metals (10%): Separated using magnetic separators; compacted for sale.
- Glass (10%): Collected separately for recycling, handled with care due to fragility.
- Other (10%): Textiles, rubber, and other recyclable materials sorted and processed accordingly.

1. Facility Layout

MRF Centre (160 m^2)

Section	Nos./ Qty.	Area Allocation (m^2)	Description
Receiving Area & Tipping Area	1	20	For unloading and initial segregation of dry waste from collection vehicles.
Sorting/Processing Area	1	90	Manual sorting area with flat sorting conveyor belts Includes OWCs, conveyor belts, ballistic separator, and magnetic separator.
Bale Storage/ Dispatch Area	1	15	For storing compressed bales of recyclables like plastics, paper, and metals. And ready to move for the recycler.
Office with toilet	1	10	Includes supervisor's office, rest area, and hygiene facilities with Separate facilities for male and female workers.
Security Cabin	1	10	Located near the entry for weighing incoming and outgoing waste loads.
Weigh Balance/Machine	1	5	At the main entrance to monitor entry and exit of vehicles.
Miscellaneous Space/ (Pathways and emergency exits)	1	10	For pathways, circulation, and additional storage.

2. Machinery and Equipment

Essential Machinery

Machinery	Specifications	Quantity
Weigh Balance/Machine	1 Ton	1
Ballistic Separator	Capacity: 5–10 TPD, adjustable paddles	1
Magnetic Separator	High-intensity, auto-cleaning	1
Conveyor Belts	Flat type, 7.8 m & 4 m lengths (2 units)	2
Hydraulic Compactor Machine	Vertical, Single Cylinder, 25 Tonne (Jack force)	1
HDPE Wheeled Bins	Capacity: 100 Liters	10
Organic Composter Machine	Capacity: 50 Kg	8
	Capacity: 500 Kg	1
Pallet Truck	Manual, 1 T capacity	1

Proposed Sites (8 Locations) for the Installation of 50 Kg capacity Organic Waste Composter and HDPE Wheeled Bins-

1) Sitapur, 2) Sonprayag, 3) Gaurikund, 4) Jungle chatti, 5) Bhim bali, 6) Choti lincholi, 7) Badi lincholi, 8) Base camp

3. Operational Plan

Workflow:

1. **Receiving and Sorting**:
   - Waste unloaded into receiving area.
   - Conveyed to sorting conveyor for manual segregation.
2. **Mechanical Processing**:
   - Ballistic separator separates 2D (plastics, paper) and 3D (bottles, cans) materials.
   - Magnetic separator removes ferrous materials.
3. **Baling and Storage**:
   - Sorted materials compressed into bales.
   - Bales stored in basement storage area.
4. **Dispatch**:
   - Processed materials dispatched to recyclers periodically.

Workforce Requirements:

Role	Number	Responsibilities
Supervisor	1	Oversee operations, manage records.
Sorting Workers	6	Manual segregation of waste.
Baler Compactor Operator	1	Operate baling machine.
Security Personnel	2	Monitor entry/exit, manage weighbridge.

Suggested Placement of Equipment:

Weight Balance Machine: Place in the Weighing Area to align with its purpose. This ensures incoming and outgoing materials are properly weighed before or after processing.

Ballistic Separator: Place in the Sorting Area as it is critical for segregating lightweight and heavy materials during sorting.

Magnetic Separator: Place adjacent to the Ballistic Separator in the Sorting/Processing Area to separate ferrous metals efficiently after initial sorting.

Conveyor Belts: 4m Conveyor Belt: Place between the Receiving/Tipping Area and the Sorting Area to transport materials for processing.

8m Conveyor Belt: Place between the Sorting/Processing Area and the Bale Storage/Dispatch Area to move processed materials for storage or dispatch.

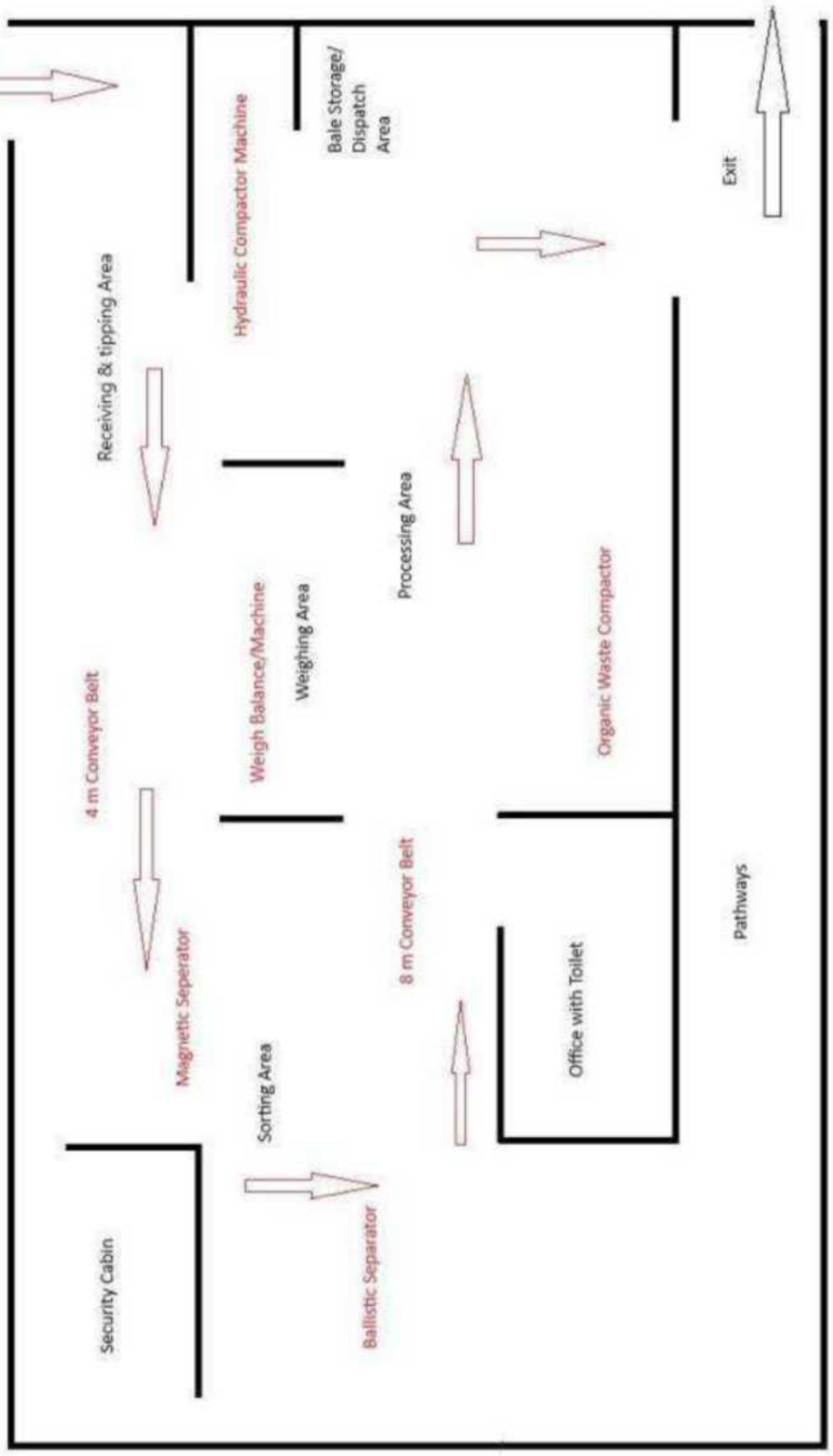
Hydraulic Compactor Machine: Place in the Bale Storage/Dispatch Area as it compacts recyclable materials into bales ready for dispatch.

Organic Waste Compactor Machine: Place near the Sorting/Processing Area or along the Pathways, close to where organic waste is sorted, to handle organic material efficiently.

Cost Estimates

Operational Expenditure (OPEX)

S.No.	Component	Annual Cost (₹)
1	Salaries	15,00,000
2	Electricity & Maintenance	5,00,000
3	Water Supply	1,00,000
4	Miscellaneous	3,00,000
Total		**₹24,00,000/year**



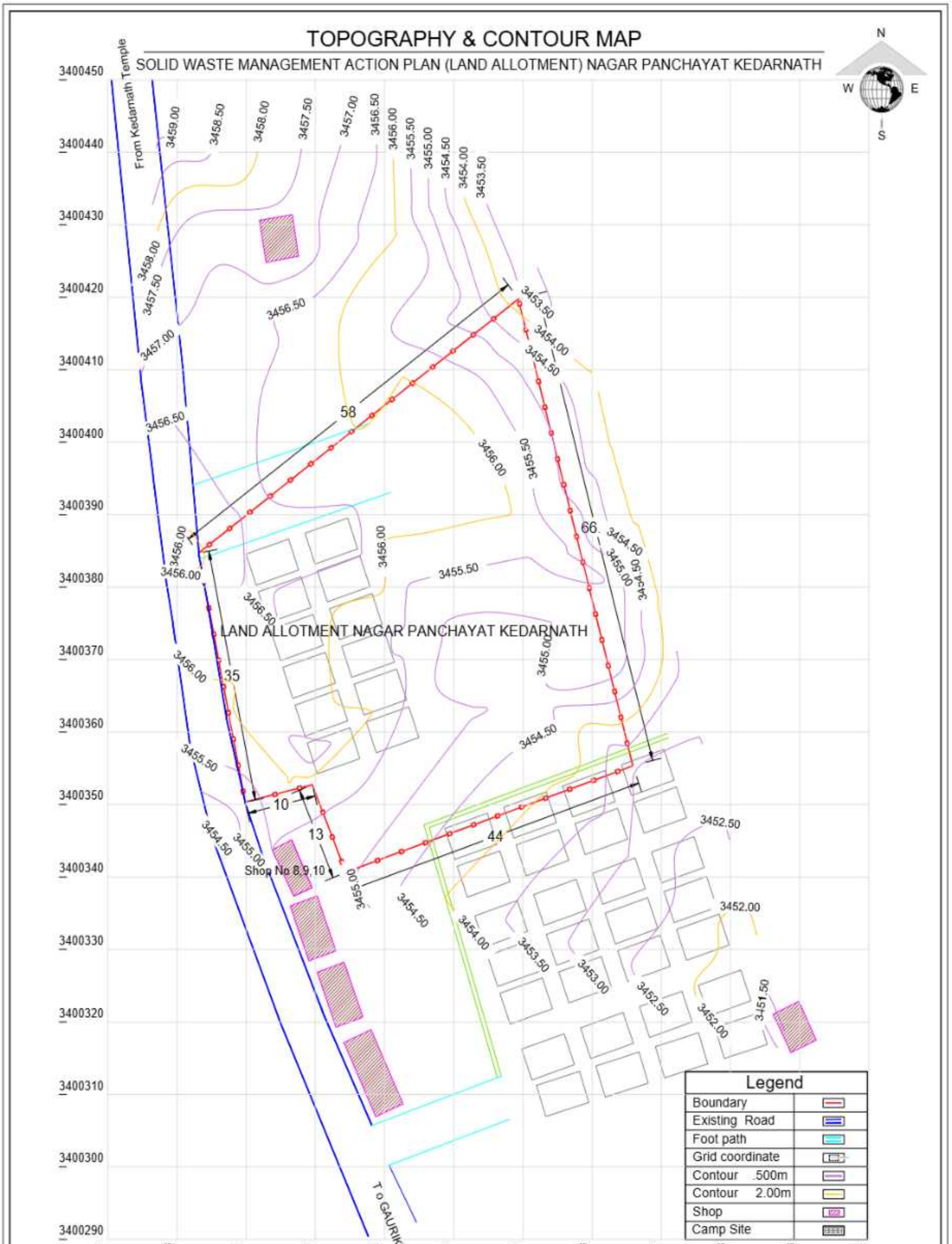
Basic MRF Floor Plan for 10 m * 16 m (160 Sq. M.) Area

Capital Expenditure (CAPEX)

S.No.	Component	No.	Rate (₹ in lakhs)	Total Cost (₹ in lakhs)	GST %	GST Amount	Total Amount (₹ in lakhs)
1	**Cost of MRF Shed**	**1**	**72.35**	**72.35**	-	-	72.35
2	**Cost of Protection Work & GI Sheet Covering for MRF Centre**	**1**	**46.37**	**46.37**	-	-	46.37
	Contingencies on item 1 & 2 @ 5 %			**5.94**	-	-	5.94
3	**Electricity Expenses**	**1**	**L.S.**	**3.00**	-	-	3.00
4	**Water Supply**	**1**	**L.S.**	**1.5**	-	-	1.50
5	**Machinery & Equipment**						
5.1	Weigh Balance/Machine	1	0.25	0.25	18%	0.045	0.29
5.2	Ballistic Separator	1	15	15	18%	2.7	17.70
5.3	Magnetic Separator	1	1	1	18%	0.18	1.18
5.4	Conveyor Belts 4 m	1	1	1	18%	0.18	1.18
5.5	Conveyor Belts 8 m	1	1.8	1.8	18%	0.324	2.12
5.5	Hydraulic Compactor Machine	1	3.75	3.75	18%	0.675	4.42
5.6	HDPE Wheeled Bins	20	0.02	0.4	18%	0.072	0.47
5.7	Pallet Truck	1	0.15	0.15	18%	0.027	0.17
5.8	Organic Composter Machine (Capacity 50KG/Day)	8	6.75	70.88	12%	8.49	79.37
	Freight & installation Charges	8	0.95	7.6	18%	1.36	8.96
5.9	Organic Composter Machine (Capacity 500KG/Day)	1	33	33	12%	3.96	36.96
	Freight & installation Charges	1	2.1	2.1	18%	0.38	2.48
	Total			**₹ 266.09**		**₹ 18.39**	**₹ 284.46**
6	Transportation/Freight Cost	**L.S**					**₹ 25.00**
	Grand Total						**₹ 309.46**

TOPOGRAPHY & CONTOUR MAP

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH

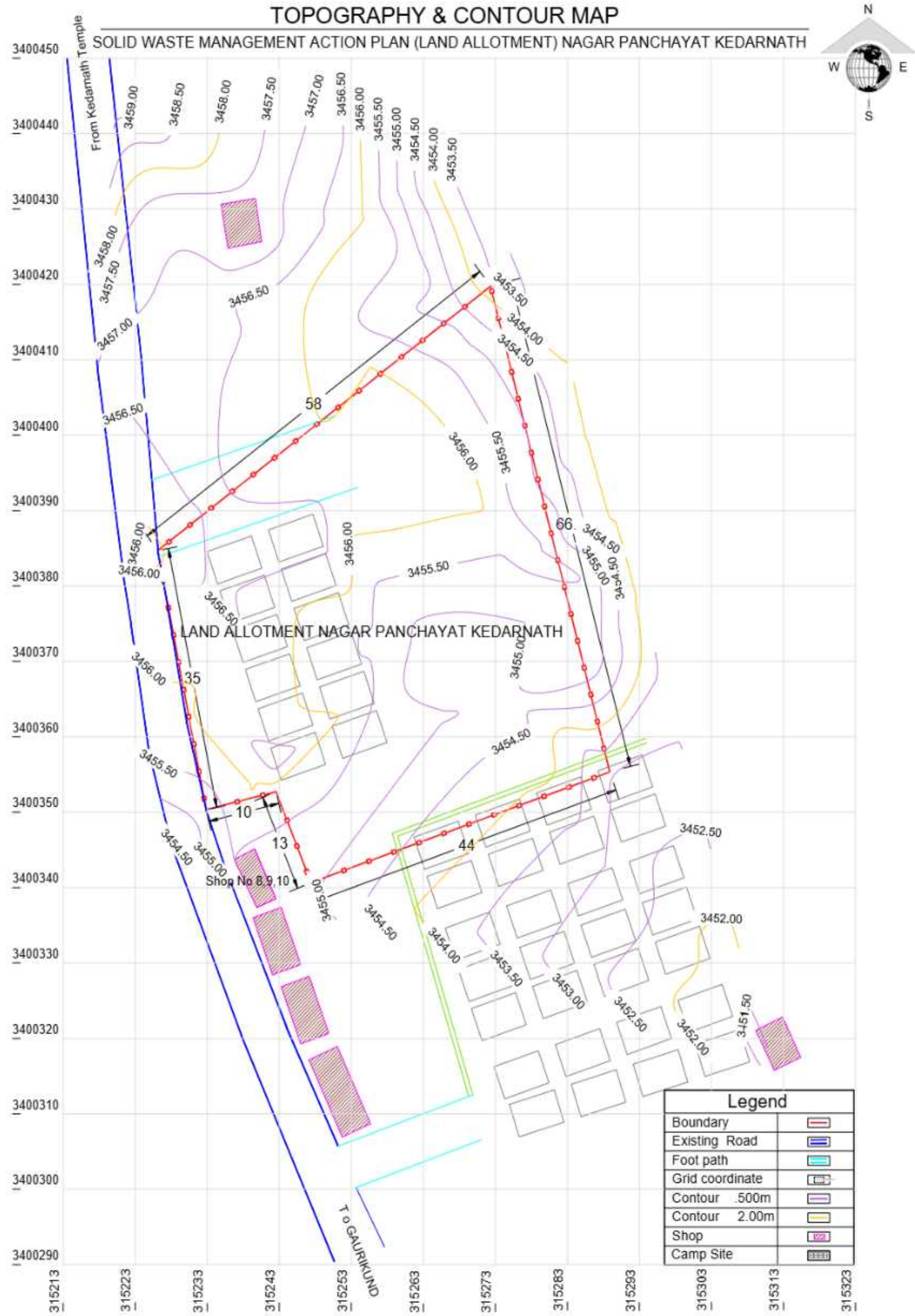


Legend	
Boundary	
Existing Road	
Foot path	
Grid coordinate	
Contour .500m	
Contour 2.00m	
Shop	
Camp Site	

CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH / KEDARNATH DHAM	Area = 3000 Sqm Area = 0.300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	NO:- 02

TOPOGRAPHY & CONTOUR MAP

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH



CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH / KEDARNATH DHAM	Area = 3000 Sqm Area = 0.300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	NO:- 02

नक्शा दावा प्रति

ग्राम : श्री केदारनाथ, रा०उ०नि० क्षे० : फाटा

तहसील : ऊखीमठ, जनपद : रुद्रप्रयाग

पैमाना

64" = 1 मील

(30)

श्री केदारनाथ मन्दिर

Manmohan Singh
राजस्व उपनिरीक्षक
23/12/24

राजस्व उपनिरीक्षक
क्षेत्र.....फाटा.....
तहसील.....ऊखीमठ.....
जनपद-रुद्रप्रयाग (

710

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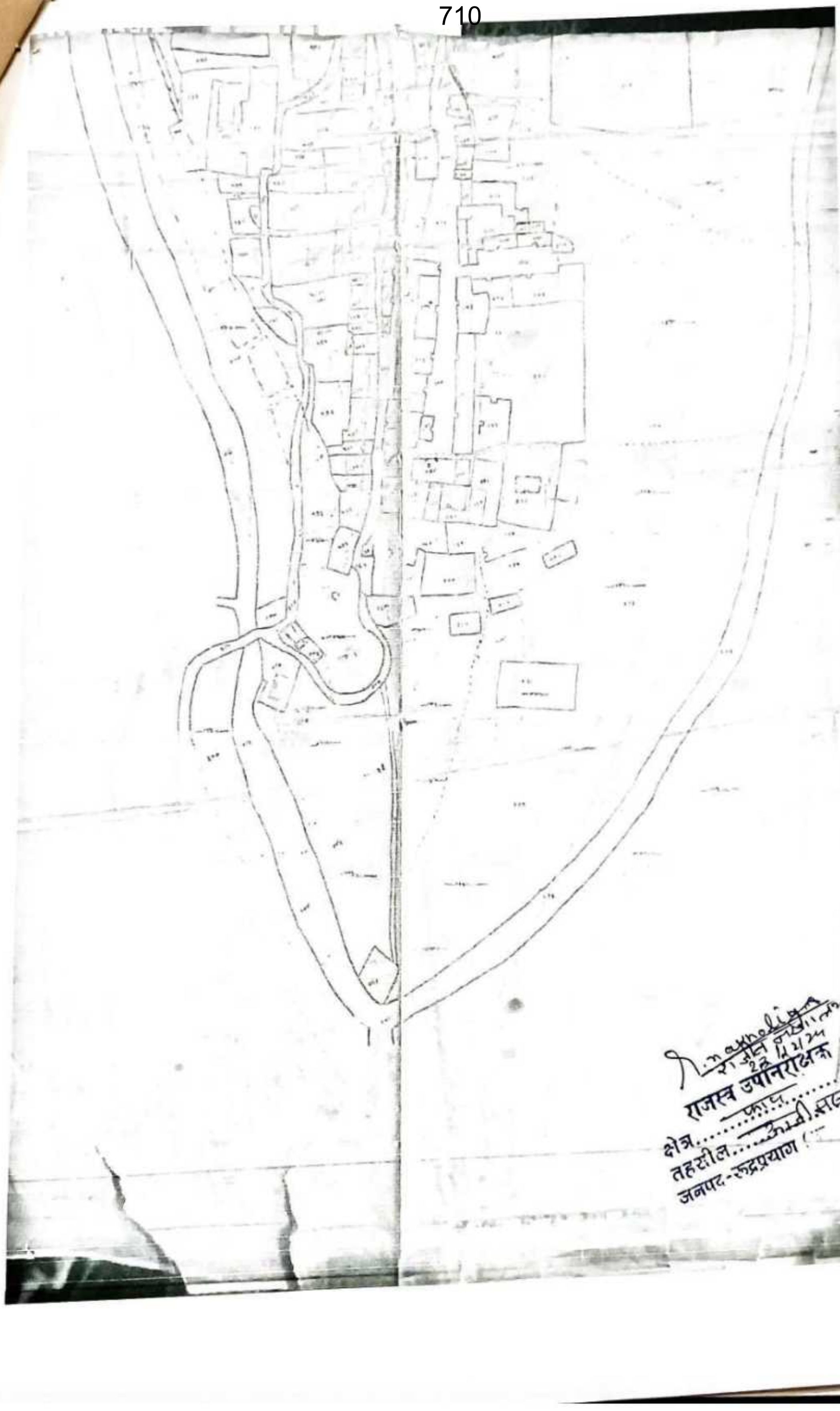

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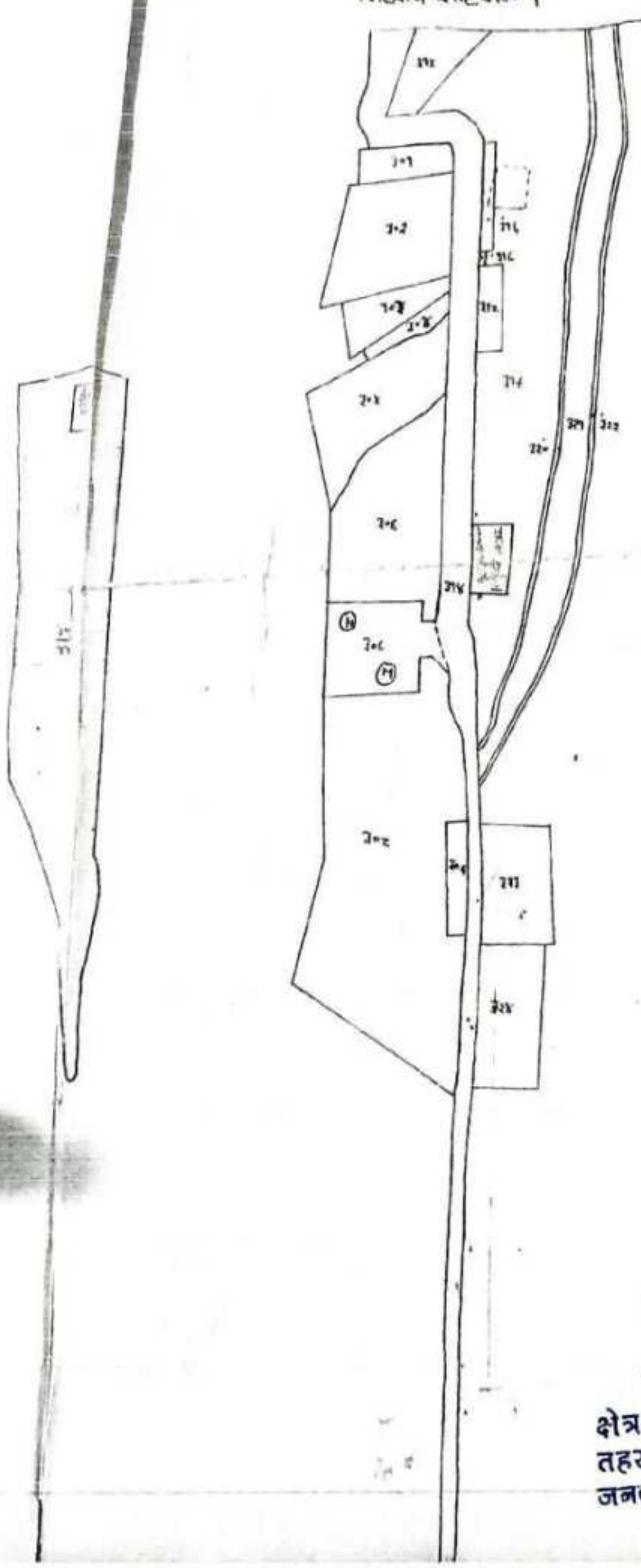
ग्राम श्री केदारनाथ, श0 30 मि0 कै0: फाटा

तहसील: ऊखीमठ, जनपद: रुद्रप्रयाग

पैमाना: 32" = मील

मिलान शीट नं0-1

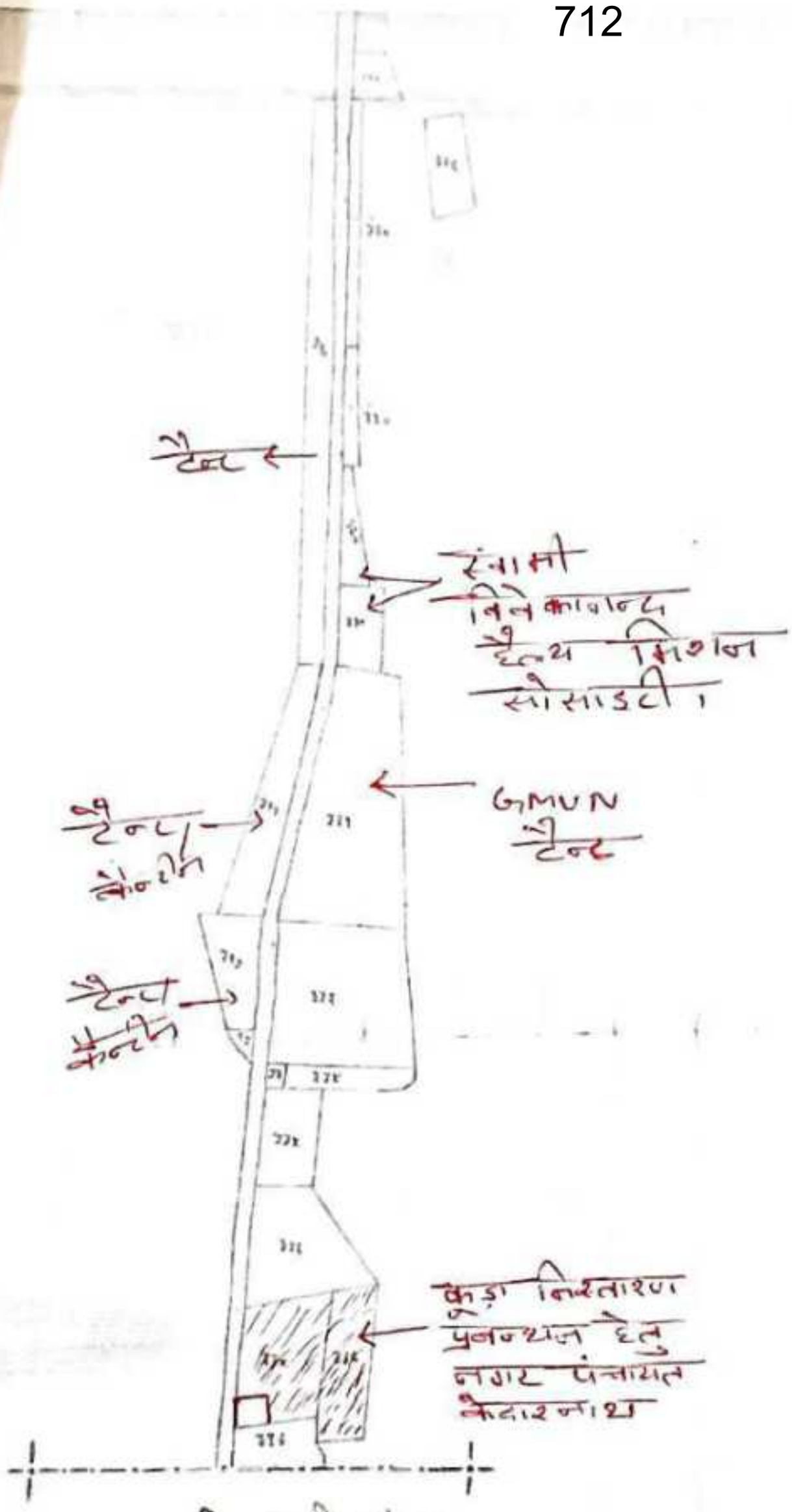


राजस्व उपनिरीक्षक

क्षेत्र.....फाटा.....

तहसील.....ऊखीमठ.....

जनपद-रुद्रप्रयाग.....



मिलान शीट सं०-3

सहायक अभिलेख अधिकारी,
ऊखीमठ।

D. nagarkoti
जा. जांच अधिकारी
23/12/24
राजस्व उपनिरीक्षक
क्षेत्र.....प्र.प.....
तहसील.....ऊ.ख.....
जनपद-रुद्रप्रयाग

नक्शा दावा प्रति

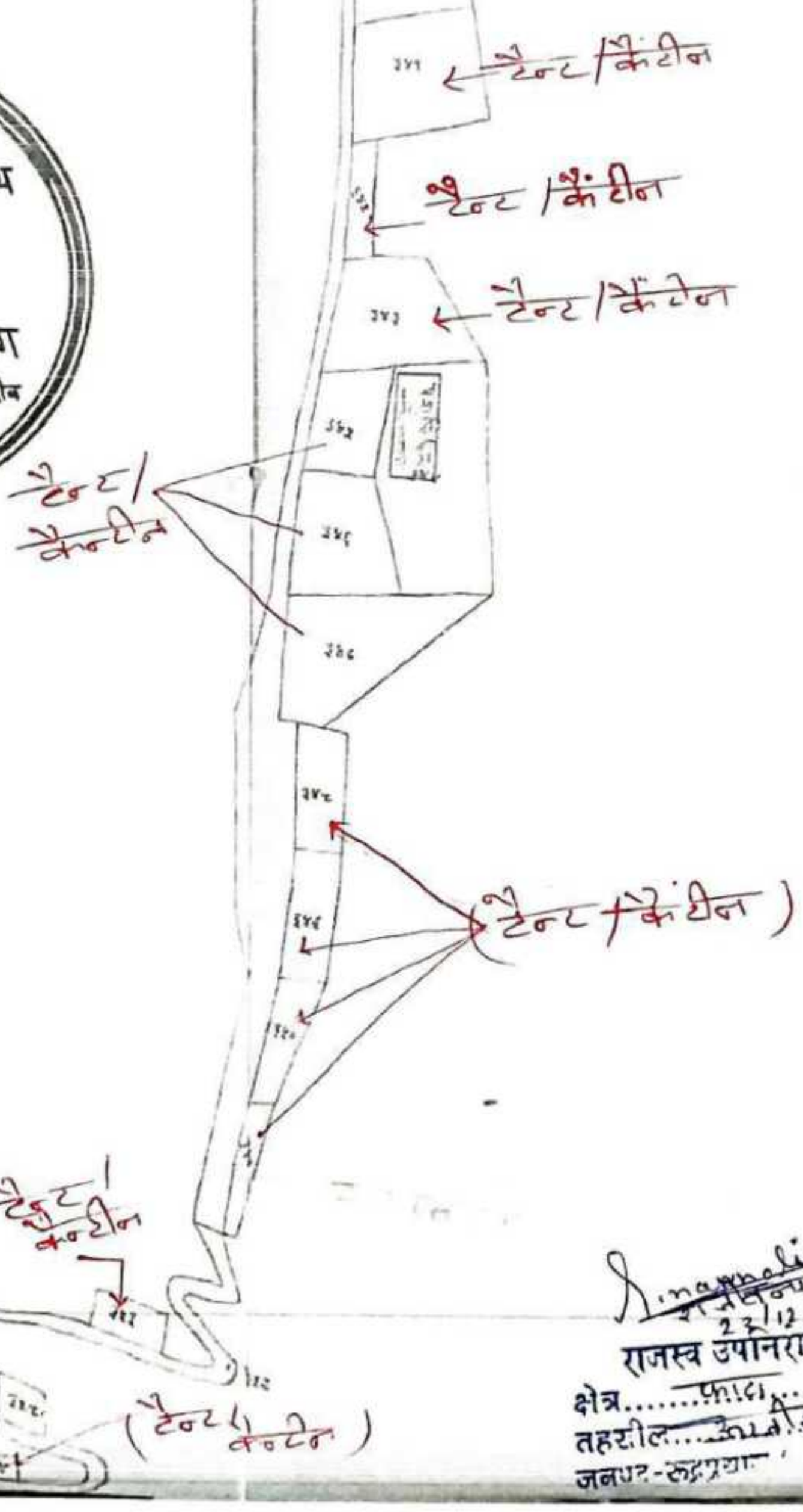
(30)

ग्राम : श्री केदारनाथ, रा०उ०नि० फाटा

तहसील : ऊखीमठ, जनपद : रुद्रप्रयाग

मौलवी शीट नं० 3

पैमाना : 32" = 1 मील



राजस्व उपनिरीक्षक

क्षेत्र.....फाटा.....

तहसील.....ऊखीमठ

जनपद-रुद्रप्रयाग

(सलीम मुहम्मद)
मानचित्रकार

(शफ़ी अहमद)
सर्वे कानूनगो

(तेजपाल)
सर्वे नायब तहसीलदार
अमरोहा

राजस्व उपनिरीक्षक
क्षेत्र.....फुलारी.....
तहसील.....अमरोहा
जनपद.....मुरादाबाद

सहायक अभिलेख अधिकारी
अमरोहा

AnyScanner

Name of work-Construction of Shed,Protection Work and G.I sheet Covering for MRF centre in Kedarnath.

SUMMARY OF COST

S.N	Particular of items	Nos	Cost(in lakh)	Amount
1	Cost of Shed.(16 X 10)m	1	72.35	72.35
2	Proposed Construction of Protection work & G.I sheet Covering for MRF centre in Kedarnath.	1	46.37	46.37
			Total	118.72
	Contigencies@5.00%			5.94
			Grand Total	**124.66**

Name of work: Construction of MRF Shed in Kedarnath .

Bill of Quantity

S.N.	Item of work	Quantity	Unit	Rate	Amount
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.	37.31	cum	737.00	27495.44
2	Providing and laying in position cement concrete 1:4:8 excluding the cost of centering and shuttering i/c all.	23.83	cum	16678.00	397474.27
3	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement -All work up to plinth level: 1 :1.5:3 (1 cement : 1.5 coarse sand (zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources) i/c all.	29.54	cum	27316.00	806941.96
4	Centering and shuttering including strutting, propping etc. and removal of form for Foundations, footings, bases of columns, etc. for mass concrete i/c all.	79.20	sqm	1572.00	124502.40
5	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.	3478.45	kg	179.00	622643.04
6	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete.	10695.40	kg	303.00	3240706.20
7	Random Rubble stone masonary laid in 1:6 cement and sand mortar i/c all.	6.18	cum	13056.70	80721.74
8	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 and for all lift.	52.10	cum	580.00	30215.68

9	Providing corrugated G.S. sheet roofing including vertical I curved surface 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, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 thick with zinc coating not less than 275 gm/m2	228.42	sqm	1695.00	387165.12
10	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete. 0.80 mm thick with zinc coating not less than 275 gm/m2	16.60	m	1083.30	17982.78
11	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3 mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete. 0.80 mm thick with zinc coating not less than 275	33.20	m	1029.65	34184.38
12	Providing and fixing 1 mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer.	12.00	sqm	9937.00	119244.00
13	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1 :2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal size derived from natural sources)	20.13	cum	23368.00	470281.00
14	Providing and fixing of Puf pannel to walls as per required shape and design directed by engineer in charge including material,labour and all fixing.(Rates taken as per Gem portal)	196.00	Sqm	3900.00	764400.00
15	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture i/c all.	238.90	Sqm	255.00	60919.50
				TOTAL=	7184877.51
	Add cartage for item no 10,11 & 14 due to rates are taken from DSR 2023 and Gem portal.			L.S	50000.00
				G. Total	7234877.51
				Says(lakh)	**72.35**

Name of work: Construction of MRF Shed in Kedarnath .

Detail of Measurements

S No.	Item of Work	No.	Length	Width	Height	Quantity	Unit
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on						
	Fd.	10	1.45	1.45	1.65	34.69	cum
	Plinth beam Long side	2	16.00	0.60	0.10	1.92	cum
	Plinth beam S.side	2	8.80	0.60	0.10	1.06	cum
	Ded	-10	0.60	0.60	0.10	-0.36	cum
					Total	37.31	cum
2	Providing and laying in position cement concrete 1:4:8 excluding the cost of centering and shuttering i/c all.						
		10	1.45	1.45	0.15	3.15	cum
	Base B/W Long side	2	16.00	0.60	0.10	1.92	cum
	Base B/W S.side	2	8.80	0.60	0.10	1.06	cum
	Ded	-10	0.60	0.60	0.10	-0.36	cum
	Floor	1	16.00	10.00	0.10	16.00	cum
	Apron	1	16.00	0.75	0.10	1.20	cum
	Apron	1	11.50	0.75	0.10	0.86	cum
					Total	23.83	cum
3	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement -All work up to plinth level : 1 :1.5:3 (1 cement : 1.5 coarse sand (zone-Ill) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources)						
	footing	10	1.35	1.35	0.60	10.94	cum
	fdn.	10	0.90	0.90	0.90	7.29	cum
	Upto Plinth	10	0.60	0.60	0.60	2.16	cum
	Plinth beam Long side	2	16.00	0.60	0.35	6.72	cum
	Plinth beam S.side	2	8.80	0.60	0.35	3.70	cum
	Ded	-10	0.60	0.60	0.35	-1.26	cum
					Total	29.54	cum

4	Centering and shuttering including strutting, propping etc. and removal of form for Foundations, footings, bases of columns, etc. for mass concrete i/c all.						
	footing	40	1.35		0.60	32.40	sqm
	fdn.	40	0.90		0.90	32.40	sqm
	Upto Plinth	40	0.60		0.60	14.40	sqm
	Plinth beam Long side	4	16.00		0.35	22.40	sqm
	Plinth beam S.side	2	8.80		0.35	6.16	sqm
					Total	79.20	sqm
5	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.						
	Taking 1.50 % of total Qt. of item no 3	0.015	29.541	7850		3478.45275	Kg
						3478.45275	Kg
6	Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with						
	M.S Plate (15 mm thick)	10	0.6	0.60	118 kg/sqm	424.8	Kg
	Nuts,bolts,fixtures etc @15% of total wt. of plate	1				63.72	Kg
	Vertical square Pipe (180 mm*180mm*10mm)	10	4.00	@	53 Kg/m	2120	Kg
	Truss base (172 mm*92mm*4.8 mm) E	10	11.5	@	18.71 Kg/m	2151.65	Kg
	Inclined (100 mm*100mm*5 mm) A	20	6.88	@	14.80 Kg/m	2036.48	Kg
	Members (60*60*4) B					0	
	(0.67 + 1.81+1.34+2.13)= 5.95m	20	5.95	@	6.97 Kg/m	829.43	Kg
	Centre Vertical	10	2.00	@	6.97 Kg/m	139.4	Kg
	purlin member(145*82*4.8) C	8	16.00	@	15.92 Kg/m	2037.76	Kg
	Tie runner(60*60*4) D	8	16.00	@	6.97 Kg/m	892.16	Kg
					Total	10695.4	Kg
7	Random Rubble stone masonary laid in 1:6 cement and sand mortar i/c all.						
	Upto Plinth	2	16.00	0.60	0.23	4.42	Cum

		2	8.80	0.60	0.23	2.43	Cum
	Ded	-8	0.60	0.60	0.23	-0.66	Cum
					Total	6.18	Cum
8	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 and for all lift						
		1	14.8	8.80	0.40	52.10	Cum
					Total	52.10	Cum
9	Providing corrugated G.S. sheet roofing including vertical I curved surface 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, including a coat of approved steel primer and two coats of approved paint on overlapping of sheets complete (up to any pitch in horizontal/ vertical or curved surfaces), excluding the cost of purlins, rafters and						
		2	16.6	6.9		228.4	sqm
					Total	228.4	Sqm
10	Providing ridges or hips of width 60 cm overall width plain G.S. sheet fixed with polymer coated J or L hooks, bolts and nuts 8 mm dia G.I. limpet and bitumen washers complete. 12.4.1 0.80 mm thick with zinc coating not less than 275 gm/m2						
		1	16.60			16.60	M
					Total	16.6	M
11	Providing and fixing 15 cm wide, 45 cm overall semi-circular plain G.S. sheet gutter with iron brackets 40x3 mm size, bolts, nuts and washers etc., including making necessary connections with rain water pipes complete. 12.7.1 0.80 mm thick with zinc coating not less than 275 gm/m2						
		2	16.60			33.20	M
					Total	33.20	M

12	Providing and fixing 1 mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of						
	Door	1	3.00	4.00		12.00	
					Total	12	sqm
13	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level: 1 :2:4 (1 cement : 2 coarse sand (zone-III) derived from natural sources : 4 graded stone aggregate 20 mm nominal						
	Floor	1	16.00	10.00	0.10	16.00	
	Apron	2	16.00	0.75	0.10	2.40	
	Apron	2	11.50	0.75	0.10	1.73	
					Total	20.13	Cum
14	Providing and fixing of Puf pannel to walls as per required shape and design directed by engineer in charge including material,labour and all fixing.(Rates taken as per Gem portal)						
	walls	2	16.00		4.00	128.00	
		2	10.00		4.00	80.00	
	Ded Door	-1	3.00		4.00	-12.00	
					Total	196.00	sqm
15	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture						
	Vertical square Pipe (180 mm*180mm*10mm)	10	4.00	0.72		28.8	Sqm
	Truss base (172 mm*92mm*4.8 mm) E	10	11.5	0.524		60.26	Sqm
	Inclined (100 mm*100mm*5 mm) A	20	6.88	0.40		55.04	Sqm
	Members (60*60*4) B					0	Sqm
	(0.67 + 1.81+1.34+2.13)= 5.95m	20	5.95	0.24		28.56	Sqm
	Centre Vertical	10	2.00	0.24		4.8	Sqm
	purlin member(145*82*4.8) C	8	16.00	0.24		30.72	Sqm
	Tie runner(60*60*4) D	8	16.00	0.24		30.72	Sqm
					Total	238.90	sqm

Name of Work :-Proposed construction of Protection work & G.I sheet covering for MRF centre in Kedarnath.

BILL OF QUANTITY

S.No.	Item of Work	Quantity	UNIT	Rate	AMOUNT
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.	950.00	Cum	737.00	700150.00
2	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause 305.1 of MORD Specifiction	87.00	Cum	1369.00	119103.00
3	Providing concrete for plain/ reinforced concrete in open foundations complete as per drawings and technical specifications Clause 802, 803, 1202 & 1203	9.75	Cum	29368.00	286338.00
4	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..	4996.38	KG	303.00	1513903.14
5	Providing corrugated G.S. sheet roofing including vertical / curved surface 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	339.00	Sqm	1695.00	574605.00
6	Random rubble stone masonary laid dry by locally available approved stone including supply of all material labour, T&P etc. required for proper completion of work as per detail PWD specification and as per direction of Engineer in charge	31.05	Cum	7215.70	224047.49
7	Random Rubble Stone Masonry laid1:6, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specifiction	93.33	Cum	13056.70	1218625.33
				Total	**4636771.96**
				SAY(in lakh)	**46.37**

Name of Work :-Proposed construction of Protection work & G.I sheet covering for MRF centre in Kedarnath.

DETAIL OF MEASUREMENT

S No.	Item of Work	No.	Length	Width	Height	Quantity	Unit
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead						
		1	50.00	20.00	0.95	950.00	Cum
					Total	**950.00**	**Cum**
2	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause						
	Column						
		78	0.50	0.50	0.50	9.75	Cum
		1	50.00	1.27	0.90	57.00	Cum
		1	45.00	0.60	0.75	20.25	Cum
					Total	**87.00**	**Cum**
3	Providing concrete for plain/ reinforced concrete in open foundations complete as per drawings and technical specifications Clause 802, 803, 1202 & 1203						
		78	0.50	0.50	0.50	9.75	Cum
					Total	**9.75**	**Cum**
4	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..						
	Main Post @ 70x70x5 hollow pipe vertical	78	3		10.11	2365.74	Kg
	horizontal pipe @ 50x25x5 hollow pipe	3	226		3.88	2630.64	Kg
					Total	**4996.38**	**Kg**
5	Providing corrugated G.S. sheet roofing including vertical / curved surface 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, including a coat of a						
		1	226	1.50		339.00	Sqm
					Total	**339.00**	**Sqm**
6	Random rubble stone masonary laid dry by locally available approved stone including supply of all material labour, T&P etc. required for proper completion of work as per detail PWD specification and as per direction of						
		1	45.00	0.60	1.15	31.05	Cum
					Total	**31.05**	**Cum**

7	Random Rubble Stone Masonry laid1:6, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specifiction						
		1	50.00	0.93	2.00	93.33	Cum
					Total	**93.33**	**Cum**

E

D

C

B

A

1

2

0.30

3.81

3.89

16.00

3.89

3.81

0.30

9.40

0.30

CN1

CN1

CN1

CN1

CN1

CN1

CN1

CN1

CN1

15MM THK BASE PLATE

20MM Dia Bars (8 nos)

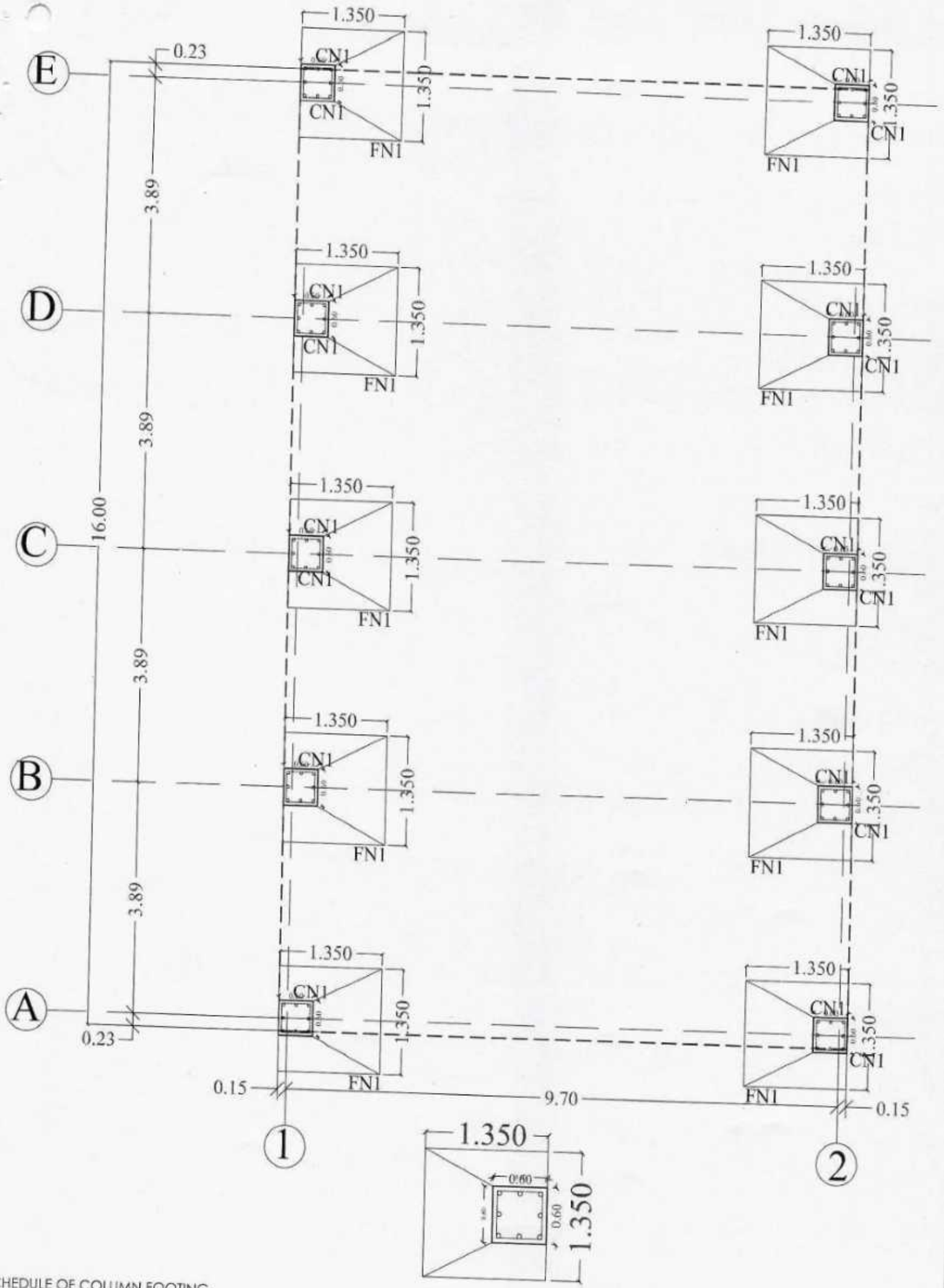
10MM Rings @ 150mm C/C

R.C.C (M25)

P.C.C (1:4:8)

FOOTING DETAIL

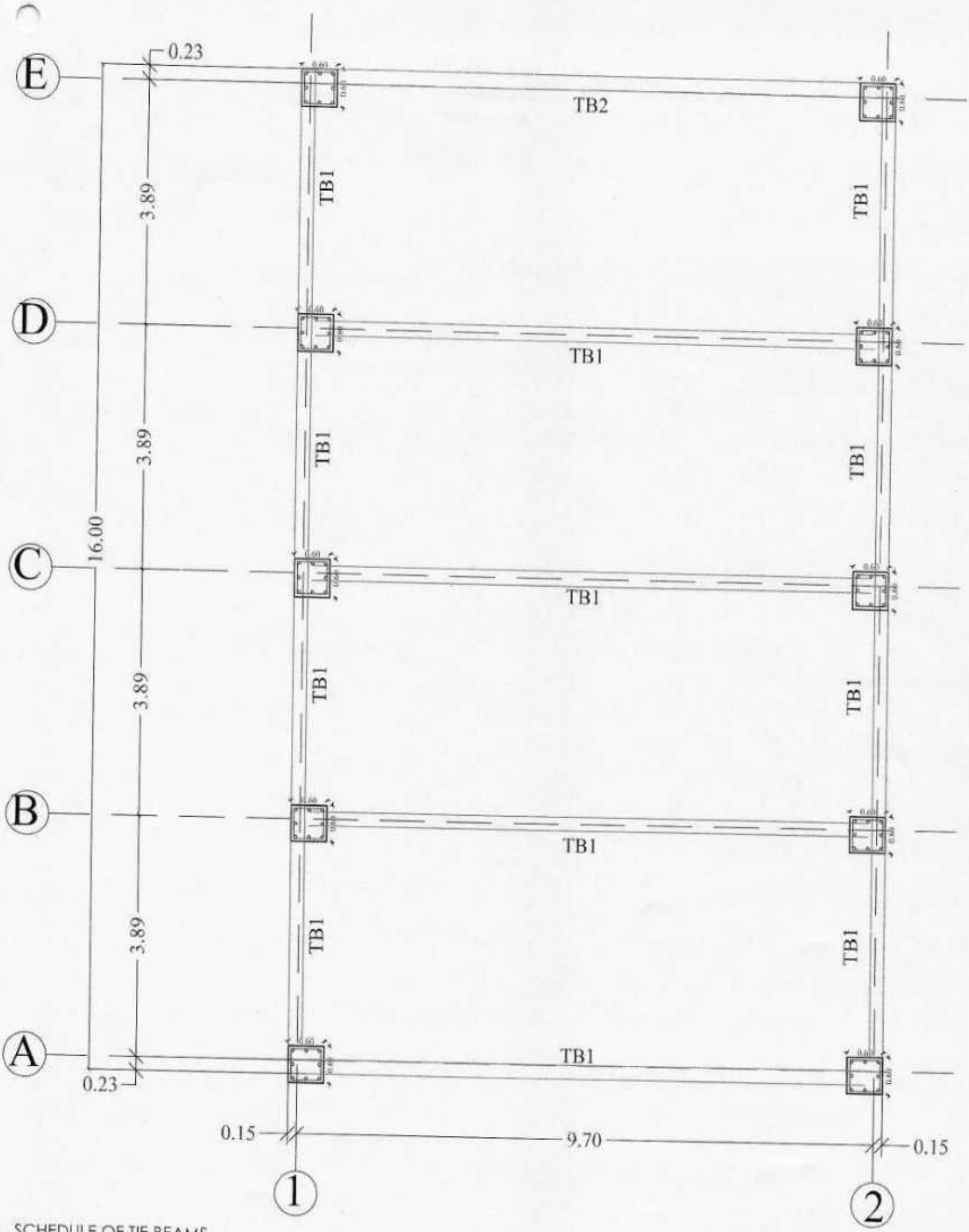
COLUMN LAYTOUT PLAN



SCHEDULE OF COLUMN FOOTING

Sr. No.	NAME OF FOOTING	TYPE OF FOOTING	SIZE (MM)	DEPTH BELOW THE COLUMN (mm)	DEPTH AT OUTER EDGE (mm)	BOTTOM REIN.		TOP REIN.	
						ALONG SHORT SPAN	ALONG LONG SPAN	ALONG SHORT SPAN	ALONG LONG SPAN
1.	FN1	Isolate Footing	As per Drawing	750	750	16Ø @ 150 C/C.	16Ø @ 150 C/C.	12Ø @ 175 C/C.	12Ø @ 175 C/C.
USE M-25 GRADE CONCRETE									

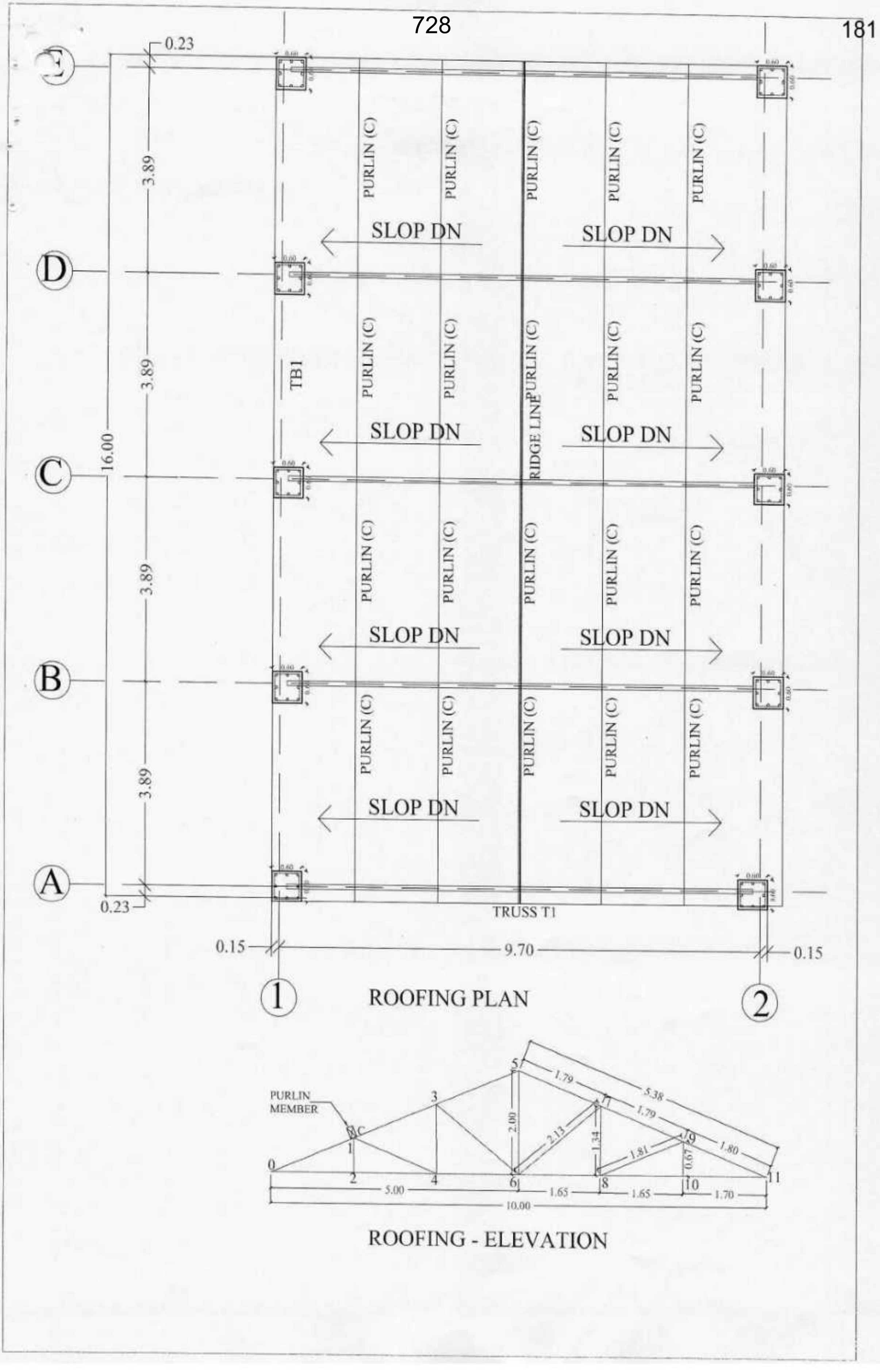
FOOTING LAYTOUT PLAN



SCHEDULE OF TIE BEAMS

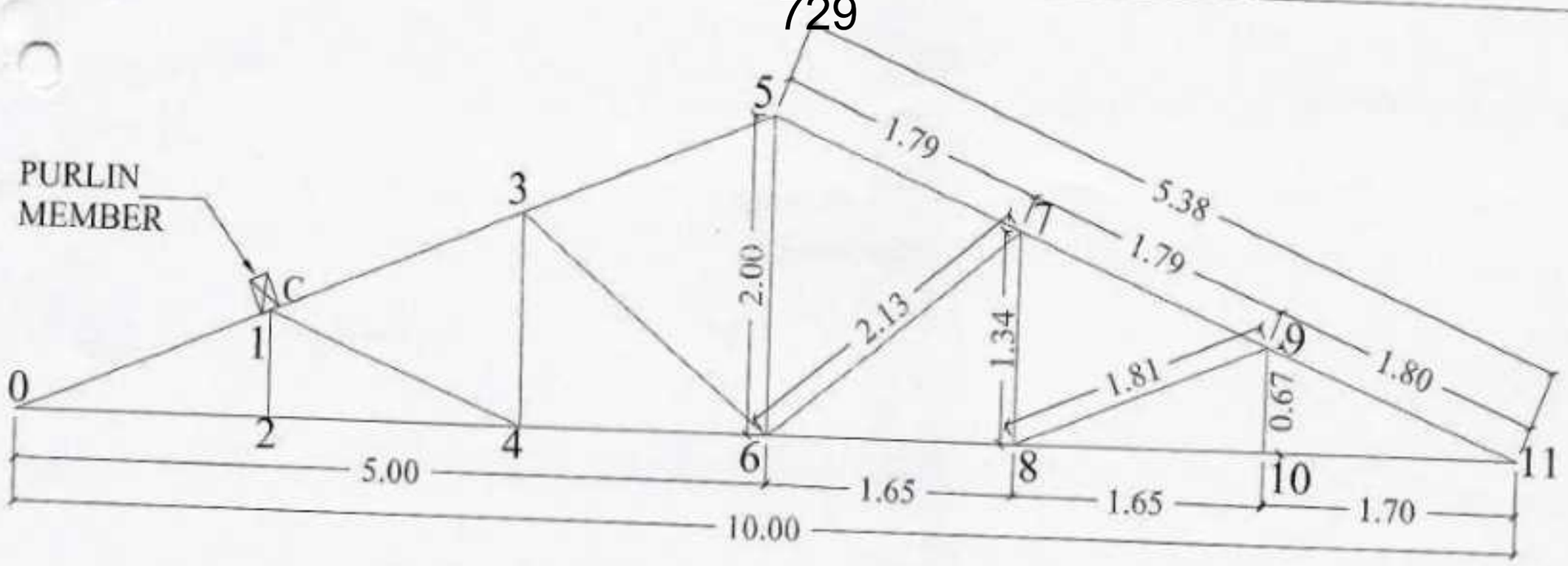
Sr. No.	TYPE OF TIE BEAM	REINFORCEMENT						
		SIZE(MM)		BOTTOM BARS	TOP BARS	STIRRUPS		
		B	D			DIA	NO. OF LEGS	SPACING (MM)
1.	TB1	300	450	3 - 16Ø	3 - 16Ø	8Ø	2	150
2.	TB2	300	450	3 - 20Ø	3 - 16Ø	8Ø	2	150
USE M-25 GRADE CONCRETE								

TIE BEAM LAYTOUT PLAN

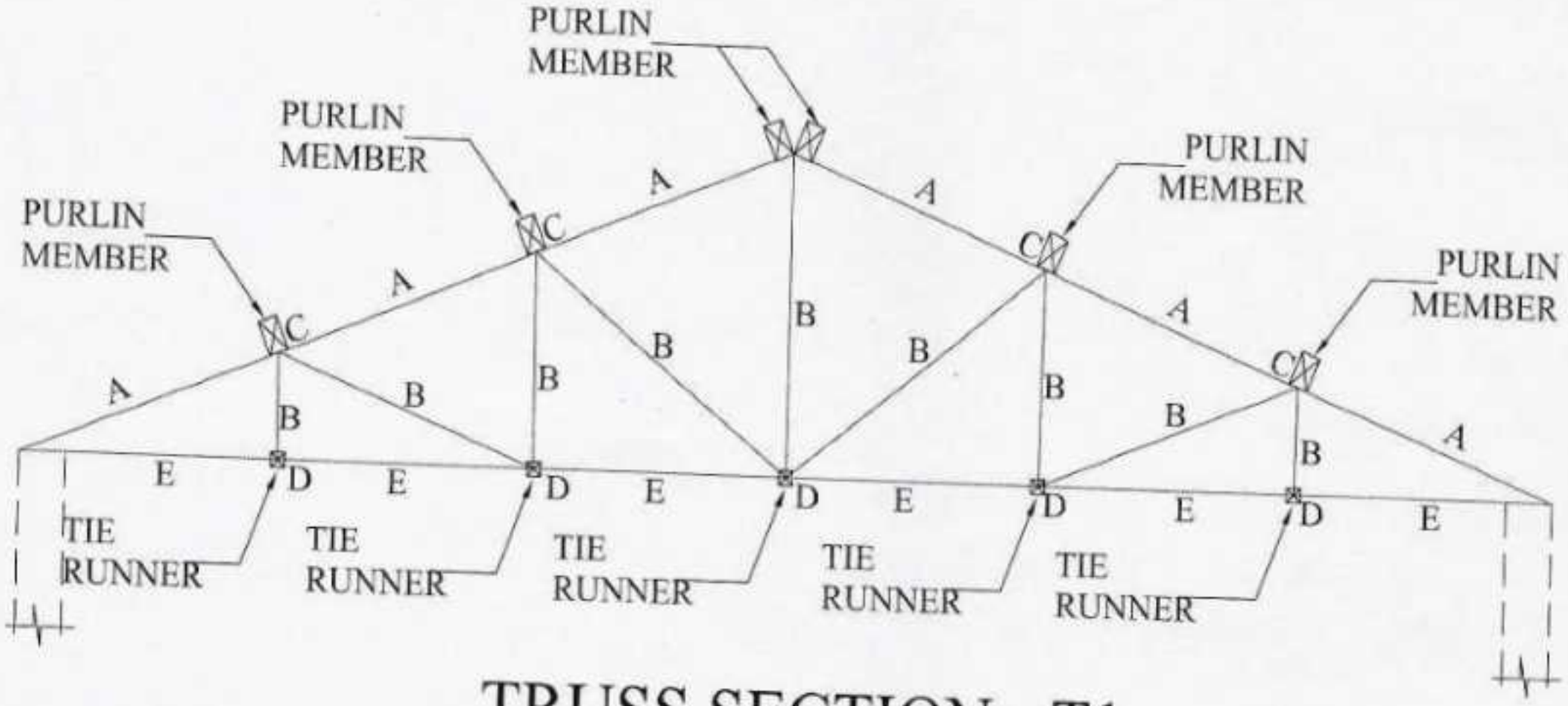


ROOFING PLAN

ROOFING - ELEVATION

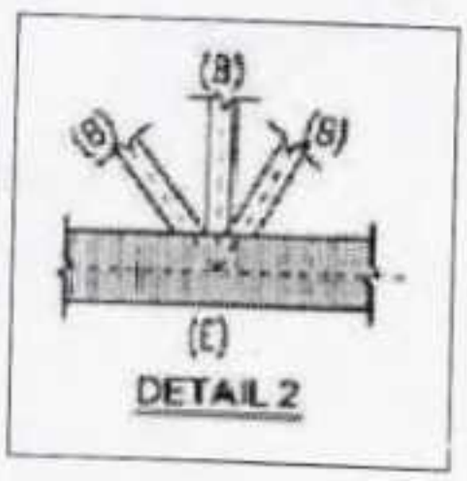


TRUSS SECTION - T1

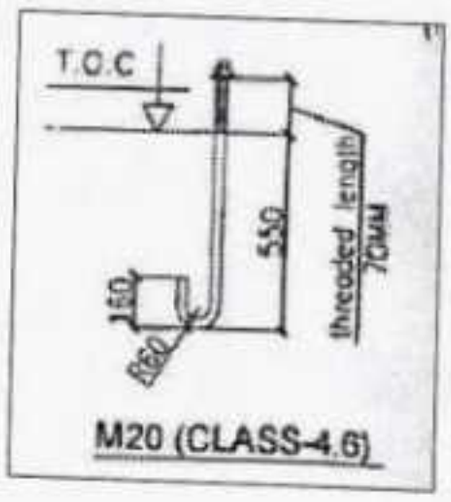


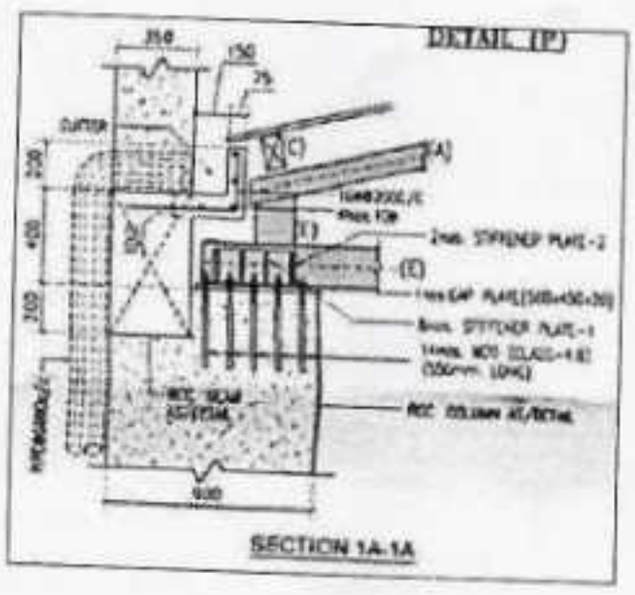
TRUSS SECTION - T1

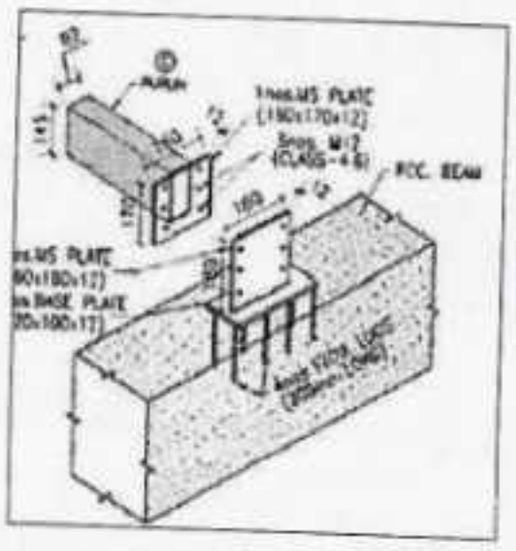
MEMBER SCHEDULE		
MEMBER NO.	MEMBER SIZE (DXB)	GRADE OF STEEL
(A)	SHS - 100 X 100 X 5	YST 310
(B)	SHS - 60 X 60 X 4	YST 310
(C) (PURLINS)	RHS - 145 X 82 X 4.8	YST 310
(D) (TIE RUNNER)	SHS - 60 X 60 X 4	YST 310
(E)	RHS - 172 X 92 X 4.8	YST 310



DETAIL 2







कार्यालय अधीक्षण अभियन्ता
सप्तम् वृत्त लोक निर्माण विभाग
गोपेश्वर (चमोली)

E-Mail: sepwdgope@rediffmail.com

पत्रांक – 1960/173 सप्तम्-7/2023 दिनांक :– 10/04/2023

सेवा में,

मै0 राज कन्स्ट्रक्शन
ए0 511, पैसफिक हिल्स, राजपुर रोड
देहरादून।

विषयः– श्री केदारनाथ धाम परिक्षेत्रान्तर्गत गतिमान निर्माण कार्यो पर कार्यरत श्रमिकों के विश्राम तथा रात्रि प्रवास की सुविधा हेतु, सरस्वती नदी एंव भैरव मन्दिर मार्ग के मध्य अस्थाई लेबर हट/बंकर नं0–4 का निर्माण कार्य। (साईज 30.00 मी0 X 6.60मी0 क्षमता 200 श्रमिक)।
Tender ID:- 2023_pwd_56478_1

उपरोक्त विषयक श्री केदारनाथ धाम परिक्षेत्रान्तर्गत गतिमान निर्माण कार्यो पर कार्यरत श्रमिकों के विश्राम तथा रात्रि प्रवास की सुविधा हेतु, सरस्वती नदी एंव भैरव मन्दिर मार्ग के मध्य अस्थाई लेबर हट/बंकर नं0–4 का निर्माण कार्य। (साईज 30.00 मी0 X 6.60मी0 क्षमता 200 श्रमिक) हेतु आपके द्वारा दी गयी निविदा दरें उत्तराखण्ड सरकार की ओर से निम्न हस्ताक्षरकर्ता द्वारा रू0 1,59,93,504.96 (एक करोड उन्सठ लाख तिरानब्बे हजार पांच सौ चार रूपये एवं छयानब्बे पैसे) मात्र के लिए स्वीकृत की जाती है।

अतः आपको सूचित किया जाता है कि आप पत्र निर्गत होने की तिथि के 7 दिन के अन्तर्गत उत्तराखण्ड शासन द्वारा जारी शासनादेशों के अनुसार अनुबन्ध हेतु रू0 7,99,675.00 (सात लाख नियानब्बे हजार छः सौ पिचत्तर रूपये) मात्र की परफॉरमेन्स सिक्यूरिटी मात्र, जो कि अधीक्षण अभियन्ता, सप्तम् वृत्त, लो0नि0वि0 गोपेश्वर के नाम बन्धक हो एवं अनुबन्ध पर हस्ताक्षर करने हेतु आप स्वयं अधिशासी अभियन्ता, निर्माण खण्ड, लो0नि0वि0 गुप्तकाशी के कार्यालय में उपस्थित हों एवं इसके अतिरिक्त अनुबन्ध हेतु रू0 100.00 मात्र का नॉन–ज्यूडिशियल स्टॉम्प भी जमा करें।

यदि आप निश्चित समय के अन्दर उपस्थित न हुये तो उक्त स्वीकृति वापस ले ली जायेगी तथा आपके बकाया अवशेषों में से उक्त धरोहर धनराशि काटकर उत्तराखण्ड सरकार के नाम जब्त कर राजस्व खाते में डाल दी जायेगी, तत्पश्चात् आपका कोई विवाद इस सम्बन्ध में मान्य नहीं होगा।

अधीक्षण अभियन्ता
सप्तम् वृत्त, लो0नि0वि0
गोपेश्वर

प्रतिलिपिः–
1. अधिशासी अभियन्ता, निर्माण खण्ड, लो0नि0वि0 गुप्तकाशी को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।
2. अनुबन्ध हेतु।

अधीक्षण अभियन्ता
सप्तम् वृत्त, लो0नि0वि0
गोपेश्वर
10/04/23

(B11)

(MM 184

Office of The Superintending Engineeer, 7th Circle, P.W.D. Gopeshwar

E-mail: sepwdgope@rediffmail.com

No. 2001/173 यात्रा-7/2023 Date: 12/04/2023

To,

M/S Raj Construction
A511, Pacific hills Rajpur road
Dehradun.

Subject: **Construction work of temporary labour hut/bunker no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of labourers working on reconstruction work of Shri Kedarnath Dham.**

Your contract Bond No. 03/SE-7/2023 Dated 12/4/2023 For the above mentioned work has been accepted by the under signed on behalf of Government of Uttarakhand.

Please start the work at once and completed it within 06 months positively.

The date of start and date completion of the work is as following:-

1. Date of Start 12/4/2023
2. Date of Completion 11/10/2023

(Er. Rajesh Chandra Sharma)
Superintending Engineer
7th Circle P.W.D.
Gopeshwar

Copy to the following for information and necessary action :-

1. Executive Engineer, Construction division, PWD Guptkashi, Rudraprayag.
2. Bond Copy.
3. Office Copy.

Superintending Engineer
7th Circle P.W.D.
Gopeshwar
12/4/23

CONTRACTOR

7 वां वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

अधीक्षण अभियन्ता, सप्तम् वृत्त, लोनिविo गोपेश्वर।

Contract Bond no. 03/SE-7/2023 Date. 12/4/2023

¼ value of work done:-

¼ value of work done:-

¼ value of work done:-

Name of Work- Construction work of temporary labour hut/bunker no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of labourers working on reconstruction work of Shri Kedarnath Dham.(Size 30.00 m X 6.60 M Capicity 200 Labour).

1. Name of Contractor:- M/S Raj Construction, A511, Pacific hills, Dehradun.
2. Estimated Cost:- 1,60,01,938.61
3. Amount of Bond Rs:- 1,59,93,804.96
4. Amount of E.M. Rs... 3,30,000.00

PC → 41391158735S Rs 1,30,000.00
Vide AC - 41763743246 Rs 1,00,000.00
AC → 41762864162 Rs 1,48,000.00
AIC - 41270435509 Rs 40,000.00
AIC → 88080000000[illegible] Rs 29,000.00
Total 5,57,000.00

5. Date of Start:- 12/4/2023
6. Date of Completion:- 11/10/2023
7. Defect of Liability Period:- Acc - A10545512772 Rs:- 4,00,000.00

S.No of Bill	M.B. No.	Amount of Bill	Stock / Machinery	5 % S.D.	2% I.Tax / 2% GST / 1% L. Cess	Royalty	12% GST	By Cheque

Form

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अधीक्षण अभियन्ता
7वां वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

eProcurement System Government of Uttarakhand
Created By: PRAVEEN KUMAR KARANWAL
Created Date/Time: 05-Apr-2023 12:15 PM

Tender Title: Construction work of temporary labour hut no.4 between Saraswati river and Bhairav Mandir road for rest and night stay convenience of laborers working on reconstruction work of Shri Kedarnath Dham

Tender ID: 2023_pwd_56478_1

Tender Inviting Authority: Superintending Engineer 7th Circle PWD Gopeshwar

Contract No: 1372/173 Yatayat-7/2023 Date 13-03-2023

REVISED SCHEDULE OF WORK / ITEM(S)

Sl.No	Description of Work / Item(s)	No.of Qty	Units	Estimated Rate	Estimated Amount	M/s Raj Construction(GSTN-05AHBPC5164D1ZZ)		Bhagat Singh Rawat Contractor(GSTN-05CJHPS6370P1ZE)	
						Rate	Amount	Rate	Amount
1.00	Note :- GST inclusive in rates.								
2.00	(i) Site Development, Superstructure etc. Work.								
3.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. All Kinds of Soil.	731.25	Cum	737	538931.25	733	536006.25	750	548437.5
4.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. Ordinary Rock.	354.38	Cum	1369	485146.22	1365	483728.7	1400	496132
5.00	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials. All kinds of soil	221.25	Cum	240	53100	240	53100	250	55312.5
6.00	Excavation in foundation for retaining, breast walls etc, in all types of soils and rocks including all lead, lift and disposal of surplus material as per direction of engineer - in - charge, as per drawing and technical specifications Clause 305.1 of MORD Specification.	20.7	Cum	1563.5	32364.45	1563	32354.1	1570	32499
7.00	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc.in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto1.5m.	61.97	Cum	580	35942.6	580	35942.6	590	36562.3
8.00	Providing and Laying of Mechanically Woven Double Twisted Hexagonal shaped Gabions (Zinc plus PVC coated), of size 3mX1mX1m with two diaphragms at 1m interval, having mesh opening 100mmx120 mm, mesh wire diameter 2.7mm/3.7mm, edge/selvedge wire diameter 3.4/4.4 mm and lacing wire diameter 2.2/3.2 mm. (The work includes filling boulders in the gabions).	10	No.	21394.58	213945.8	21300	213000	22000	220000
9.00	Cement plum masonry with 40% plum & 60% 1:3:6 cement concrete including supply of all material, labour, T&P etc. required for proper completion of the work.	203.25	Cum	12804.28	2602449.585	12800	2601600	14950	3038587.5

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10.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size) (Nominal Mix)	18.96	Cum	16678	316214.88	16678	316214.88	17000	322320
11.00	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level : 1:1.5:3 (1 cement : 1.5 coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size).	31.01	Cum	27316	847069.16	27315	847038.15	27500	852775
12.00	Centering and shuttering including strutting, propping etc. and removal of form for : Lintels, beams, plinth beams, girders, bressumers and cantilevers	215.46	Sqm	1572	338703.12	1572	338703.12	1600	344736
13.00	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete up to plinth level. Thermo-Mechanically Treated bars of grade Fe-500 D or more.	2705.9	Kg	179	484356.1	179	484356.1	180	487062
14.00	Random Rubble Stone Masonry laid Dry, in breast walls, retaining walls, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	36.2	Cum	7215.7	261208.34	7215	261183	7220	261364
15.00	Random Rubble Stone Masonry laid in 1:6 cement and sand mortar, in breast walls, retaining walls, parapets, scuppers, etc. including supply of all material, labour, T&P and royaltiies etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	91.1	Cum	13056.7	1189465.37	13056	1189401.6	13100	1193410
16.00	Hand Packed stone filling in back of walls including cost of all materials, royality, T&P etc. Complete as per direction of Engineer-in- charge. (As per PWD Uttarakhand specifications).	86.25	Cum	4075.72	351530.85	4075	351468.75	4100	353625
17.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 20 mm nominal size)	10.45	Cum	23368	244195.6	23368	244195.6	23400	244530
18.00	Steel work in built up tubular (round, square or rectangular hollow tubes etc.)trusses etc., including cutting, hoisting, fixing in position and applying a primingcoat of approved steel primer, including welding and bolted with special shapedwashers etc. complete.Hot finished seamless type tubes	11608.74	Kg	303	3517448.22	303	3517448.22	310	3598709.4
19.00	Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using flats 30x6mm for diagonal braces and central cross piece	7.2	Sqm	9937	71546.4	9937	71546.4	9950	71640

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20.00	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	143.12	Kg	295	42220.4	295	42220.4	300	42936
21.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface 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 any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.60 mm thick with zinc coating not less than 275 gm/m²	283.5	Sqm	1956	554526	1956	554526	1950	552825
22.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface 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 any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 mm thick with zinc coating not less than 275 gm/m²	322.72	Sqm	1695	547010.4	1695	547010.4	1680	542169.6
23.00	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/ 10 sqm over an under coat of primer applied @ 0.80 ltr/ 10 sqm of approved brand and manufacture	15.6	Sqm	255	3978	255	3978	300	4680
24.00	Providing and fixing 12 mm thick prelaminated particle board flat pressed three layer or graded wood particle board conforming to IS: 12823 Grade I Type II, in panelling fixed in aluminum doors, windows shutters and partition frames with C.P. brass / stainless steel screws etc. complete as per architectural drawings and directions of engineer-in-charge. Pre-laminated particle board with decorative lamination on one side and balancing lamination on other side	555.6	Sqm	2146	1192317.6	2146	1192317.6	2150	1194540
25.00	Providing & fixing Translucent white Acrylic Plastic Sheet with putty and glazing clips in steel doors, windows, clerestory windows, all complete with : 3 mm thick translucent white acrylic plastic sheet.	2.8	Sqm	2228	6238.4	2228	6238.4	2250	6300
26.00	Providing and fixing ISI marked oxidised M.S. tower bolt black finish, (Barrel type) with necessary screws etc. complete : 250x10 mm	4	No.	108	432	108	432	110	440

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27.00	Providing and fixing ISI marked oxidised M.S. tower bolt black finish (Barrel type) with necessary screws etc. complete : 150x10 mm	8	No.	80	640	80	640	90	720
28.00	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete : 125 mm	8	No.	54	432	54	432	60	480
29.00	Providing and fixing mild steel round holding down bolts with nuts and washer plates complete.	221.83	Kg	140	31056.2	140	31056.2	150	33274.5
30.00	(ii) Septic Tank, Soak Pit etc. Work.				0				
31.00	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-in-charge. All kinds of soil	54.81	Cum	737	40394.97	737	40394.97	750	41107.5
32.00	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. Ordinary Rock.	14.49	Cum	1369	19836.81	1369	19836.81	1375	19923.75
33.00	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials. All kinds of soil	11.76	Cum	240	2822.4	240	2822.4	250	2940
34.00	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc.in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto1.5m.	0.24	Cum	580	139.2	580	139.2	590	141.6
35.00	Random Rubble Stone Masonry laid Dry, in breast walls, retaining walls, etc, including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	6.15	Cum	7215.7	44376.56	7215	44372.25	7250	44587.5
36.00	Random Rubble Stone Masonry laid in 1:6 cement and sand mortar, in breast walls, retaining walls, parapets, scuppers, etc, including supply of all material, labour, T&P and royalties etc. complete as per drawing and technical specifications Clauses 702, 704, 1202 & 1203 of MORD Specification.	19.15	Cum	13056.7	250035.81	13056	250022.4	13200	252780
37.00	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level : 1:1.5:3 (1 cement :1.5 coarse sand (zone-III) : 3 graded stone aggregate 20 mm nominal size).	4.18	Cum	27316	114180.88	27316	114180.88	27350	114323
38.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:4:8 (1 Cement : 4 coarse sand (zone-III) : 8 graded stone aggregate 40 mm nominal size) (Nominal Mix)	5.05	Cum	16678	84223.9	16678	84223.9	16700	84335
39.00	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 20 mm nominal size)	1.05	Cum	23368	24536.4	23368	24536.4	23400	24570

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40.00	12 mm cement plaster of mix : 1:4 (1 cement: 4 fine sand)	26	Sqm	749	19474	749	19474	760	19760
41.00	Providing and laying Ceramic glazed floor tiles of size 300x300 mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS : 15622 of approved make in colours such as White, Ivory, Grey, Fume Red Brown, laid on 20 mm thick cement mortar 1:4 (1 Cement : 4 Coarse sand). Jointing with grey cement slurry @ 3.3 kg/sqm including pointing the joints with white cement and matching pigment etc., complete.	11.87	Sqm	2484	29485.08	2430	28844.1	2450	29081.5
42.00	Centering and shuttering including strutting, propping etc. and removal of form for all heights : Suspended floors, roofs, landings, balconies and access platform .	15.5	Sqm	1937	30023.5	1936	30008	1950	30225
43.00	Centering and shuttering including strutting, propping etc. and removal of form for : Lintels, beams, plinth beams, girders, bressumers and cantilevers	18.36	Sqm	1572	28861.92	1570	28825.2	1580	29008.8
44.00	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete up to plinth level. Thermo-Mechanically Treated bars of grade Fe-500 D or more.	492.2	Kg	179	88103.8	178	87611.6	185	91057
45.00	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	762.98	Kg	303	231182.94	303	231182.94	310	236523.8
46.00	Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using flats 30x6mm for diagonal braces and central cross piece	16	Sqm	9937	158992	9936	158976	9950	159200
47.00	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer. Fixing with 15x3 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	294.66	Kg	295	86983.7	294	86688.84	300	88458
48.00	Providing Corrugated G.S. Sheet Roofing including vertical/curved surface 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 any pitch in horizontal/ vertical or curved surfaces) excluding the cost of purlins, rafters and trusses and including cutting to size and shape wherever required. 0.63 mm thick with zinc coating not less than 275 gm/m²	90.84	Sqm	1695	153973.8	1690	153519.6	1700	154428

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49.00	Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/ 10 sqm over an under coat of primer applied @ 0.80 ltr/ 10 sqm of approved brand and manufacture	32	Sqm	255	8160	255	8160	280	8960
50.00	Providing and fixing ISI marked oxidised M.S. tower bolt,black finish, (Barrel type) with necessary screws etc. complete : 250x10 mm	20	No.	108	2160	108	2160	115	2300
51.00	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete : 125 mm	20	No.	54	1080	54	1080	60	1200
52.00	(ii) Water Supply, Sanitary & Plumbing Work				0				
53.00	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes. 110 mm diameter	30	Rm	593	17790	593	17790	600	18000
54.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Coupler 110mm	6	No.	241	1446	241	1446	250	1500
55.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Single tee with door 110x110x110 mm	4	No.	387	1548	387	1548	390	1560
56.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Single tee without door 110x110x110 mm	10	No.	369	3690	369	3690	370	3700
57.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Bend 87.5° 110 mm bend	5	No.	294	1470	294	1470	300	1500
58.00	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS :5382 leaving 10 mm gap for thermal expansion. Shoe (Plain) 110 mm Shoe	3	No.	273	819	273	819	280	840

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59.00	Providing and fixing water closet squatting pan (Indian type W.C. pan) with 100 mm sand cast iron P or S trap, 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls and floors wherever required White Vitreous china Orissa pattern W.C. pan of size 580x440 mm with integral type foot rests	10	No.	11603	116030	11603	116030	11650	116500
60.00	Providing and fixing wash basin with C.I. brackets, 15 m m dia CP Brass single hole basin m ixer of approved quality and m ake, including painting of fittings and brackets, cutting and m aking good the walls wherever required: White Vitreous China Wash basin size 550x400 m m with a 15 m m CP Brass single hole basin mixer	2	No.	8843	17686	8843	17686	8850	17700
61.00	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete. Flexible pipe 32 mm dia	2	No.	137	274	137	274	210	420
62.00	Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors : 100 mm inlet and 100 mm outlet Sand cast iron S&S as per IS: 3989.	2	No.	3411	6822	3411	6822	3450	6900
63.00	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge. : Internal work - Exposed on wall 20 mm nominal outer dia. Pipes.	30	Rm	630	18900	630	18900	640	19200
64.00	Providing and fixing uplasticised PVC connection pipe with brass unions : 45 cm length 15 mm nominal bore	5	No.	205	1025	205	1025	210	1050
65.00	Providing and placing on terrace (at all floor levels) polyethylene water storage tank ISI : 12701 marked, with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank. Circular tank	2000	Litre	18	36000	18	36000	20	40000
66.00	Providing and fixing C.P. Brass Long Body Bib Cock of approved quality conforming to IS standards and weighing not less than 690 gms. (15 mm nominal bore)	12	No.	784	9408	784	9408	790	9480
67.00	Providing and fixing C.P. brass stop cock (concealed) of standard design and of approved make conforming to IS:8931. 15 mm nominal bore.	2	No.	873	1746	873	1746	890	1780
68.00	Providing and fixing C.P. brass angle valve for basin mixer and geyser points of approved quality conforming to IS:8931 a) 15 mm nominal bore 15mm nominal bore	10	No.	778	7780	778	7780	780	7800
69.00	Providing and fixing C.P. Brass extension nipple (size 15mmx50mm) of approved make and quality as per direction of Engineer-in-charge.	2	No.	158	316	158	316	160	320

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70.00	Providing and fixing Ball Valve (brass) of approved quality, High or low pressure, with plastic floats complete : 20 mm nominal bore.	4	No.	593	2372	593	2372	600	2400
71.00	(iv) Internal Electrification Work				0				
72.00	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed medium class PVC conduit, with modular switch, modular plate, suitable GI box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required	33	Nos.	1863	61479	1860	61380	1880	62040
73.00	Supplying and fixing following modular switch/ socket on the existing modular plate & switch box including connections but excluding modular plate etc. as required				0				
74.00	5/6 A switch	6	Nos	268	1608	268	1608	280	1680
75.00	3 pin 5/6 A socket outlet	6	Nos	279	1674	279	1674	290	1740
76.00	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 3 pin 5/6 A modular socket outlet and 5/6 A modular switch, connections etc. as required.	36	Nos	929	33444	929	33444	950	34200
77.00	Supplying and fixing suitable size GI box with modular plate and cover in front on surface or in recess, including providing and fixing 6 pin 5/6 & 15/16 A modular socket outlet and 15/16 A modular switch, connections etc. as required.	12	Nos.	1048	12576	1045	12540	1060	12720
78.00	Supplying and fixing following way, Vertical type three pole and neutral, sheet steel, MCB distribution board, 415 V, on surface/ recess, complete with tinned copper bus bar, neutral bus bar, earth bar, din bar, interconnections, powder painted including earthing etc. as required. (But without MCB/RCCB/Isolator) 8 way (8 + 24), Double door	1	Nos.	20082	20082	20082	20082	20100	20100
79.00	Supplying and fixing 63A rating, four pole, 415 V, MCCB in the existing MCB DB complete with connections, testing and commissioning etc. as required.	1	Nos	10667	10667	10667	10667	10700	10700
80.00	Supplying and fixing Single pole 5 A to 32 A rating, 240/415 V, 10 kA, "C" curve, miniature circuit breaker suitable for inductive load of following poles in the existing MCB DB complete with connections, testing and commissioning etc. as required	20	Nos	433	8660	433	8660	450	9000
81.00	Wiring for circuit/ submain wiring alongwith earth wire with the following sizes of FRLS PVC insulated copper conductor, single core cable in surface/ recessed medium class PVC conduit as required.				0				
82.00	2 X 1.5 sq. mm + 1 X 1.5 sq. mm earth wire	168	Rm	299	50232	299	50232	300	50400
83.00	2 X 4 sq. mm + 1 X 4 sq. mm earth wire	180	Rm	372	66960	372	66960	380	68400
84.00	S/F of ceiling rose 3 pin 5 amp	33	Nos	223	7359	223	7359	250	8250
85.00	Earthing with G.I. earth plate 600 mm X 600 mm X 6 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 metre long etc. with charcoal/ coke and salt as required.	1	Nos	23571	23571	23571	23571	24000	24000

86.00	Providing and laying earth connection from earth electrode with 5 SWG dia G.I. Wire in 15 mm dia G.I. pipe from earth electrode including connection with G.I. thimble excavation and re-filling as required	15	Rm	103	1545	103	1545	110	1650
87.00	Supply/ Fixing of 22 watt LED Tube Light Phillips/Crompton/bajaj	31	Nos	1325	41075	1325	41075	1350	41850
88.00	S/L 3.5 CX 35 Sq mm Al. Ar Cable Polycab/KEI/Havells	25	Mtr	878	21950	878	21950	890	22250
89.00	S/F of 36 watt LED street Light Phillips/Havells/Crompton/Bajaj	2	No	6219	12438	6219	12438	6250	12500
					16001938.61		~~15993642.96~~		16603107.75

15993504.96

Total in Figures

Lowest Amount Quoted BY: M/s Raj Construction(15530528.77)

अध्यभ्यहोदय

प्रथम एवं न्यूनतम निविदादाता मै० राज कन्स्ट्रक्शन, राजपुर रोड, देहरादून की निविदा तकनीकि स्वीकृति उपरान्त, पुनरीक्षित मात्राओं, नेगोशीएशन एवं सेवा परामर्श समिति के उपरान्त रू० ~~15994364.96~~ मात्र की स्वीकृति हेतु सादर अग्रसारित।

1,59,93,504.96

सहायक अभियन्ता
निर्माण खण्ड, लो०नि०वि०
गुप्तकाशी

S.E

अधोहस्ताक्षरी अभियंता की संस्तुति के आधार पर न्यूनतम निविदादाता मै० राज कन्स्ट्रक्शन, पैसिफिक हिल्स, राजपुर रोड देहरादून ठेकेदार की निविदा रू० 1,59,93,504 वे०इन की निविदा तकनीकि स्वीकृति के उपरान्त, परामर्श समिति .96 (एक करोड उनसठ लाख तिरानवे हजार पाच सौ चार रुपये छियानवे) मात्र की स्वीकृति हेतु संस्तुति सादर प्रेषित है।

टी० सहित स्वीकृत।

अधिशासी अभियन्ता
निर्माण खण्ड, लो०नि०वि०
गुप्तकाशी

अधीक्षण अभियन्ता
7वाँ वृत्त लो० नि० वि०
गोपेश्वर (चमोली)

CONTRACTOR

सं० 3

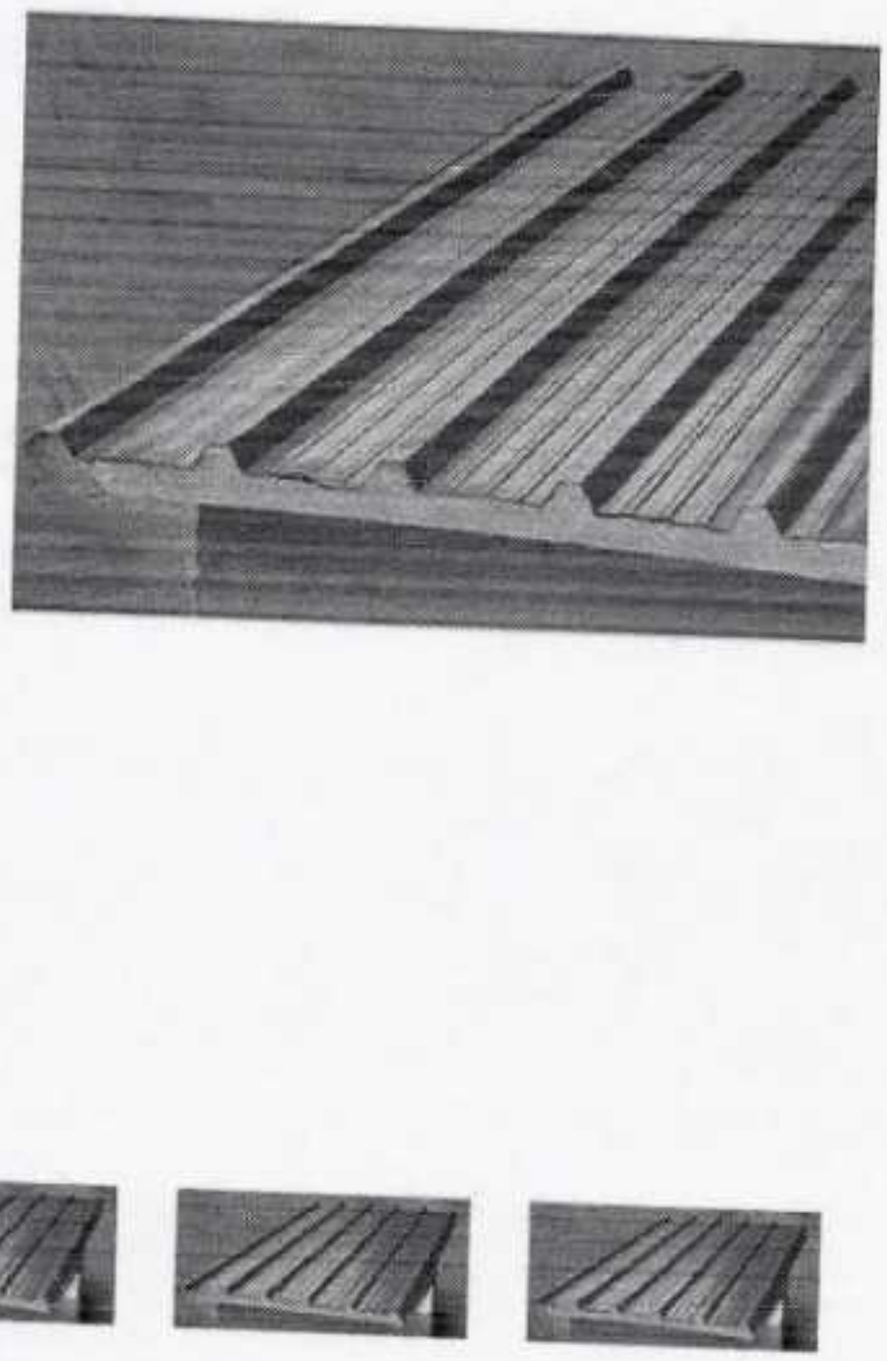
741

194

PUF Panel

HomeLand and Buildings and Structures and ThoroughfaresPrefabricated buildings and structures

Prefabricated emergency relief buildings and structuresPUF Panel (Q3 Category)



CACTUS PUF Panel use for Wall

CACTUS[R]

(Cactus PUF Panel)

₹ 39.00 99% OFF

Trends

Product Details

Price For :	1 square meter
MRP/Unit:	₹ 3,900.00
Offer Price/Unit:	**₹ 39.00**
Availability:	7000 In Stock
Min. Qty. Per Consignee:	2400
Product id:	5116877-166997910
Country Of Origin:	India
Local Content (MII):	100%

*Please Note: Local Content value is as declared by reseller since OEM is not registered on GeM

Ask GeMmy

Product Compare Product History 4

Seller Details

Sold by:	Resellers
Reseller not verified by OEM	
Catalogue not verified by OEM	
Seller Excellence	4.5 - 5.0

Specifications

Fascia options	PPGI(Prepainted galvanized iron steel) sheet conforming to IS 14246 - 2013
Thickness of fascia sheets	0.5 mm
Density of all polyurethane foam	40 ± 2 kg/cubic meter conforming to IS 11239 part II-1985 as amended upto date
External pattern of panels	As per Buyer's requirement
Foundation for panels	Building of foundation at site

VIEW MORE

MATERIAL

Fascia options	PPGI(Prepainted galvanized iron steel) sheet conforming to IS 14246 - 2013
Thickness of fascia sheets	0.5 mm
Insulation material	Polyurethane foam
Density of all polyurethane foam	40 ± 2 kg/cubic meter conforming to IS 11239 part II-1985 as amended upto date
Insulation core of panel is formed in one piece	Yes

Ask GeMmy

Product Compare Product History 4

744

Product feature	Consist of an insulating layer of rigid polyurethane foam between two layers of metal sheets
Panels For	Wall
Types of panel	Single groove panels – for general purpose an application in building / shelters
Facility of tongue-n-groove joinery for wall panels	Yes
Fire class	FR grade (fire resistance grade)
External pattern of panels	As per Buyer's requirement
Provision of male-female type groove made with extended wall panel sheets	Yes
Provision of cam lock system	No
Scope of supply(offer price to include all cost component)	Supply of Product only
Transportation / freight charges	Offer prices are on free delivery at consignee site basis
Foundation for panels	Building of foundation at site shall be the responsibility of the consignee and the seller shall install / erect and commission the structure on the foundation constructed up to plinth level by the consignee

DIMENSION

Ask GeMmy

Width – Wall panel ± 10 mm	1185 mm
Width – Roof panel ± 5 mm	980 mm
Width – Door panel ± 10 mm	900 mm
Width – Floor panel ± 5 mm	980 mm
Length – Wall panel ± 10 mm	2500 mm
Length – Roof panel ± 10 mm	2000 mm
Length – Door panel	1800 mm
Length – Floor panel	2000 mm
Core thickness of PUF panel	30 mm

COLOUR AND FINISH

Grade of Zinc Coating	120 gms/square meter
Surface finish	With 50 microns thick PVC guard film

PERFORMANCE

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Product Video

Ballistic Separator Machine For Solid Waste, Electronic

₹ 15,00,000/ Piece **Get Latest Price**

Usage/Application	Waste Sorting
Applicable Industry	Waste Management
Power Source	Electronic
Features	Higher throughput rates, Low operating costs,...
Material	Municipal Solid Waste
Automation Grade	Manual

SVM Infraestate Ballistic separators are designed for sorting 2D materials (plastic film, paper, cardboard and fibres) and 3D materials (containers, plastic bottles, cans, stone, wood, etc.). They can also sort fine particles that can be collected separately with the optional variable screen openings.
A ballistic separator is a high load segregating device that separates out wastes of different kinds. It consists of parallel agitating paddles and a deck that oscillates at high speed so as to sort a stream of waste passed through it.

Separates Waste Into 3 Fractions - They can also sort fine particles which, with the optional variable screen openings, can be collected separately.

- Lighter material which moves upwards due to eccentric motion supported by a fan which mainly contains plastic papers, wrappers, cloth, papers etc.
- Heavier/3D material – which is heavy in weight and slides down on the paddles to the bottom & gets separated which mainly contains C&D waste, coconut shells, glass, metals, footwear & pet bottles
- Minus material which screens down from the mesh paddling system normally contains earth and other smaller size material

View Less Details

Get Latest Price

SVM Infraestate Private Limited

Noida, Gautam Buddha Nagar, Uttar Pradesh

5/5 ★★★★★ (2)

GST- 09AAPCS3813B1ZE

Verified Supplier | Manufacturer

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Find products similar to **Ballistic Separator Machine For Solid Waste, Electronic** near **Noida**

WHEM Is "2062" Ballistic Separat...

3 Solid Waste Compost Plant,...

Food Waste Composting...

Solid Waste Treatment Plant,...

Treatment Capacity: 30 Tph...

Technoscreen Ballistic Separat...

U value (heat transfer coefficient) in watt per square meter Kelvin	0.15
R value (measure of resistance to heat flow through a given thickness of material) British Thermal Units Per Hour Per Square Feet Degrees Fahrenheit	9.8
Thermal conductivity value at 10 degree centigrade (test method ASTM C 518-98)	0.021 w/nk
Compressive strength at 10 % deformation (Kg per square centimetre) (test method ASTM D 1621-94)	2.1
Bending strength (Kg per square centimetre)	4
Tensile strength (Kg per square centimetre) (test method ISO 1926:2005)	3.7
Adhesive strength(Kg per square centimetre) – foam to steel	2.9
Water absorption (volume percent) at 100% RH (test method ISO 2896:2001)	0.2 %
Closed cell content (%)	94
Vapour permeability at 90% (RH) and 38 degree centigrade (gms per Hr[dot] square meter)	0.12

CERTIFICATION

Availability of Test Report from Designated AHSP / NABL / ILAC accredited or Central Government Lab to prove conformity of products to the specification	Yes
Warranty Period in years	1

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MAGNA TRONIX Double Drum Magnetic Separator, Capacity: 1.5 Ton/Hour

₹ 24,000 Get Latest Price

Capacity	1.5 Ton/Hour
Type Of Magnet Used	Ferrite
Type Of Magnetic Separators	Double Drum Magnetic Separator
Brand	MAGNA TRONIX
Applications	Pharmaceutical & Biochemical
Apparatus Weight	800 kg

View All Details

Get Latest Price

Magna Tronix

West Mambalam, Chennai, Tamil Nadu

4.3/5 ★★★★★ (54)

GST- 33AANPM2649A1ZY

TrustSEAL Verified | Leading Supplier

Verified Exporter | Manufacturer

Company Video

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86% Response Rate

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Find products similar to **MAGNA TRONIX Double Drum Magnetic Separator, Capacity: 1.5 Ton/Hour** near **Chennai**

Magnetic Drum Separator,...

Star Trace India

Redhills, Chennai, Tamil Nadu

₹ 1,50,000

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Magnetic Drum Separator,...

Star Trace India

Padianallur, Chennai, Tamil Nadu

₹ 1,50,000

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Get Latest Price

Magnetic Wet Drum Separator,...

Vibromag...

Redhills, Chennai, Tamil Nadu

₹ 1,00,000

View Mobile Number

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Magnetic Drum Separator,...

Vibromag...

Redhills, Chennai, Tamil Nadu

₹ 1,00,000

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Magnetic Drum Separator,...

Star Trace Privat...

Redhills, Chennai, Tamil Nadu

₹ 85,000

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Magnetic Drum Separator,...

Star Trace Solutio...

Redhills, Chennai, Tamil Nadu

₹ 98,000

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Suspension Magnet in Chennai

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Magnetic Roll Separator in Chennai

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Product Gallery | Company Details

Product Image

Send enquiry for **Double Drum Magnetic Separator**

Submit Requirement

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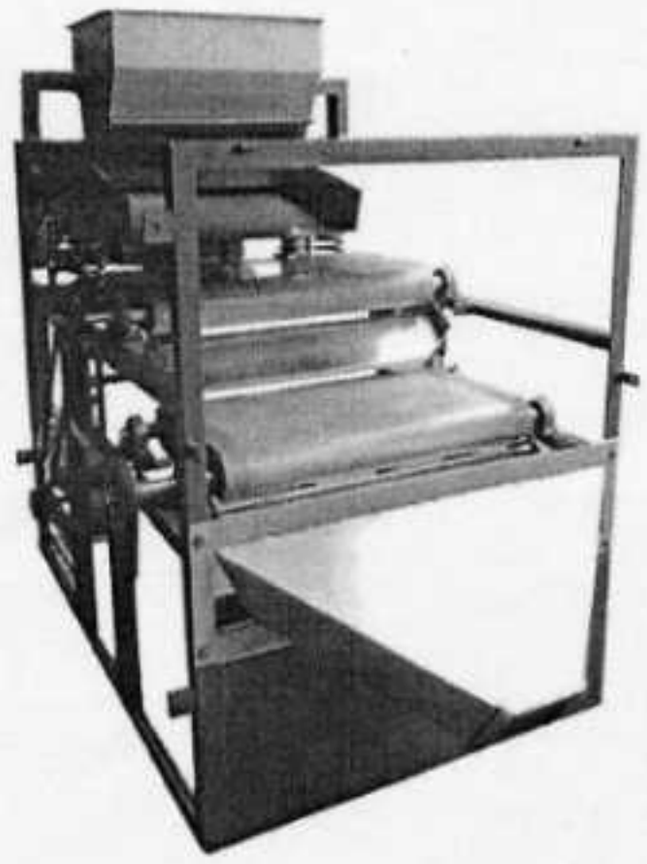

Product Video | Product Brochure

High Intensity Roller Type Magnetic Separator

₹ 1,00,000/ Piece Get Latest Price

Roller Diameter	65 mm
Roller/Belt Width	1000 mm
Type Of Magnet Used	Neodymium
Type Of Magnetic Separators	Double Stage Roll type Magnetic Separator
Applications	Mine And Mineral Industry, Ceramic And...

View All Details

Get Latest Price

Kumar Magnet Industries

Odhav, Ahmedabad, Gujarat

4.3/5 ★★★★★ (71)

GST- 24BNBPM9953P1Z9

TrustSEAL Verified | Leading Supplier

Verified Exporter | Manufacturer

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73% Response Rate

Contact Supplier

Find products similar to **High Intensity Roller Type Magnetic Separator** near **Ahmedabad**

High Intensity Roller Type...

Shree...

Odhav, Ahmedabad, Gujarat

₹ 2,30,000/ Piece

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High Intensity Roller Type...

Sonal Magnetics

Odhav, Ahmedabad, Gujarat

₹ 4,50,000/ Piece

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Get Latest Price

Wet High Intensity Magnetic...

Linux Magnetics

Kathwada, Ahmedabad, Gujarat

₹ 1,50,000

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Get Latest Price

MS High Intensity Magnetic Single...

Aanal Magnetic...

Odhav, Ahmedabad, Gujarat

₹ 2,75,000/ Unit

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Get Latest Price

Multi Stage Roller Magnetic...

Excel Magnetics

Kathwada, Ahmedabad, Gujarat

₹ 2,00,000/ Piece

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Get Latest Price

High Intensity Permanent...

Shree Ambica...

Khodiyarnagar, Ahmedabad, Gujarat

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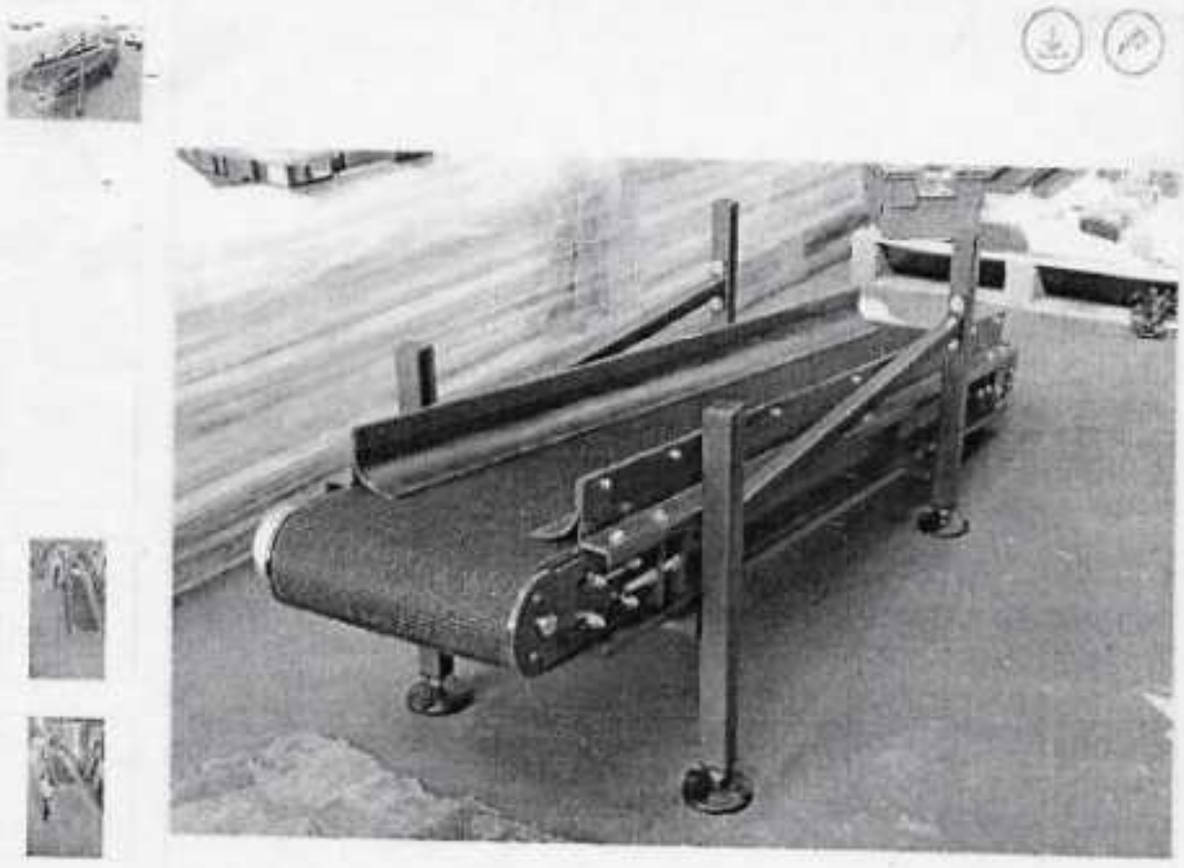

IndiaMART > Conveyor Systems & Components > Belt Conveyors > Flat Belt Conveyor

VEPL Flat Belt Conveyor, For Material Handling, 100kg

₹ 1,00,000/ Unit Get Latest Price

Usage/Application	Material Handling
Brand	VEPL
Capacity	100kg
Material	Mild Steel
Belt Material	PVC
Belt Width	500-1200mm
Voltage	415V
Belt Speed	0-60mtr/min
Warranty	1 year
Model Name/Number	VEPL-FBC
Country of Origin	Made in India

Product Video Product Brochure

A **conveyor belt** is the carrying medium of a **belt conveyor system** (often shortened to belt conveyor). A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with a closed loop of carrying medium—the conveyor belt—that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volumes of resources and agricultural materials, such as grain, salt, coal, ore, sand, overburden a nd more.

View Less Details

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Verticon Equipments Private Limited

Chikhali, Pimpri Chinchwad, Pune, Maharashtra

4.8/5 ★★★★★ (40)

GST- 27AAGCV9154P1ZF

TrustSEAL Verified Leading Supplier

Manufacturer

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88% Response Rate

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Find products similar to **VEPL Flat Belt Conveyor, For Material Handling, 100kg** near **Pimpri Chinchwad**

Rubber Flat Belt Conveyor, Load...

Rudra Industries

Hanuman Nagar Tamhane Wasti,...

₹ 1,20,000/ Piece

Metal Industrial Flat Belt...

Techzen...

Deals In Pimpri Chinchwad

₹ 95,000/ Piece

Rubber Belt Conveyor, Materi...

Verticon...

Chikhali, Pimpri Chinchwad,...

₹ 1,80,000/ Piece

Mild Steel Gravity Roller Conveyor,...

Liftocon...

Deals In Pimpri Chinchwad

₹ 9,000/ Piece

Material Handling Belt Conveyor

Das Systems

Deals In Pimpri Chinchwad

₹ 8,000/ Meter

Flat Belt Conveyor, For Pharma,...

M/S Arise...

Deals In Pimpri Chinchwad

₹ 2,10,000/ Piece

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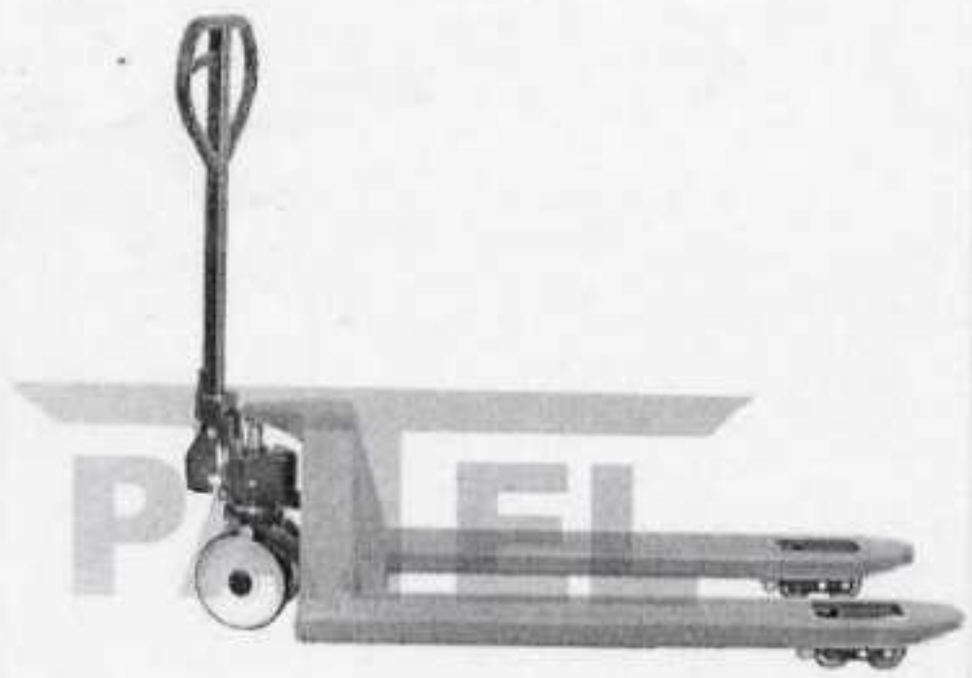

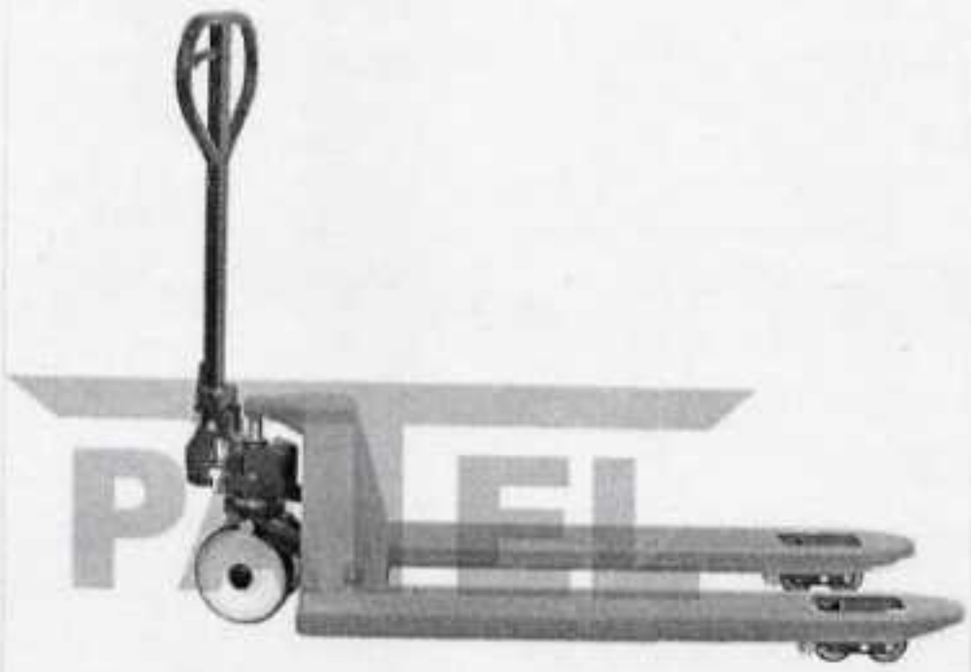

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Multifunction Hand Pal Truck, Capacity: 1ton, 3ton, 4ton, 5ton

₹ 15,000/ Piece Get La Price

Capacity	1ton,2ton,3ton,
Fork Length	1150mm/as pe customer requi
Fork width	550mm /as per customer requi

Item Code: 101

Multifunction Hand Pallet Truck

View All Details

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Patel Material Handling Equipment

Naroda, Ahmedaba Gujarat

4.2/5 ★★★★★ (

GST- 24AKPPP940

TrustSEAL Verified

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Manufacturer | Company Vi

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88% Response Rate

Find products similar to **Multifunction Hand Pallet Truck, Capacity: 1ton, 2ton, 3ton, 4ton, 5ton** near **Ahmedabad**

Scale Pallet Truck, Capacity: 3 Ton, 5...

Stacker's & Mover...

Vatva, Ahmedabad, Gujarat

₹ 85,000/ piece

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Utkal Hand Pallet Truck, Loading...

Utkal Engineers

Vikram Nagar, Ahmedabad, Gujarat

₹ 15,000/ Piece

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Patel Godrej Hand Pallet Truck,...

Patel Material...

Naroda, Ahmedabad, Gujarat

₹ 15,000/ Piece

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Annapurana Battery Operated Hydraul...

M/s Annapurna...

Vadaj, Ahmedabad, Gujarat

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Hydraulic Hand Pallet Truck

Saideep Industries

GIDC Naroda, Ahmedabad, Gujarat

₹ 12,500/ Piece

View Mobile Number

Get Latest Price

1.5 Ton Hand Pallet Truck

Sky Industries

Naroda, Ahmedabad, Gujarat

₹ 25,000/ Piece

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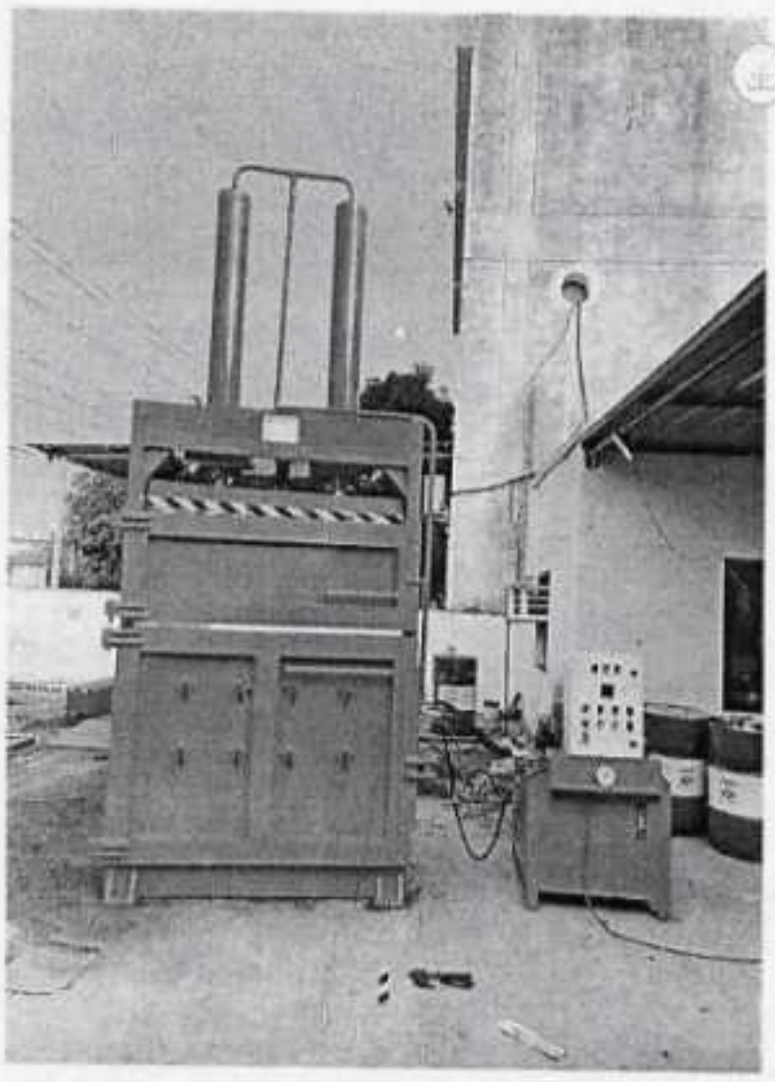

Product Video | Product Brochure

Mild Steel 30-60 ton Hydraulic Vertical Baler In Manesar, Capacity: 50 Ton, Model Name/Number: Ragnor

₹ 3,75,000 Get Latest Price

Max Force or Load	60-90 ton
Usage/Application	Industrial
Max Load Capacity	30-60 ton
Material	MILD STEEL
Model Name/Number	RAGNOR
Capacity	50 TON
Bail Weight	100-150 KGS
Brand	RAGNOR
Automation Grade	Automatic
Minimum Order Quantity	1

Ragnor Hydraulics" is located in **IMT Manesar, Gurgaon** and the working area is 10000 sq. feet. Many years of research & development, vast experience & production capabilities has earned a reputed name in the field of High Technology Quality Products. Our company is equipped with in-house computer aided designing and manufacturing facilities and supplying machines to top Indian companies.

A sound establishment of Ragnor Hydraulics in **2016** has made a rapid growth in the Indian market. We are engaged in **Manufacturing, Suppling & Exportering** a vast assortment of**Car Lifts, Dock Leveler, Hydraulic Scissor Lift, Hydraulic Cutting Machine, Hydraulic Power Packs, Hydraulic Cylinders, Container Tilters, Hydraulic Goods Lift, Hydraulic Presses, Industrial Sheds, Baler And Baling Press Machine, Drum Crushers And Compactor, etc.**

Our dedicated and highly proficient team of engineers is constantly involved in the process of production. Our in-house production line allows us to undertake orders as per the specific requirements of our esteemed clients. Our products have established a sound recognition in the various markets which brings us repeated orders. At Ragnor Hydraulics, we have a separate quality control department who ensure that every machine is tested for quality and performance. We guarantee all our customers that our manufactured hydraulic presses pass strict and complete quality controls. Our timely after-sale services are also dedicated to fulfill the customer's hour of need.

In addition to this, we also render optimum quality **Annual Maintenance Contract Service** and **Hydraulic Press Job Work.** Under the guidance of **"Mr. Ravinder Kaushik" (CEO),** we have been able to provide maximum satisfaction to our clients.

Ragnor Hydraulics

Manesar, Gurugram, Haryana

4.6/5 ★★★★★ (24)

GST- 06AAUFR8563K1ZA

TrustSEAL Verified	Star Supplier
Verified Exporter	Manufacturer

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Contact Supplier

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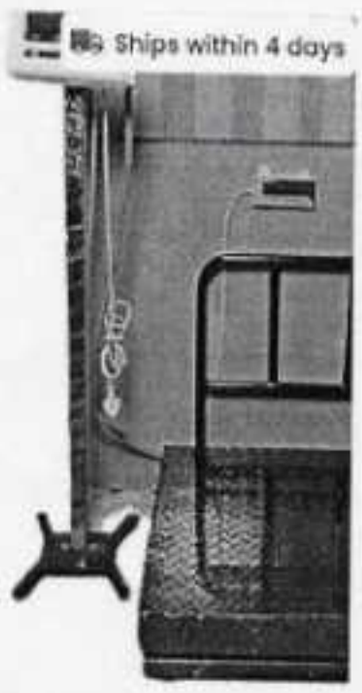

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DIGITONE 1000 Kg (1 Ton) Digital Platform Weighing Scales DGP1TON

Visit the DIGITONE Store POWER BRAND

EMI starts at ₹2665/month. No Cost EMI available. EMI options

AVAILABLE OFFERS View Offers

- Use SAVE1500 & get ₹1500* off. Valid for GST-Registered Users Only. View
- Use SAVE3000 & get ₹3000* off. Valid for GST-Registered Users Only. View
- Use NEW3000 & get ₹3000* off. Only Valid on your first

FEATURES More Details

Type of Product	Weighing Scales
Dimension	1000x1000
Model No	DGP1TON
Display	Digital

More DIGITONE Analytical Weighing Scale products
More Analytical Weighing Scale products

₹29,999 (Incl. of all taxes)

₹25,423 + 18% GST

MRP ~~₹30,975~~ 3.15% OFF

Quantity − 1 + Minimum Order Quanity- 1 Piece

Bulk quantity Discounts!!

Select	Quantity	Discounted price per piece(Incl. of all taxes)
○	2	₹28,955.20
○	3	₹28,694.25
○	4	₹28,433.30
○	5-more	₹27,911.40

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Check Delivery Details

Enter Pincode Check

PREPAID	Available
PART COD	Available
COD	Unavailable
RETURN	Available Return period : 7 days

Warranty as per brand | 100% Original Products | Secure payments | 100% Buyer protection | Top Brands

SPECIFICATIONS

Type of Product	Weighing Scales
Dimension	1000x1000
Model No	DGP1TON
Display	Digital
Product Sub Type	Platform Weighing Scale
Weighing Capacity (kg)	1 Ton
Country of Origin	India
Name of Manufacturer/Packer/Importer	DIGITA COMPUTER SERVICE

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Product Brochure

Aristo Hdpe 90L Whee Dustbin

₹ 2,047 Get Latest Price

Capacity	90 L
Color	Black, Blue, R Green, Yellow
Usage/Application	Home, Office, I
Brand	Aristo
Structure	Foot Pedal
Material	HDPE
Minimum Order Quantity	10

View All Details

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Krishna Polymer Industrie

Rohini Sector 15, N

4.2/5 ★★★★★ (

GST- 07AROPG46

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Find products similar to **Aristo Hdpe 90L Wheeled Dustbin** near **New Delhi**

120 Liter Wheeled Dustbin

Subhash Sales...

New Delhi

₹ 2,050

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Plastic Open Top 240 L Wheeled Du...

Subhash Sales...

New Delhi

₹ 2,850

View Mobile Number

Get Latest Price

Plastic 40 Ltr swing square Dustbin

Prisha Enterprises

Bawana, New Delhi

₹ 460

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Get Latest Price

Plastic Nilkamal Dustbin

Scope Unlimited

Deals In New Delhi

₹ 2,500

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Plastic 2 Wheeled Dustbin 90L

KC Green...

Sainik Farms, New Delhi

₹ 1,800

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Aristo HDPE Wheeled Garbage...

S S Enterprises

Mayur Vihar Phase 1, New Delhi

₹ 2,050

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Plastic Dustbin | Bio Medical Waste Bins | Nilkamal Dustbins | Plastic Bins in Delhi | Garbage Bin in New Delhi

209

50 kg

BIORAPID

Commercials

	Quantity (Nos)	Unit Rate (Rs.)	GST	Amount (Rs.)
50 kgs / day				
Bio Rapid 75	1	₹ 675,000	12%	₹ 7,56,000
SubTotal				**₹ 7,56,000**
Freight,Packing & Insurance		₹ 60,000	18%	₹ 70,800
Installation, Commissioning & Training		₹ 35,000	18%	₹ 41,300
Grand Total				**₹ 8,68,100**

Terms and Conditions

- Taxes: GST as applicable
- **Freight and Installation to be charged extra. The freight charged is up to the place where road is available. Any other expenses for the cartage of machine to the site will be borne by client.**
- Delivery Period: Within 60-70 days from the date of PO & Advance
- Payment Terms: 100% Advance prior to dispatch
- Warranty: 12 months from the date of installation and commissioning
- Validity of offer: This offer is valid for acceptance within 30 days.

EXCEL

210

500/cg

BIORAPID

Commercials

500 kgs / day	Qty (Nos)	Unit Rate (Rs.)	Rate	GST	Amount (Rs.)
BioRapid 500	2	₹ 1,650,000	₹ 33,00,000	12%	₹ 36,96,000
Sub-Total					**₹ 36,96,000**
Freight,Packing & Insurance		₹ 150000		18%	₹ 1,77,000
Installation, Commissioning & Training		₹ 60,000		18%	₹ 72,600
Grand Total					**₹ 39,45,600**

Terms and Conditions

- Taxes: GST as applicable
- **Freight and Installation to be charged extra. The Freight charged is up to the place where road is available. Any other expense for the cartage of machine to the site will be borne by Client.**
- Delivery Period: Within 60-70 days from the date of PO & Advance
- Payment Terms: 100% Advance prior to dispatch
- Warranty: 12 months from the date of installation and commissioning
- Validity of offer: This offer is valid for acceptance within 30 days.

57


EXCEL
BIORAPID
BIORAPID
211

BIORAPID

Components

760

BIORAPID

Process

761

BIORAPID

Process

BIORAPID

762

Specifications

	Parameters	BioRapid 500
General Specs.	Capacity (kg/day)	500
	Vessel volume (L)	4200
	MOC of Vessel and Shaft	MS Painted
	MOC of Outer Cover	MS Powder coated
Technical Specs.	Electric Supply	3 Phase, 4 Pole
	Motor (HP)	12.5 HP
	Waste shredder	Single stage
	Shredder Capacity (per hour)	200 kg
	Shredder Motor (HP)	2.0 HP
	Overall dimensions (m)	**3.1 x 2.6 x 2.2**
Other Req.	Space requirement	**175 sq. ft.**
	Electrical consumption (units/day)	25-30
	Machine Weight (kg)	**4105**

BIORAPID

Commercials

500 kgs / day	Qty (Nos)	Unit Rate (Rs.)	Rate	GST	Amount (Rs.)
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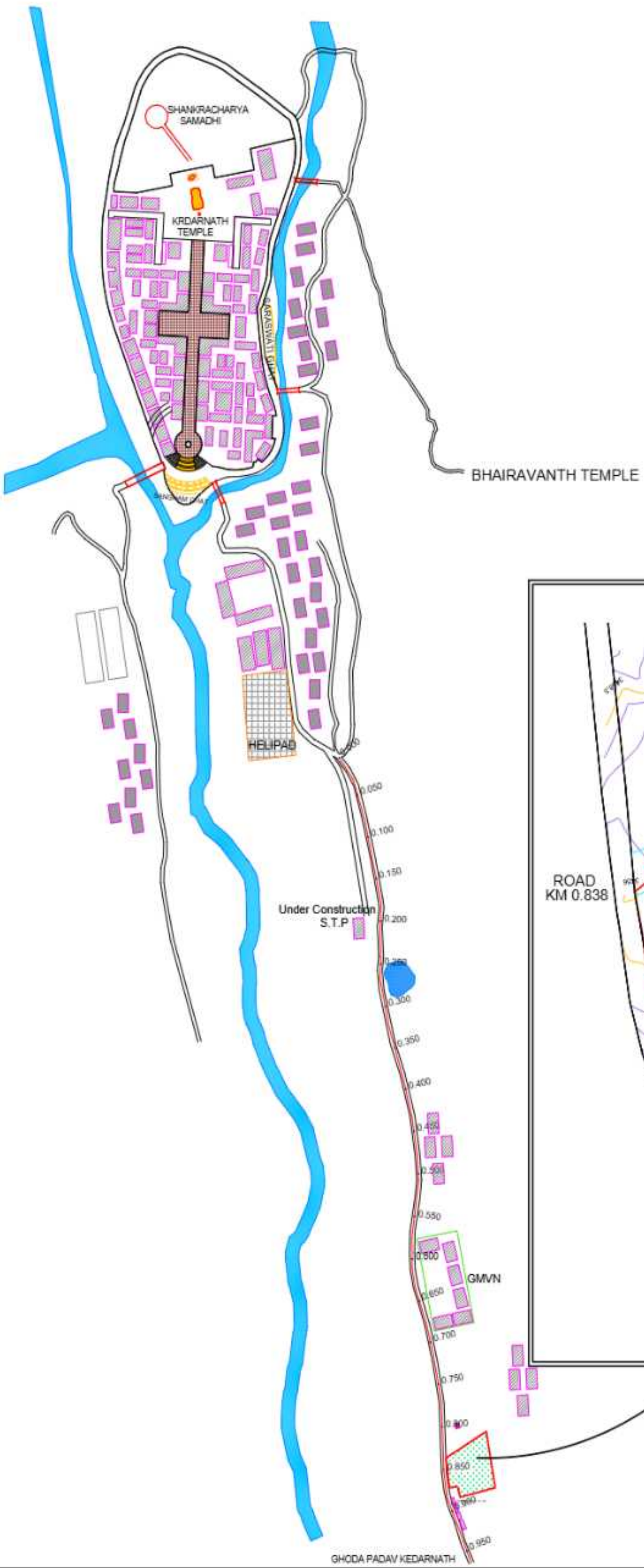
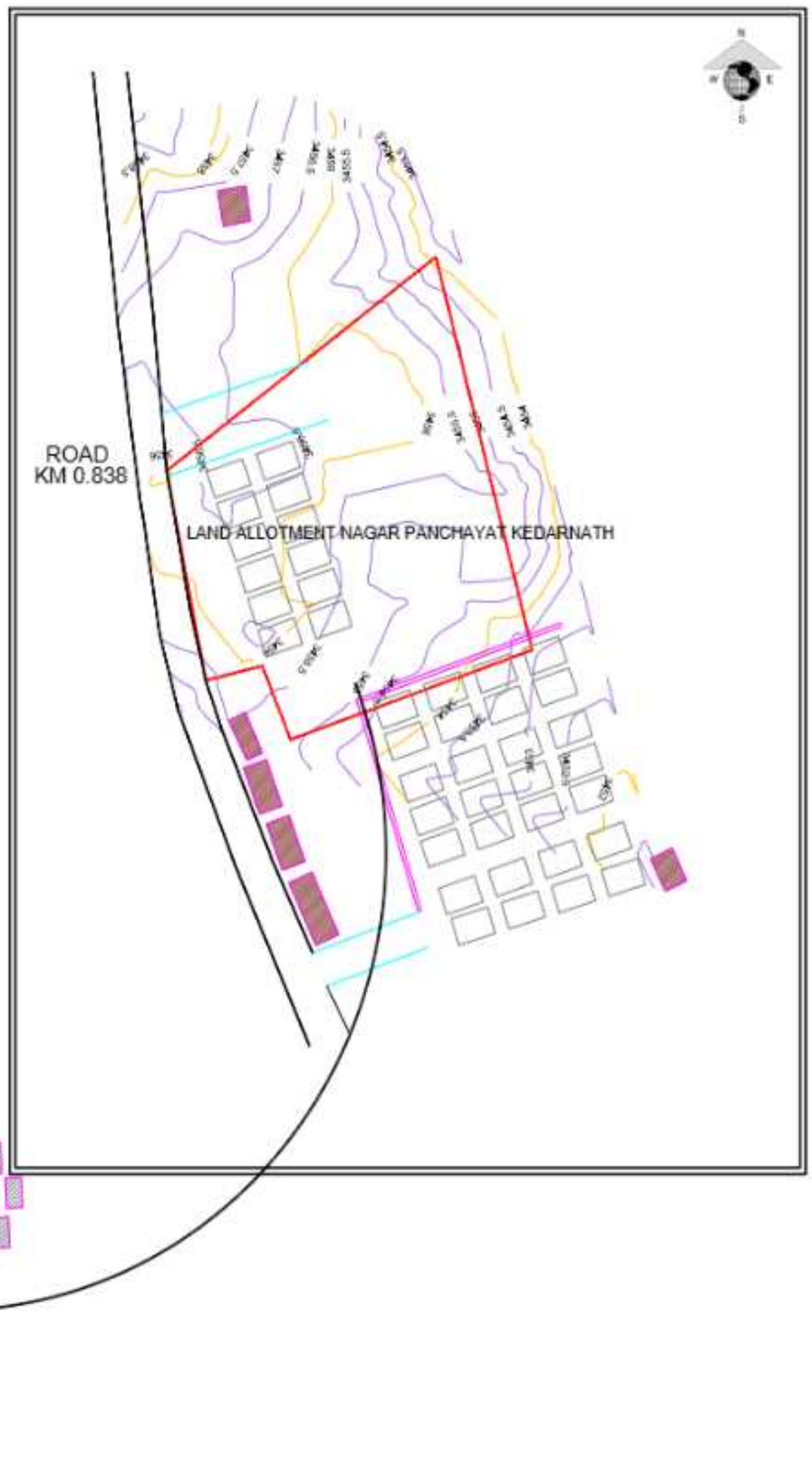
KEY PLAN

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH/KEDARNATHDHAM

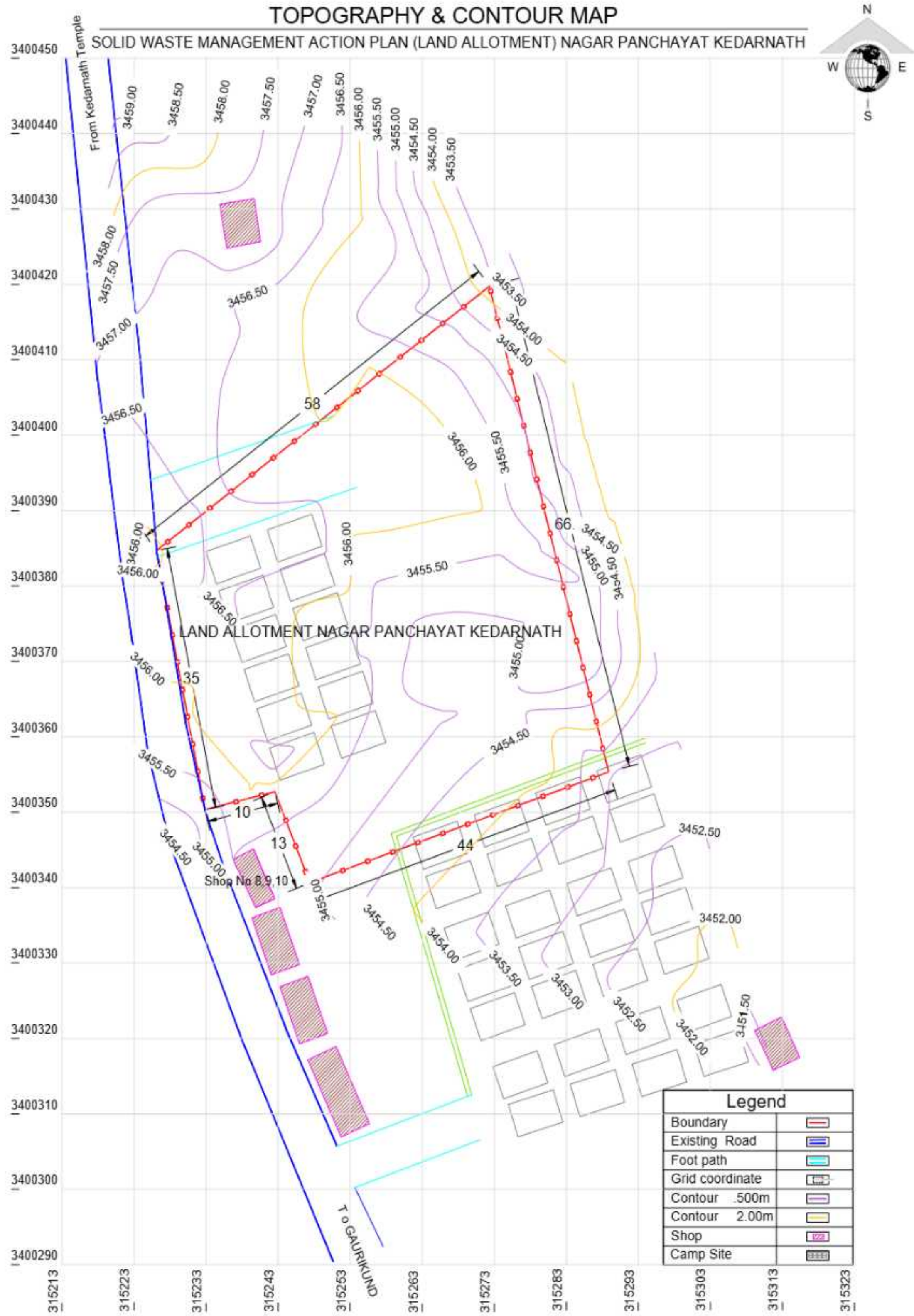


Legend	
Kedarnath temple	
Existing Foot path	
Existing House/Shop	
Mandakini River	
Contour .500m	
Contour 2.00m	
HELIPAD	
Camp Site	
Boundary	
Bridge	
Temple stairs	



TOPOGRAPHY & CONTOUR MAP

SOLID WASTE MANAGEMENT ACTION PLAN (LAND ALLOTMENT) NAGAR PANCHAYAT KEDARNATH



Legend	
Boundary	
Existing Road	
Foot path	
Grid coordinate	
Contour .500m	
Contour 2.00m	
Shop	
Camp Site	

CLIENT:-	PROJECT:	LAND ALLOTMENT	PREPARED BY:-	SCALE:-	SHEET
NAGAR PANCHAYAT KEDARNATH/ KEDARNATH DHAM RUDRAPRAYAG (U.K.)	SOLID WASTE MANAGEMENT ACTION PLAN NAGAR PANCHAYAT KEDARNATH / KEDARNATH DHAM	Area = 3000 Sqm Area = 0.300 Hect Khasra no = 337& 338	DIGITAL LAND SURVEY & ENGINEERING	1:500	NO:- 02

N.P.A./2022- 381
Office of Nagar Panchayat Arki,
Teh. Arki, Distt. Solan (H.P.)

Date: Arki, 11, April,2022

To whom it may concern

This is to certify that, we are using OWC 500 KG per day capacity supplied by M/s. Excel Industries Ltd. for decentralised waste management system in our town, Arki, District Solan, Himachal Pradesh. Around 500 kg wet waste is treated by use of Bioculum and Sanitreat and they are working satisfactory without any operational issues.

The system and use of Bioculum and Sanitreat helping us dispose off the wet waste with reduced composting cycle to 10 days and eliminating foul odour during composting process. We place on record our appreciation for the M/s EXCEL Industries Limited, for making the composting process easier and efficient.

Secretary
Nagar Panchayat Arki.

mc/swm/2022-1802 Dt. 12/4/2022

To whom so ever it may concern

We adopted decentralised waste management system in our town in the year 2021. Around 1000 kg wet waste is treated by use of Excel Industries Ltd's OWC machine along with Bioculum and Sanitreat.

OWC machine shreds, homogenises wet waste with horticulture waste like dry grass, dry leaves. Bioculumis mixedWet Waste to for accelerate the composting process and Sanitreat is used to control foul odour. OWC machine and its shredders are working satisfactorily without any operational issues.

Use of OWC, Bioculum and Sanitreat has brought efficiency in handling wet waste and reduced the composting cycle to 10 days and eliminating foul odour during composting process. We place on record our appreciation for the M/s EXCEL Industries Limited, for making the composting process easier and efficient.

Thanking you,

Yours truly,

Executive Officer

Municipal Council

Sundernagar Distt.Mandi

Himachal Pradseh

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