Effluent Treatment Plant cum Sewage Treatment Plant (Capacity- 2.0 + 25.0 KLD)

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Abstract: The method of treatment of industrial effluent is treated chemically and gets mix in equalization with domestic effluent (grey water) followed by biological treatment and tertiary treatment to filtration & adsorption column. Sewage water enters to the screen chamber, screen chamber (manually cleaned removable type), should be provided to screen of large floating collection /equalization tank. The effluent from the equalization tank should be made to re-circulate the effluent to enable the content of the effluent screen, and equalization tank, the over ground STP comprises Bio Reactor and Tube Settler. The overflow from the over ground Tube Settler flows by gravity into the Disinfection cum treated effluent holding chamber. ETP cum STP is preferred over to install ETP & STP unit separately. ETP cum STP have common filtration unit along with this benefit of Effluent is undergo biological Treatment & dis-infection. ETP cum STP treatment method is found better where both industrial/process wastewater and domestic/sewage generated because this type of system doesn't need filtration or tertiary treatment facility for each separate treatment scheme. And the influent after treatment by chemical undergoes biological treatment which improves its water quality.

IndexTerms **– industrial waste water, grey water, Effluent Treatment Plant, Sewage Treatment Plant, biological treatment, chemical treatment.**

I. INTRODUCTION

ETP cum STP plays an important role in industries where industrial process effluent & domestic effluent generates. The main function of these plants is to make the water clean which pollutes in industries. The treatment of effluent has become the need of hours as it stops spreading the diseases and illness and demand of fresh water. It helps society in making the water as well as environment clean. The raw effluent contains various toxic organic and inorganic compounds, chemicals, pathogenic microorganisms etc. if they are released into environment without any treatment our natural water bodies will be severely affected by them. As we cannot deny the contribution of industries, institutes, agricultural practice, apartments, etc. We must find a solution to minimize the pollution. For this, the wastewater must be treated before releasing into the environment. Effluent treatment is a process that removes unusual contaminants from wastewater and brings back it to the environment for reuse. The treatment includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce a treated effluent and a solid waste (sludge) which can be reused or discharged into the environment safely. Appropriate and effective treatment system is very crucial.

M/S Motherson Automotive Elastomers Technology (MAE) is a unit of Motherson Sumi Systems Limited is going to install an Effluent cum Sewage Treatment Plant to treat waste water generated from manufacturing process & sewage generation from domestic activities. For this work, they released tender for it and finally we got selected for this work

The quantum of waste water generation from manufacturing process (Cooling tower, Floor Washing, Machine Cooling, etc) shall be around 2.0KLD and quantum of waste water from domestic activities (Toilets, Kitchen, etc) shall be around 23.0KLD
ETP cum STP is preferred over to install ETP & STP unit separately. ETP cum STP have common filtration unit along with this benefit of Effluent is undergo biological Treatment & dis-infection.

II. LITERATURE REVIEW

PHYSICO-CHEMICAL PROCESS

The type of treatment selected depends on the size of particles present in the wastewater. In practice, treatment efficiency also depends on particle size. Solids of the size that are visible to the naked eye can be separated either by settling under the influence of gravity. However, very fine particles of a colloidal nature (called colloids, size < 1 µm) which have high stability are significant pollutants. It is not possible to separate these solids by filtration because they pass through any filter. However, separation by Physico-Chemical Treatments is possible.
Physico-chemical treatment of wastewater focuses primarily on the separation of colloidal particles. This is achieved through the addition of chemicals (called Coagulants and Flocculants). These change the physical state of the colloids allowing them to remain in an indefinitely stable form and therefore form into particles or flocks with settling properties.

Stages of the Physio-Chemical Process Coagulation

Coagulation refers to destabilization or neutralization of the negative charges contained in the wastewater by the addition of a coagulant applied during rapid mixing. The quantity of coagulant applied during coagulation depends on the quality of water (domestic or industrial).

Flocculation

In this stage, previously formed flocks group together, increasing in volume and density, allowing them to be sedimented. During the flocculation stage, chemicals referred to as flocculants are applied (assisted flocculation). These products allow flocks to come together and adhere, increasing their size anddensity.

Sedimentation or clarification

This is the stage of flock removal by solid - liquid separation. For this, low, medium and high rate settlers are commonly used. The rate is determined by the speed at which water and sludge

Treatment Scheme of ETP portion (Individual Units & Process)

The method of treatment of effluent is physiochemical treatment followed by Biological Treatment. In chemical Treatment waste water treated by caustic/lime, alum and polyelectrolyte to settle down the chemical sludge and in biological treatment waste water treated by diffused aeration systems and undergo effluent decomposition.

The individual units of the ETP portion are as follows:

Physical Treatment:

Screen Chamber: Waste water generated should pass through a bar screen chamber for removal of floating matters.

Collection tank: From the screen chamber water should come in to the collection tank. Where it is equalized by air purging grid system.

Chemical treatment:

Chemical Reaction Tank

From the collection tank water should be pumped in the chemical reaction result with a minimum dose. Polyelectrolyte is also added in this tank to hasten the floc formation process. Mixing of chemicals is done with diffused aeration. Air is provided through diffuser pipes from air blower.

Primary Tube Settler

The effluent from the reaction tank should be flows by gravity to the primary settling tank which is a tube settler. Most of the suspended solids & chemical floc settle down in the settling tank. The clear supernatant from the top overflows enters to the biological reactor tank. And chemical settled floc (Sludge) should be drain to the sludge drying beds.

Treatment Scheme of STP (Individual Units & Process):

The method of treatment is physical treatment followed by biological treatment and tertiary treatment to filtration & adsorption column. Sewage water enters to the screen chamber, screen chamber (manually cleaned removable type), should be provided to screen of large floating collection /equalization tank. The effluent from the equalization tank should be made to re-circulate the effluent to enable the content of the effluent screen, and equalization tank, the over ground STP comprises Bio Reactor and Tube Settler. The overflow from the over ground Tube Settler flows by gravity into the Disinfection cum treated effluent holding chamber.

The individual units of the STP are as follows:

Screen Chamber: the waste water generated should be passed through a bar screen chamber for removal of floating matters.

Equalization Tank: From the screen chamber water should be come in the collection tank, where water will be equalized by air purging grid system.

Common units and process of ETP cum STP

Biological Treatment: Effluent water from secondary tube settler and sewage water from sewage collection enters to the Bio Reactor Tank.

Selection of Technology

MBBR (Moving Bed Biofilm Reactor) Technology is the proven process for treatment of Municipal and Industrial wastewater. The MBBR process utilizes a Continuous flow in reactor with complete mixing during the operation & Clarification occurs in the Secondary Tube Settler tank. The system offers great flexibility in comparison with other Activated Sludge Systems.

In MBBR systems, which are carried out in sequence as follows:

- MBBR tank
- React

- Settle (sedimentation/clarification)
- Chlorination
- Filtration

Silent features ofMBBR Technology:

- Small Footprint
- Simple Design.
- Easy to operate
- Suitable for variable Organic and Hydraulic load.
- Biological Nutrient removal.
- A higher degree of operational flexibility with respect to effluent quality and Dissolved Oxygen (DO) controlled aeration system.
- Complete quiescent settling for improved Total Suspended Solids (TSS) removal.
- Proven treatment process capacity upgrades and phasing do not require modification or interruption of current treatment process.
- Significantly smaller footprint requires less site work on yard plumbing.
- Power consumption is typically less than that of a conventional plant with substantial power savings at lower flows (i.e., greater turndown capability)

Fluidized Aerobic Bio Media (FAB): In this biological system, it has to be operated 24 hours. The effluent enters the aeration chamber to oxidize the organic to CO_2 and H_2O by aeration principle. Aeration tank is fitted with suitable capacity of air diffusers to provide a minimum of 2ppm of dissolved oxygen and Bio Media to maintain the perfect contact time for biological reaction and bacteria growth.

Tube Settler: Then water should be come from the Bioreactor to secondary Tube Settler where Sludge settled. The settled sludge of the settling tank is moved to the sludge drying beds.

Dis - Infection Tank: The water from tube settler should be collected in to the disinfection tank, where shot dosing (1 PPM) of sodium Hypo chlorite is given.

Tertiary Treatment Units: Tertiary treatment units like filtration. In the multi grade filter column the TSS Level would be reduced 5- 10% and in the activated carbon filter the odour & colour of waste water.

Drying & Disposal of Sludge: The biological sludge is collected in sludge Holding Tank. The sludge from the Sludge holding tank is disposed off at outside area or it should be used as manure by further Treating and the filtrate from the sludge holding tank returns to the collection tank.

III. METHODOLOGY

DESIGN BASIS OF EFFLUENT TREATMENT SYSTEM

The proposed ETP unit is designed to treat industrial effluent with following Characteristics:

Operating Hours: 20
Process type: Physicochemical treatment
Nature of Effluent: industrial effluent

Daily Average Flow: 1.5 KLD

ETP unit Capacity design: 2.0KLD

Waste water generated from: Cooling tower, machine cooling, process, washing etc

S. No.	Parameter	Unit	Trade Effluent
1.	Plant Capacity	KLD	2.0
2.	pH		3 to 9
3.	BOD	mg/l	200-300
4.	COD	mg/l	1500-2050
5.	TSS	mg/l	500-800
6.	Oil & Grease	mg/l	30-50

Tab 3.1 Raw Water Parameters (Nature of wastewater: Industrial Effluent)

S. No.	Parameter	Unit	Trade Effluent
1.	Flow	KL/day	2.0
2.	PH		6.5- 7.5
3.	BOD	mg/l	<20
4.	COD	mg/l	<150
5.	TSS	mg/l	<50
6.	TDS	mg/l	<2100
7.	Oil & Grease	mg/l	<10

Tab 3.2 Treated Effluent Parameter (According to CPCB & SPCB Norms)

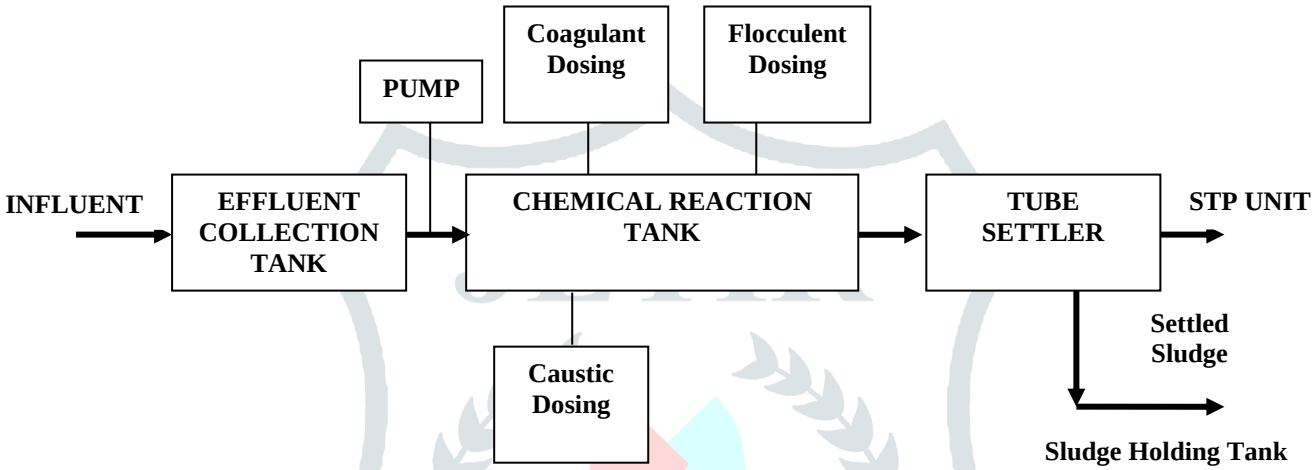

Fig. 3.1 Process block diagram of Effluent treatment Plant

DESIGN BASIS SEWAGE TREATMENT PLANT

The proposed STP is designed to treat domestic sewage with following Characteristics:

Operating Hours: 20
Process type: Moving Bed Bio Reactor (MBBR)
Nature of Effluent: Domestic Sewage
As per Central Ground Water Authority Water consumption in an industry per employee: 45lpcd
Total No of Employees: 500
Total Water Demand: 22.5KLD
Estimated Sewage Generation: 22.5 X 90% = 20.25KLD
Daily Average Flow: 20.25 KLD
STP unit Design Capacity: 25.0KLD

SN.	Parameters	Raw sewage	Treated water (After ACF)
1	pH	7.5	7.0 - 7.5
2	BOD	250 PPM	<20 PPM
3	COD	450 PPM	<150 PPM
4	TSS	300 PPM	<50 PPM
5	Oil and Grease	10 PPM	<10 PPM
6	TDS	2100 PPM	<2100 PPM

Tab 3.3 STP assumed parameters of inlet & outlet (outlet parameters as per NGT OA 1038/2018)

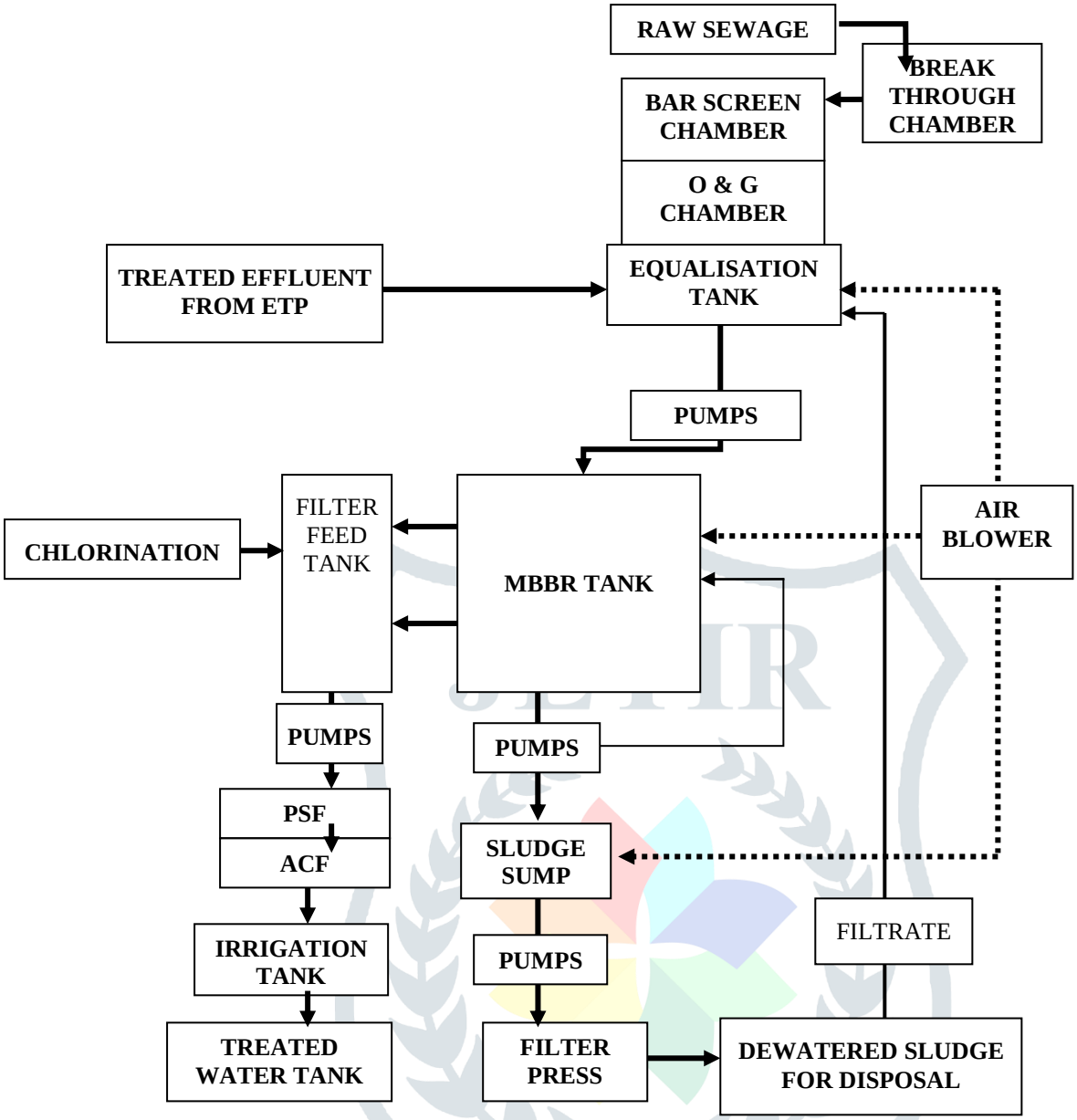

Fig. 3.2 Process Block Diagram of the STP unit

IV. DESIGN CRITERIA FOR ETP cum STP

Bar Screen

1. Flow velocity through screen maximum 0.3m/sec
2. Solid to be captured 12mm or more
3. Placement of a coarse screen before the fine screen will be beneficial

Collection Tank of ETP unit

Minimum Detention time: 6-8hrs (to handle peak flow)

O &G Trap Chamber

Minimum Detention time: 2.0-3.0hrs (to trap FOG)

Equalization Tank

1. Minimum Detention time: 6-8hrs (to handle peak flow)
2. Air for mixing and avoid settling septicity.
3. Air Flow $1m^3/m^3$ of tank volume.

Raw Effluent Lifting Pump & Sewage Lifting Pump

Capacity calculated based on 20 hrs. /day working of STP, to leave sufficient margin for change over, maintenance rest periods etc.

Reaction Tank

Minimum Detention time: 0.30hr (to mix chemicals thoroughly)

Primary Tube Settler

Minimum Detention time: 2-2.5hrs (to allow settling of suspended solids)

Aeration or MBBR Tank

1. Design BOD 250mg/l
2. Aeration time 8-12hrs
3. F/M ratio 0.12 (to achieve over 95% removal of BOD)
4. MLSS 3500mg/l
5. Air 50-60m^3/hr/kg BOD
6. Diffuser Flux Rate 8-12m^3/running meter/hr

Secondary Tube Settler

1. Overflow rate 12-18m^3/m^2/day
2. Detention time 2.5-3.0 hrs.
3. Solid Loading 2-3kg/m^2/hr
4. Weir Loading less than 50m^3/running meter/day

Pressure Sand Filter

Loading rate less than 12m^3/m^2/hr.

Activated Carbon Filter

1. Loading rate 10m^3/m^2/hr.
2. Carbon charge for 6-8 months replacement.

Hypo Dosing

5ppm dosing to leave 0.5-2.0ppm residual

Excess Sludge

0.25-0.25 kg excess solids per kg BOD removed (dry basis)

Sludge Conditioning

1. 0.8-1.2 kg lime per kg dry activated sludge.
2. 1-2% polymer to sludge on dry weight basis.

V. DESIGN AND DETAILS OF INDIVIDUAL UNITS

Detail of the civil different units in the ETP cum STP

Details of civil					
S.N.	Units	Size	No.	MOC	Volume (m^3)
1.	Break Through Chamber	0.8x1.0x1.0M	01	RCC	0.8
2.	Screen Chamber	0.6x1.0x0.7 M	01	RCC	0.42
3.	Oil & Grease Trap	1.0x1.0x1.5M	03	RCC	4.5

4.	Collection for ETP	1.85x1.0x1.5M	01	RCC	2.775
5.	Equalization for STP	3.0x3.0x3.0M	01	RCC	27.00
6.	Foundation for Unit	7.3x4.35M	01	RCC	Area-31.75m^2

UNIT DETAIL OF ETP

UNIT: EFFLUENT COLLECTION TANK			
Length	1.85 m	Construction	RCC
Width	1.0 m	Quantity	01 No.
Depth	1.5 m		

EQUIPMENT: RAW EFFLUENT PUMP			
Quantity	2 no. (1W+1S)	Type	Centrifugal self-Priming
Flow	0.5 m^3/h	MOC	Cast Iron
Head	12m		

UNIT :CHEMICAL REACTION TANK			
Volume	0.75 m^3	Air mixing	Through Air grid
MOC	MS-FRP (inside)	Quantity	01 No.
PE Dosing system	HDPE tank of 100 Lt.	PE dosing Pump	0-20 LPH, 1 no.
ALUM Dosing system	HDPE tank of 100 Lt.	ALUM dosing Pump	0-20 LPH, 1 no.
CAUSTIC Dosing System	HDPE tank of 100 Lt.	CAUSTIC Dosing Pump	0-20 LPH 1no.

UNIT : PRIMARY SETTLING TANK			
Settling Area	1.8 m^2	Type	Tube Type
Settling media	Tube Deck Type	Modules	PVC
MOC of tank	MS-FRP (inside)		

UNIT DETAILS OF STP

Unit: BREAK THROUGH CHAMBER			
Screen type	REDUCE TURBULENCE		
Quantity	01 No.	Length	0.8m
Width	1.0 m	Designed velocity	1.25 m^3/hr

Depth	1.0 m		
MOC	SS		

Unit: BAR SCREEN			
Screen type	Coarse & Fine Screen		
Quantity	02 Nos.	Clear spacing	6 mm
Width	1.0 m	Designed velocity	0.3 m/s
Depth	0.7 m	Screen	1.0 X 0.7m
MOC	SS		

Unit: OIL & GREASE TRAP			
Process	Grit removal by settling and trapping of floating Oil & Grease at baffle wall		
Length	1.0 m	Quantity	3.0
Width	1.0 m	Construction	RCC
Depth	1.5 m	Cleaning	Automatically

UNIT : EQUALIZATION TANK			
Construction	RCC	Air Supply	Through Air Grid
Length	3.0 m	Aeration	Perforated Air Grid
Width	3.0 m	Location for grid	ottom of tank to cover entire surface
Depth	3.0 m		
Quantity	01 No.		

EQUIPMENT : RAW SEWAGE TRANSFER PUMPS			
Quantity	2 Nos.(1W+1S)	Type	entrifugal self- priming
Flow rate	1.25 m^3/hr	MOC	Cast Iron
Head	12m	Drive	Coupled to motor

EQUIPMENT : RAW SEWAGE LIFTING PUMPS			
Quantity	2 Nos.(1W+1S)	Type	Vertical Cutter Pump
Flow rate	1.25 m^3/hr	MOC	Cast Iron
Head	12m	Drive	Inbuilt motor
UNIT : MBBR TANK			
MOC	MS with FRP	No. of Chambers	2

length	1.50 m	Aeration	Fine bubble Diffuser
Width	1.50 m	Designed	25KLD
Depth	3.0 m	MBBR media MOC	PVC
Air Grid	Bubble diffuser	Type	fine

EQUIPMENT: AIR BLOWER			
Air Flow	40 m^3/hr	Quantity	2 Nos. (1W+1S)
MOC	Cast Iron	Type	Twin type Positive displacement

EQUIPMENT: SLUDGE RE-CIRCULATION PUMP			
Quantity	2 Nos.	Flow	0.5m3/hr
Type	Centrifugal	Head	12 m
MOC	CI	RPM	2900

UNIT: CHLORINE CONTACT TANK			
Volume of tank	4.5m^3	Disinfectant	Free Chlorine
Chlorine Dosage	4 ppm	Process of dosing	Hypo solution through dosing pump
Solution making tank	1	Solution tank volume	100 Lt./HDPE
No. of Dosing pumps	1	Pump capacity	0-6 Lph
Pump MOC	PP		

EQUIPMENT: FILTER FEED PUMPS			
Quantity	2 Nos. (1W+1S)	Flow	1.25 m^3/hr
Type	Centrifugal Mono block	Head	25 m
MOC	CI		

EQUIPMENT: MULTI GRADE FILTER			
Quantity	01 No.	Dia	500mm
Flow Rate	1.25 m^3/hr	MOC	MS

EQUIPMENT : ACTIVATED CARBON FILTER			
Quantity	01 No.	Dia	500mm
Flow Rate	1.25 m^3/hr	MOC	FRP
Principal Media	Activated carbon		

UNIT:SCREW PUMP			
Flow	1.0m^3/hr	Feed Pump Quantity	2 (1W+1S)
Instrumentation	1		

EQUIPMENT : FILTER PRESS			
QUANTITY	1 No.	Type	Manual Screw
Capacity	350ltr	MOC	MS body, PP PLATE 10 chamber

EQUIPMENT : OIL SKIMMER			
QUANTITY	1 No.	Type	Motorized coupled with gearbox
Capacity	20 LPH	MOC	MS body, Fuzzy-poly belt

UNIT : SLUDGE HOLDING TANK			
Length	0.5 m	Quantity	01 No.
Width	1.0 m	Construction	MS with FRP
Depth	3.0 m		

EQUIPMENT : IRRIGATION PUMP			
Quantity	2 Nos.	Type	Non clogging type submersible
Flow rate	1.25 m^3/hr	MOC	Cast Iron
Head	22 m	Drive	Coupled to motor

EQUIPMENT: MEASURING INSTRUMENTS			
Pressure	Pressure Gauge	Pressure sensing	By diaphragm
Type	Bourdon's tube/Glycerin filled	Dia. of dial	100 mm
Location	Outlet of Pumps & Blower		

Water Level	Level Control Switch	FLOW METER	02
Type	Liquid Bouncy	PH METER	02
Location	With pumps in respective tanks		

VI. CONCLUSIONS

The Wastewater generated from MAE unit, Sector 59, Noida, Dist. Gautam Budh Nagar, U.P. is going to treated by 2.0 + 25 KLD ETP cum STP. The Treatment is carried out by chemical treatment in ETP module and biological decomposition of organic matter in MBBR Reactor which is a continuous process. MBBR reactor will be operated to oxidize carbonaceous bio-chemical oxygen demand (BOD), Nitrify the Ammonia and denitrify to reduce total nitrogen to a level that meets the permit limits. The Treated water from MBBR reactor is overflow to the Secondary tube settler which allows the settling of suspended solids clear water moves to the filter feed tank and settled sludge return to the MBBR reactor to maintain MLSS, and excess sludge undergo its dewatering disposal treatment. The treated water from filter feed tank is pumped through the pressure sand filter and activated carbon filter for removal of suspended solids, final polishing and removal of any traces of color. The effluent is then disinfected with sodium hypochlorite by intermittent dosing system and passing effluent through UV lamps. The treated water can be used for flushing, gardening, chilling & washing purpose. The excess sludge fed to the filter press for dewatering and drying.

TOTAL WORKING & CONNECTED ELECTRIC LOAD

ELECTRICAL LOAD					
SR NO	DISCRIPTION	DUTY	CAPACITY	WORKING LOAD (HP)	CONNECTED LOAD (HP)
1	RAW EFFLUENT PUMP	1W+1S	0.2 m3/hr at suitable 12m head	0.5	1.0
2	PE DOSING PUMP	1W	0-20 LPH	0.05	0.05
3	ALUM DOSING PUMP	1W	0-20 LPH	0.05	0.05
4	CAUSTIC DOSING PUMP	1W	0-20 LPH	0.05	0.05
5	SEWAGE TRANSFER PUMP	1W+1S	1.25M^3/HR at suitable 12m head	1.0	2.0
6	EWAGE LIFTING PUMP	1W+1S	1.25M^3/HR at suitable 12m head	1.0	2.0
7	SLUDGE RECIRCULATION PUMP	1W+1S	0.5M^3/HR at suitable 12m head	0.5	1.0
8	FILTER FEED PUMP	1W+1S	1.25M^3/HR at suitable 25m head	1.5	3.0
9	AIR BLOWER	1W+1S	40.0M^3/HR	1.5	3.0
10	CHLORINE DOSING PUMP	1W	0-6 LPH	0.05	0.05
11	OIL SKIMMER	1W	300 LPH	1.0	1.0
12	PH METER	2W	0-14 PH RANGE	0.05	0.1

13	ELECTRO-MAGNETIC FLOWMETER	2W	0-5M^3/HR	0.15	0.3
14	SCREW PUMP	1W+1S	1.0M^3/HR	1.0	2.0
TOTAL				8.4	15.6

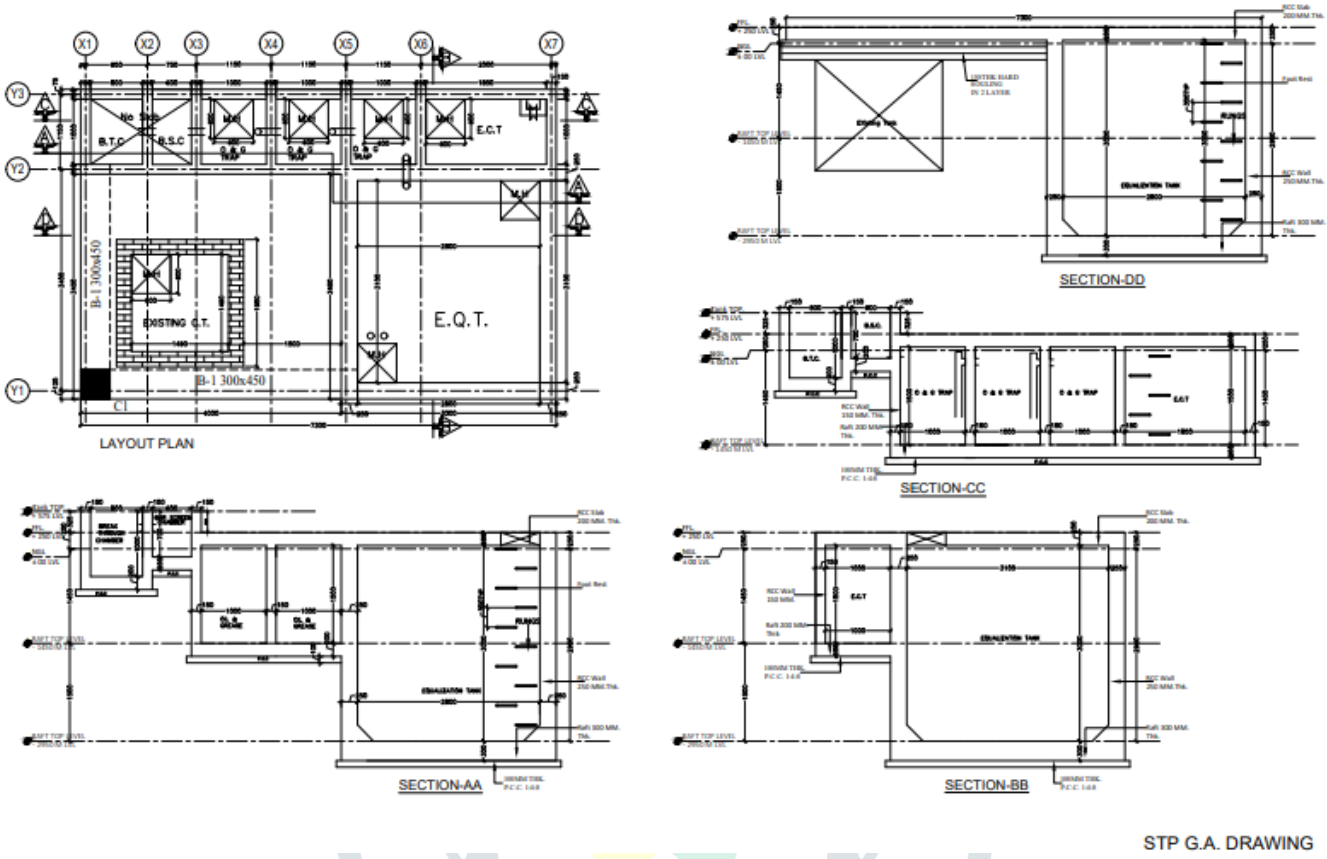

Fig.6.1 GA drawing of Civil Tanks of Effluent and STP unit

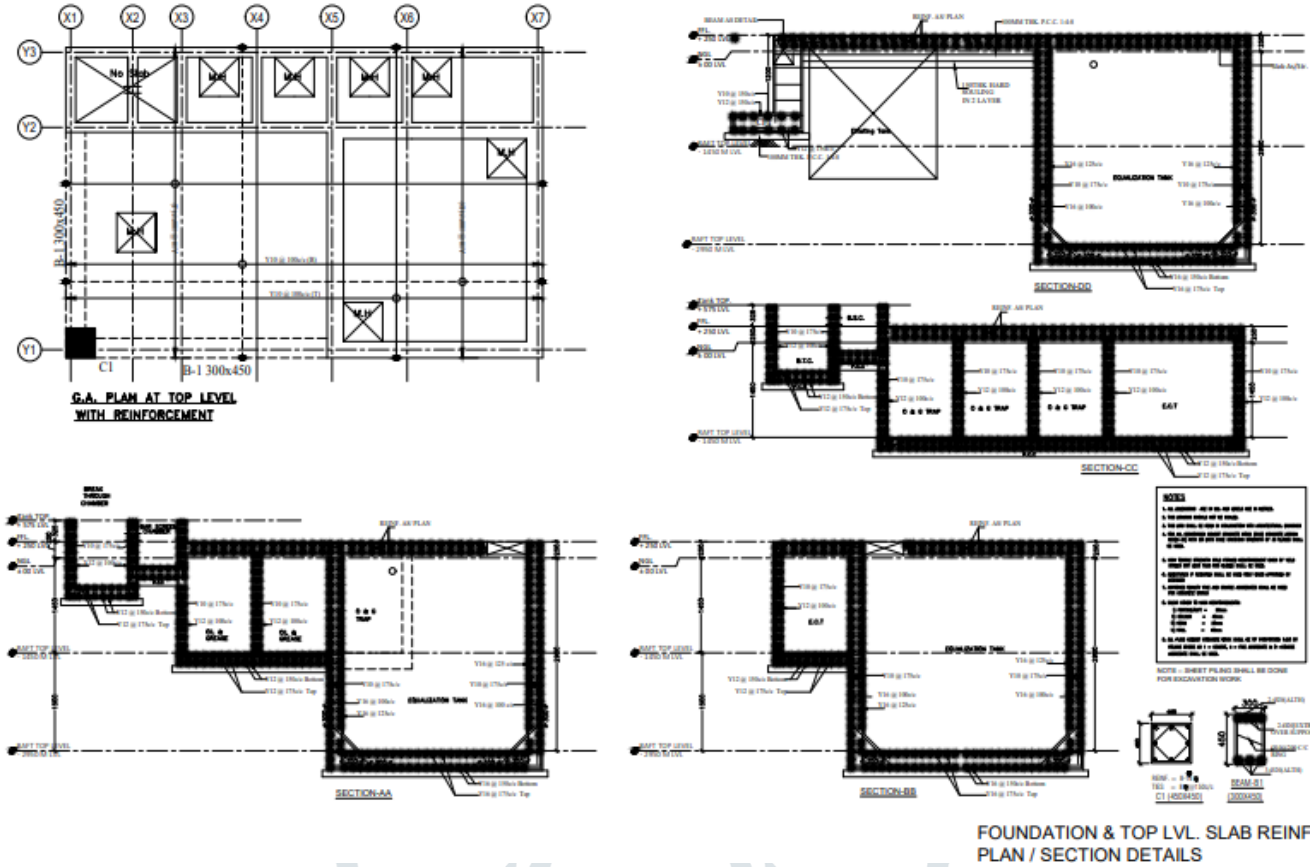

Fig.6.2 Structural Drawing of tank of Effluent and STP unit

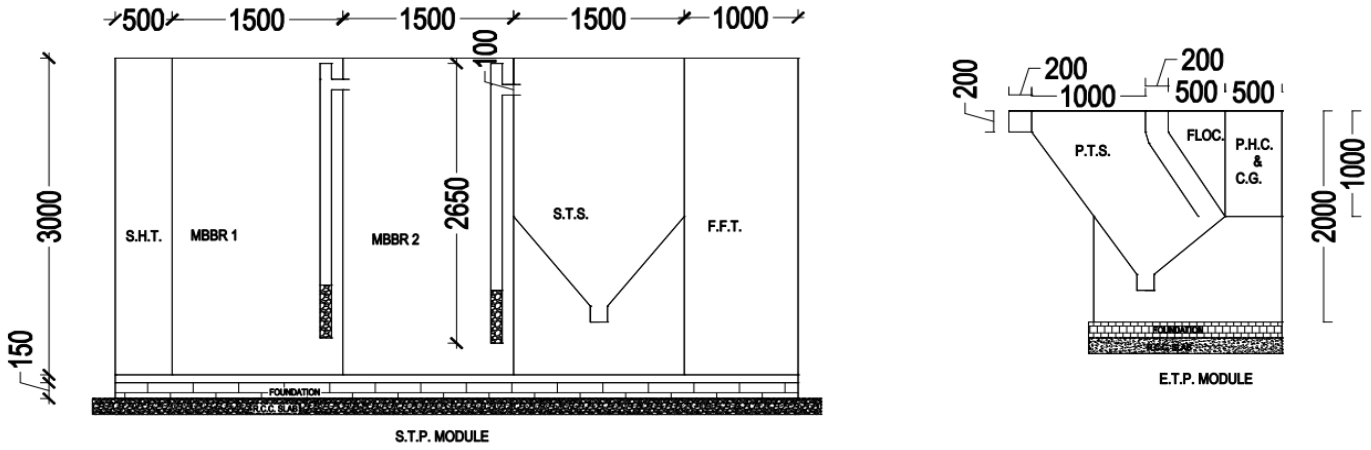

Fig. 6.3 STP & ETP module layout

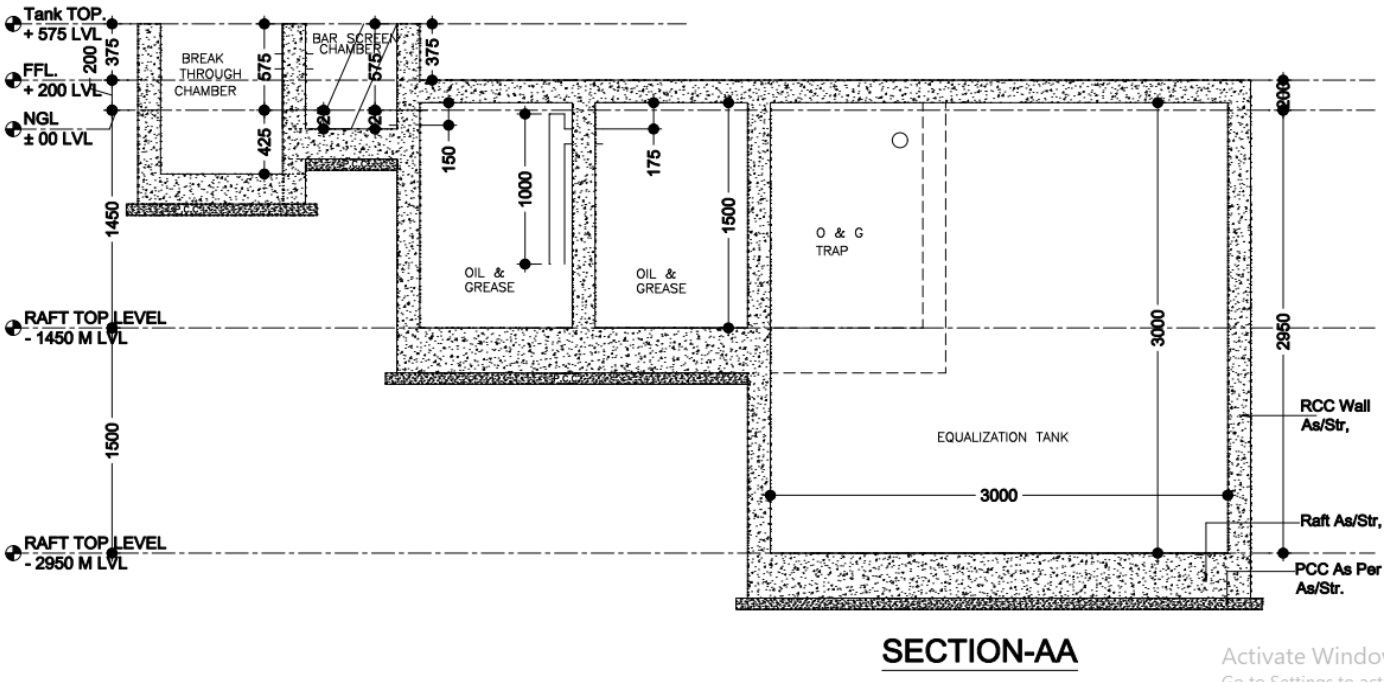

Fig. 6.4 Section A-A

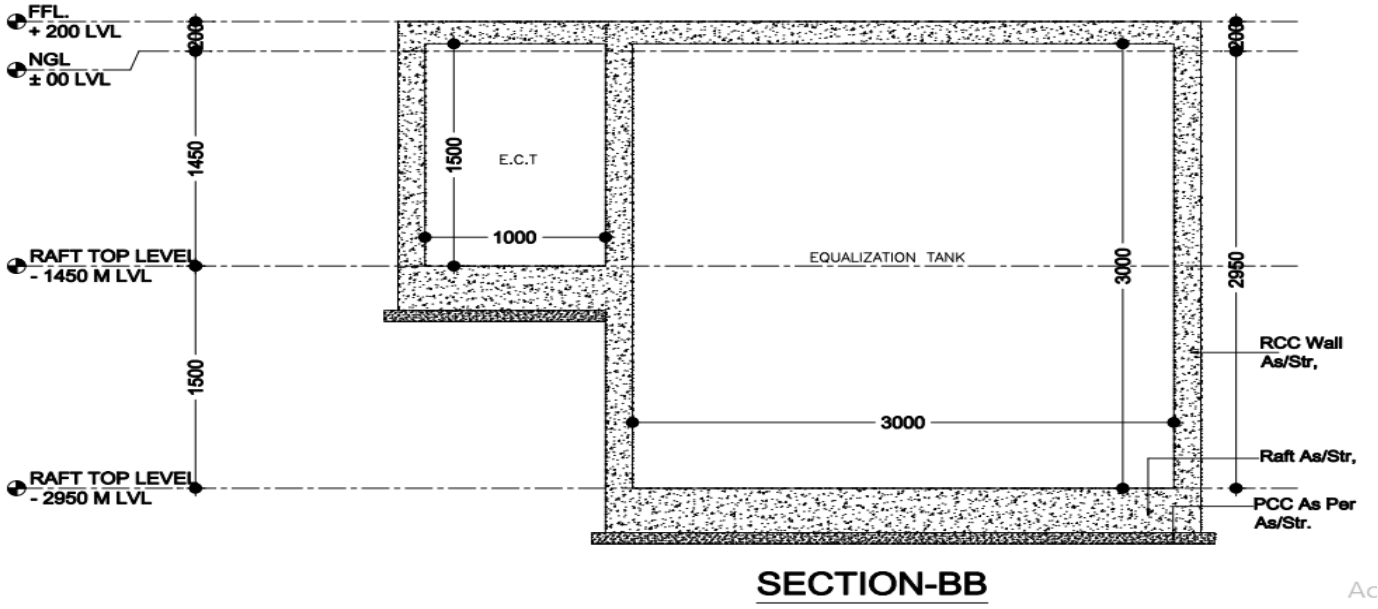

Fig. 6.5 Section B-B

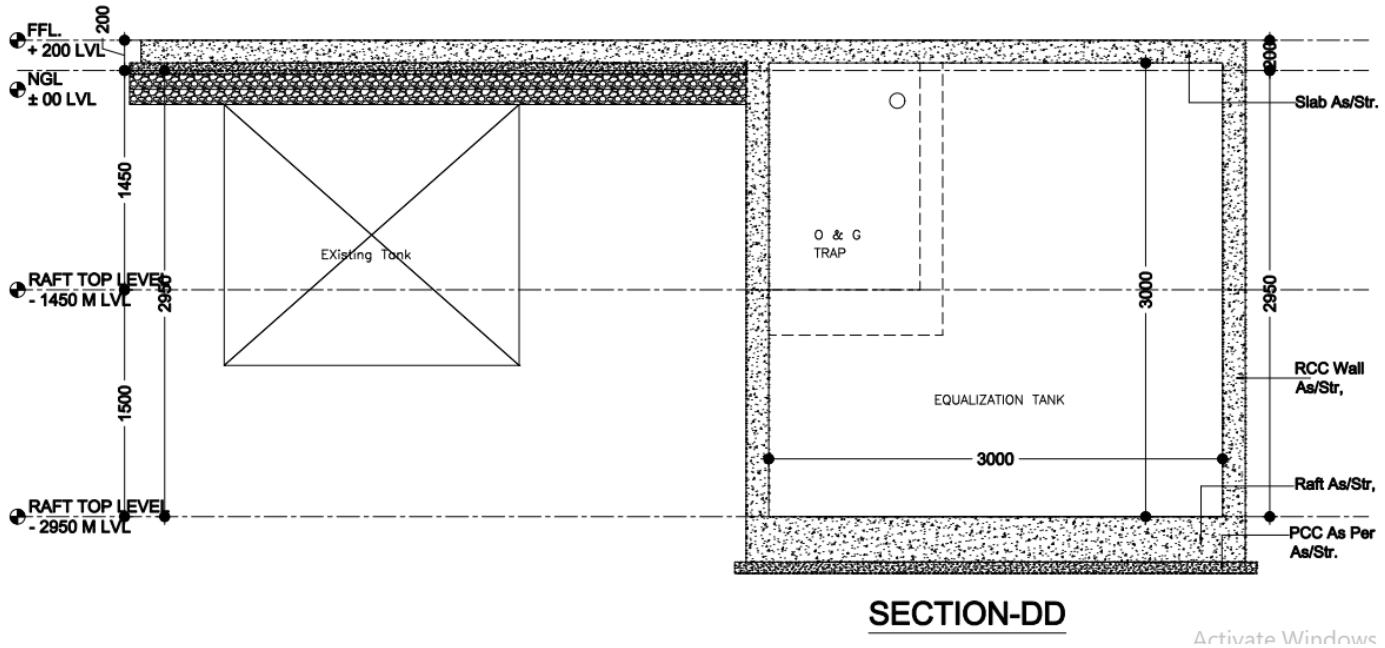

Fig. 6.6 Section D-D

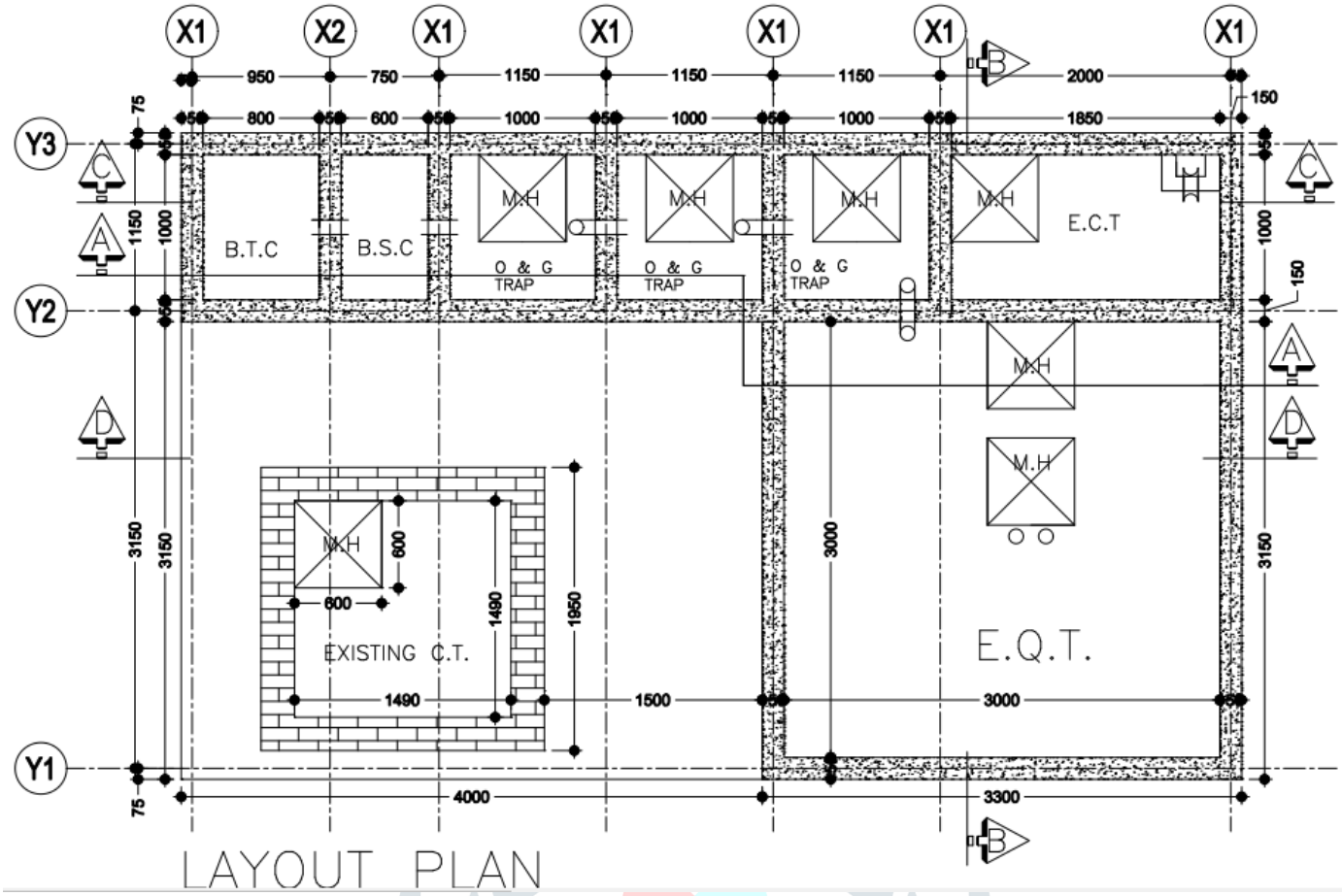

Fig. 6.7 Layout plan of Tanks

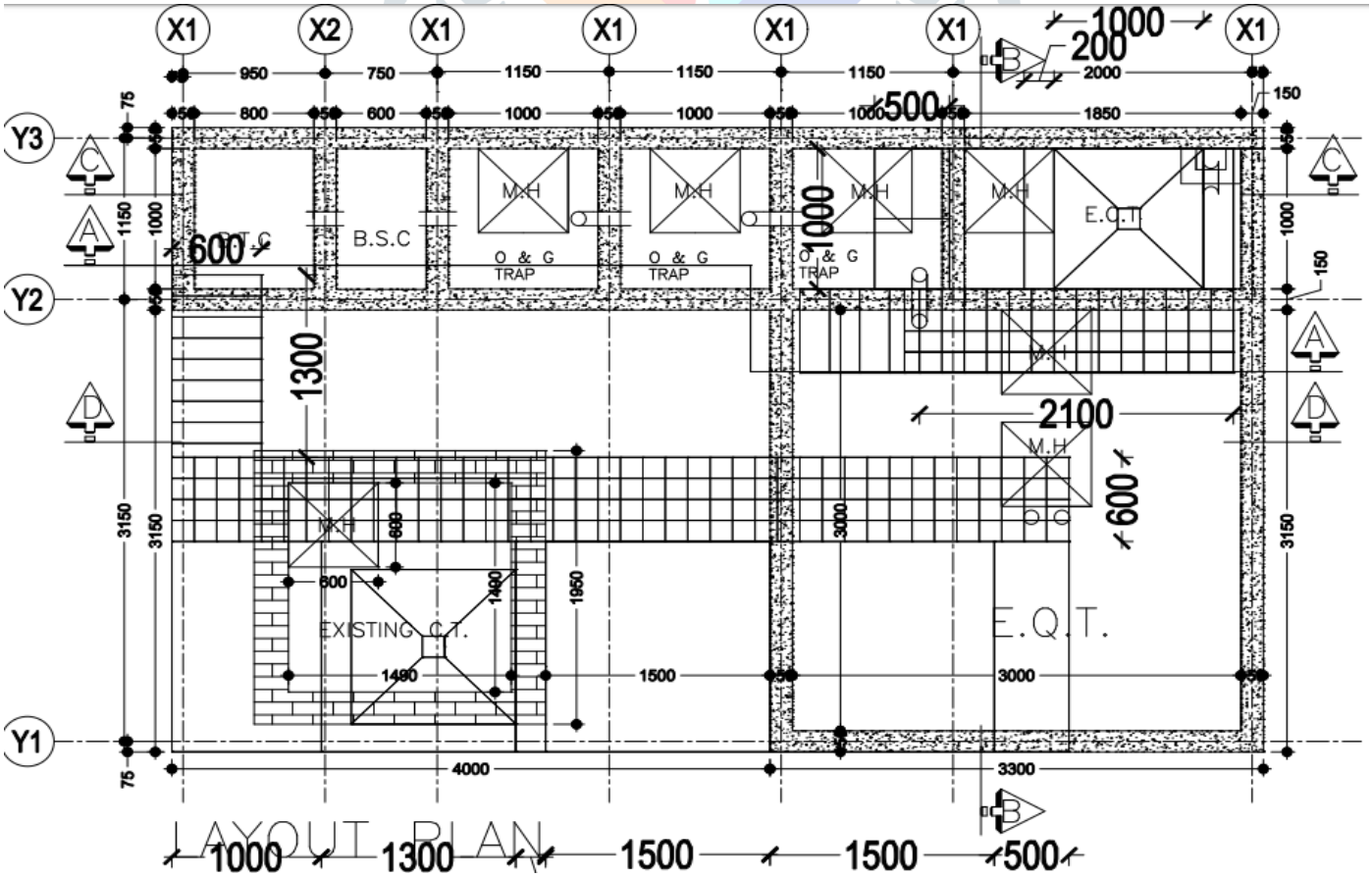

Fig. 6.8 layout of MS Tank over RCC Foundation

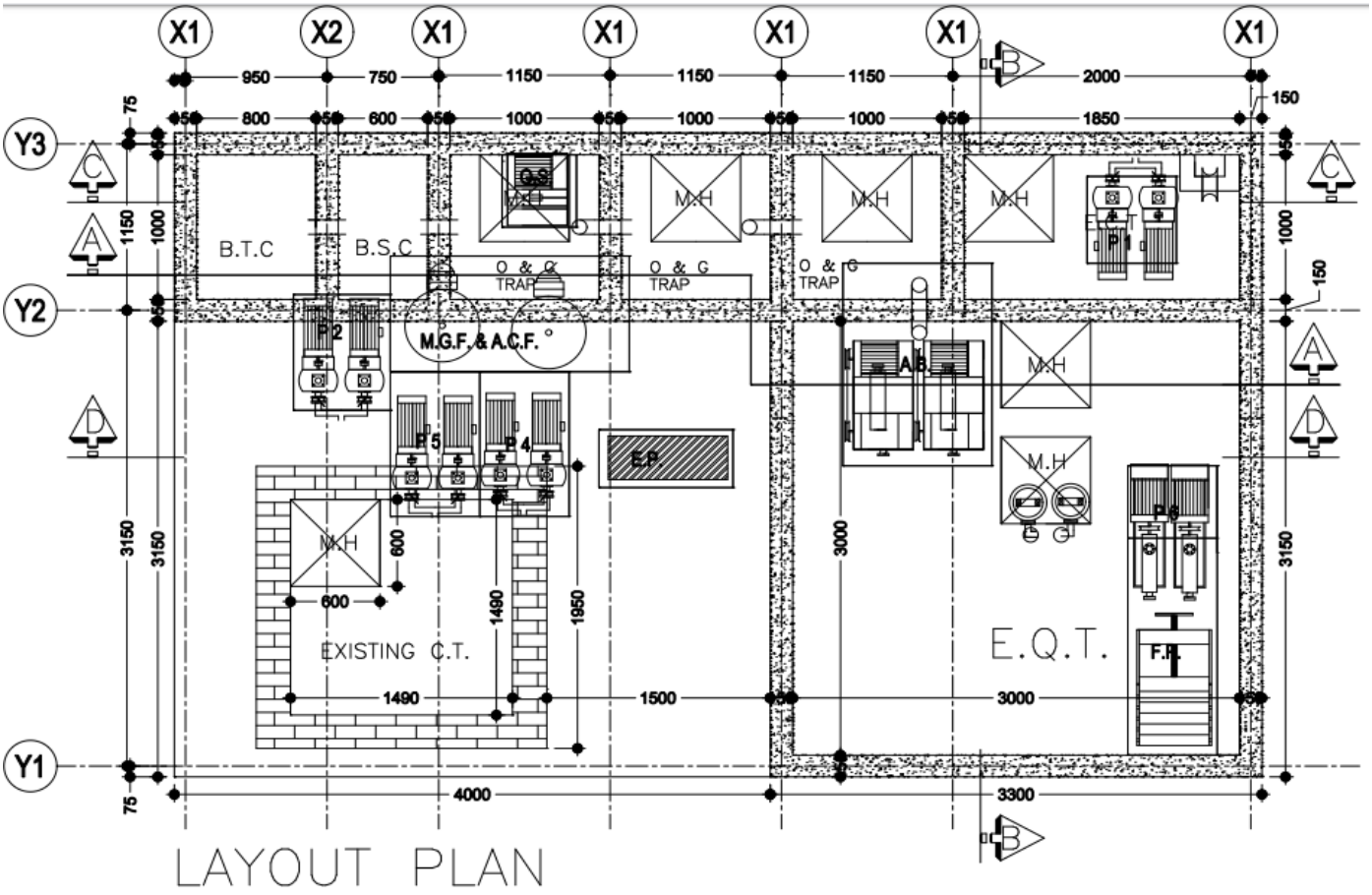

Fig. 6.9 Plant and Machinery Layout

VII. ACKNOWLEDGEMENTS

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