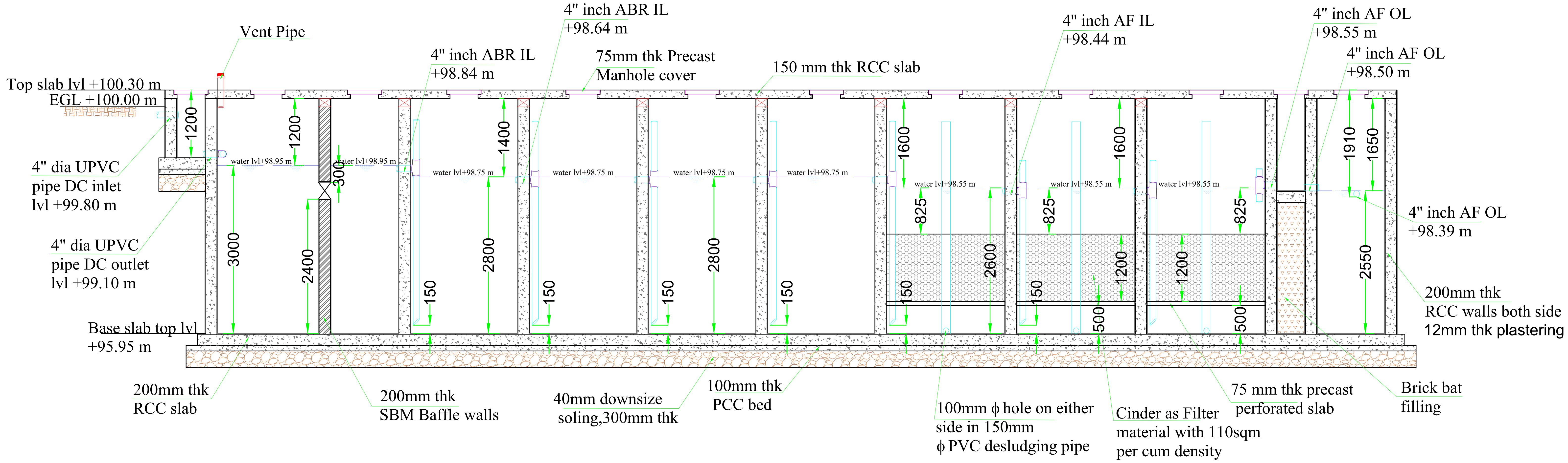
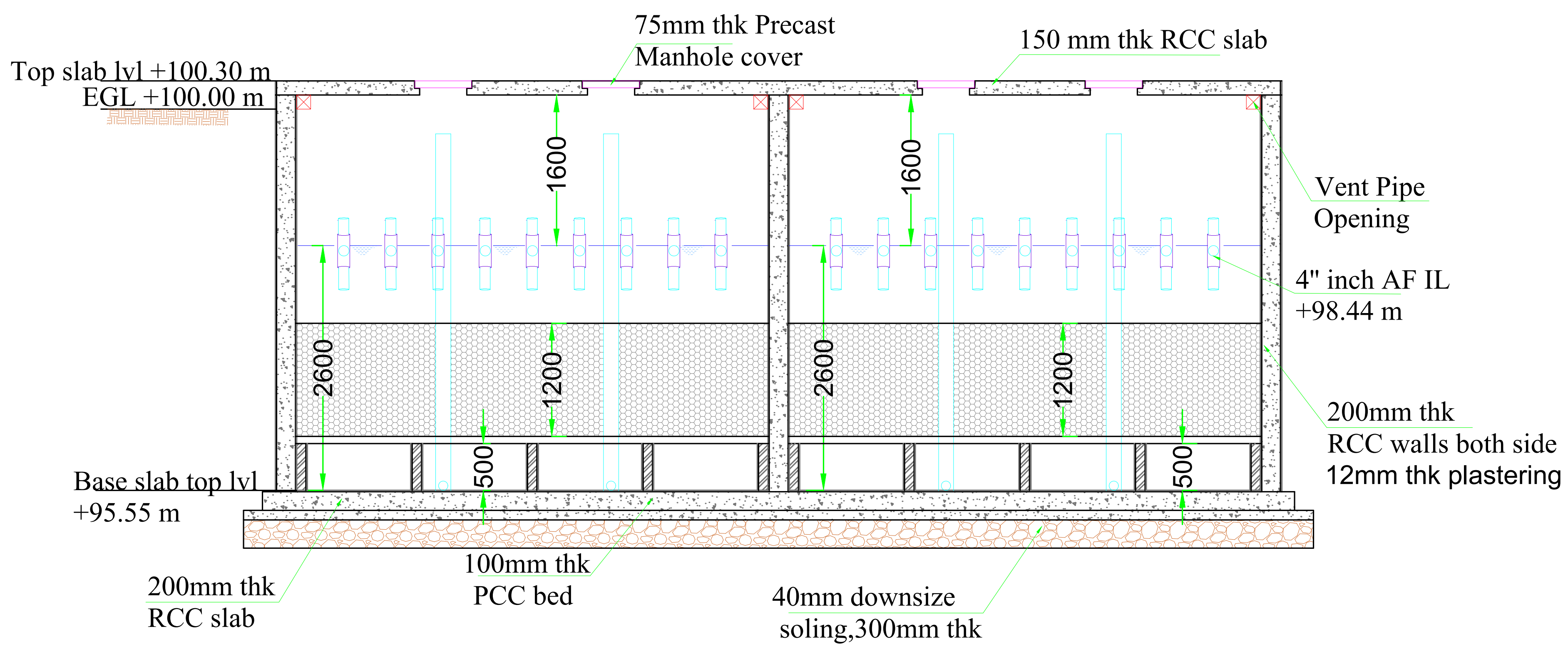
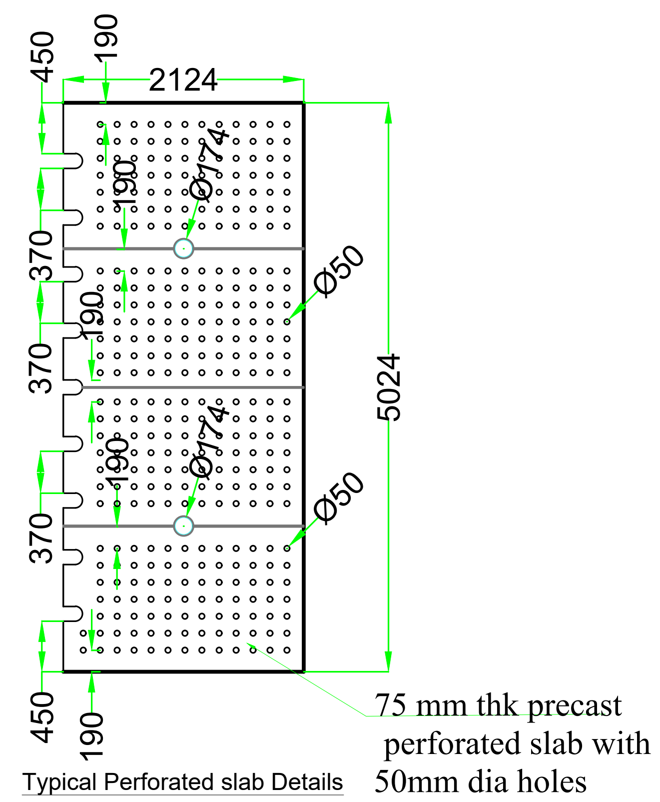


Cross Section @ A-A



Cross Section @ D-D



Typical Perforated slab Details

DWATS

NOTES

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6. FGL = Finished Ground Level
7. HFL = High Flood Level
8. IL/OL = Inlet level/Outlet Level.
9. FTL = Full Tank Level
10. TSL = Top Slab Level
11. Grade of concrete proposed (M15, M20). It is recommended to use Sulphate Resistance Cement (SRC).
12. 'R' indicates Register;
ABR indicates Anerobic Baffle Reactor
'AF' indicates Anaerobic Filter;
'CT' indicates Collection Tank
13. Use UPVC pipes (55mm, 110mm & 150 mm dia (2", 4" & 6")) which can withstand pressure of 6kg/cm².
14. Bench Mark = As per the layout plan provided

REVISIONS

DATE	REMARKS	SIGNATURE

TITLE
Settler ABR , AF,Acration Tank & Collection tank Section-AA &DD

DRG. No.
Dw/No:-02

CLIENT:
Navodaya Medical College at Raichur

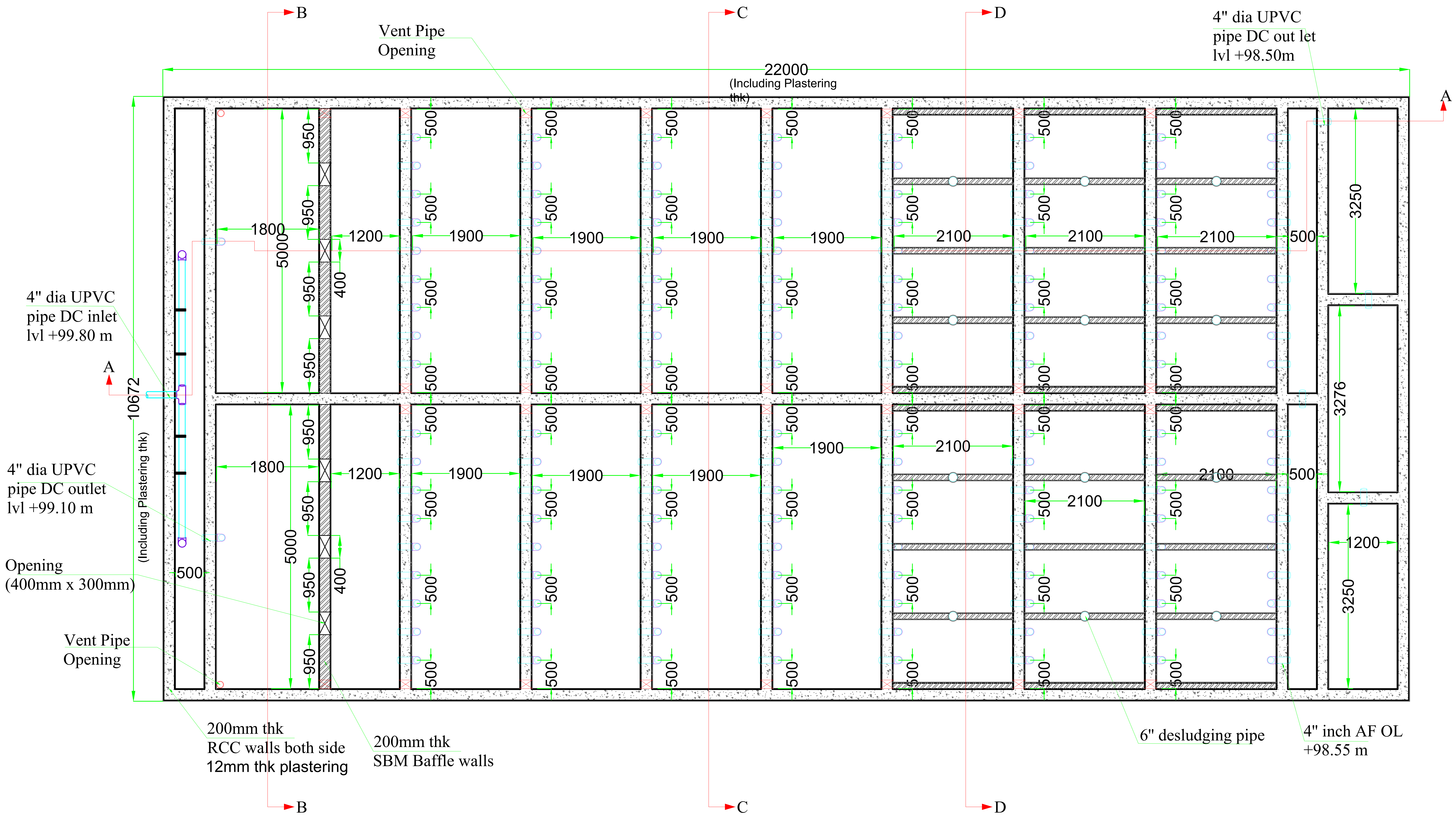
CONSULTANT:

Global Technologies at Bangalore

HQ.. # 306,
13th Cross,2nd Stage ,Pipeline Road,
Mahalakshmipuram,Bengalore - 560 086

DRAWN BY	CHECKED BY	APPROVED BY
Madhu.V	Shahapuri	Babasaheb
DATE	DATE	DATE
18-09-2019	18-09-2019	18-09-2019

SCALE: NTS SHEET 02



Sectional Plan of Settler ABR , AF,Acration Tank & Collection tank

DWATS

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14. Bench Mark = As per the layout plan provided

REVISIONS

DATE	REMARKS	SIGNATURE

TITLE
Settler ABR , AF,Acration Tank & Collection tank plan

DRG. No.
Dw/No:-01

CLIENT:
Navodaya Medical College at Raichur

CONSULTANT:

GLOBAL Technologies

Global Technologies at Bangalore

HQ.. # 306,
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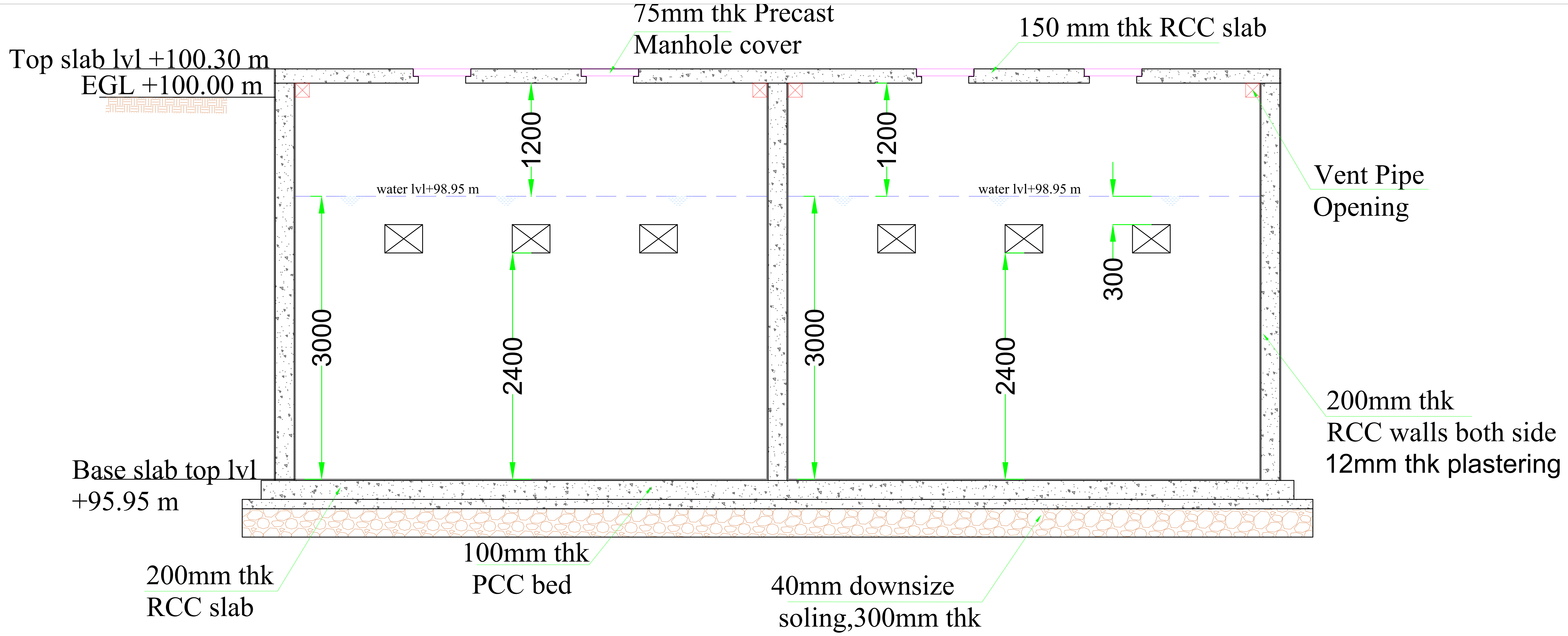
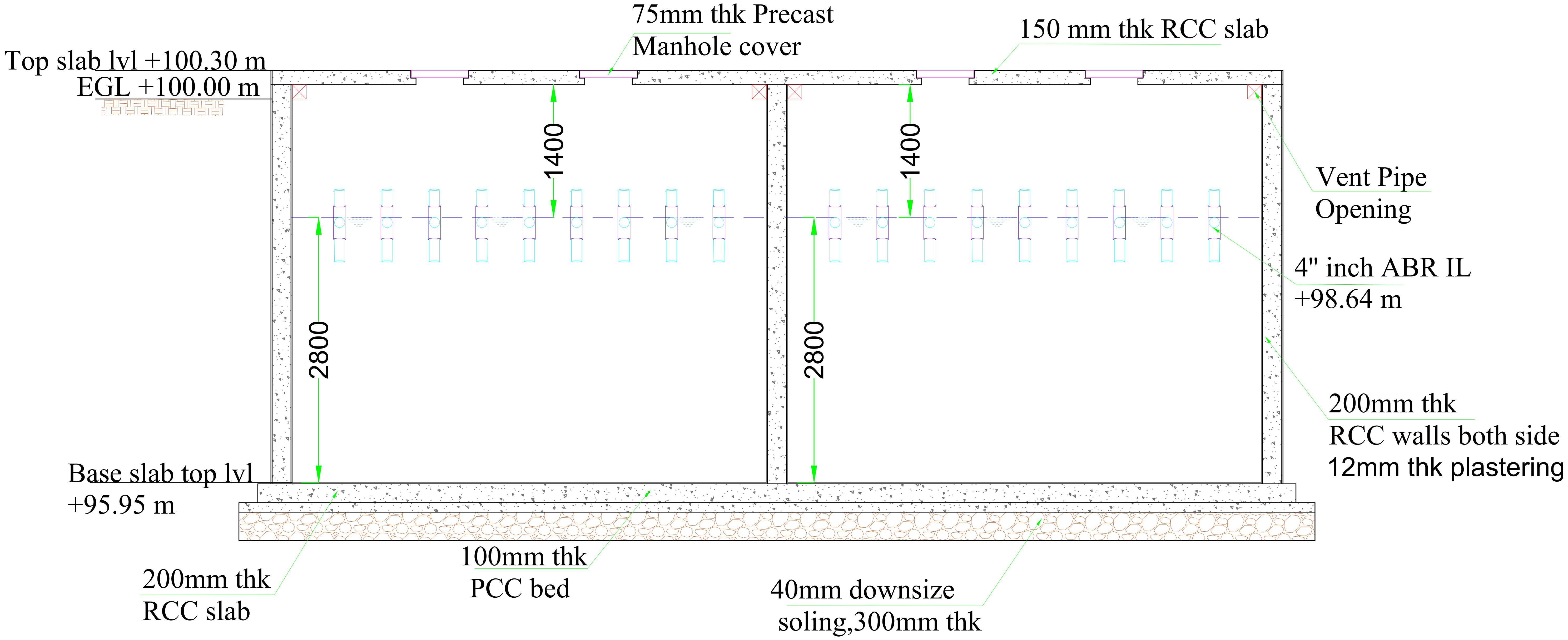
DRAWN BY	CHECKED BY	APPROVED BY
Madhu.V	Shahapuri	Babasaheb
DATE	DATE	DATE
18-09-2019	18-09-2019	18-09-2019

SCALE: NTS | SHEET 01



Cross Section @ B-B



Cross Section @ C-C

DWATS

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'AF' indicates Anaerobic Filter;
'CT' indicates Collection Tank
13. Use UPVC pipes (55mm, 110mm & 150 mm dia (2", 4" & 6")) which can withstand pressure of $6 kg/cm^2$.
14. Bench Mark = As per the layout plan provided

REVISIONS

DATE	REMARKS	SIGNATURE

TITLE
Settler ABR , AF,Acration Tank & Collection tank Section-BB &CC

DRG. No.
Dw/No:-03

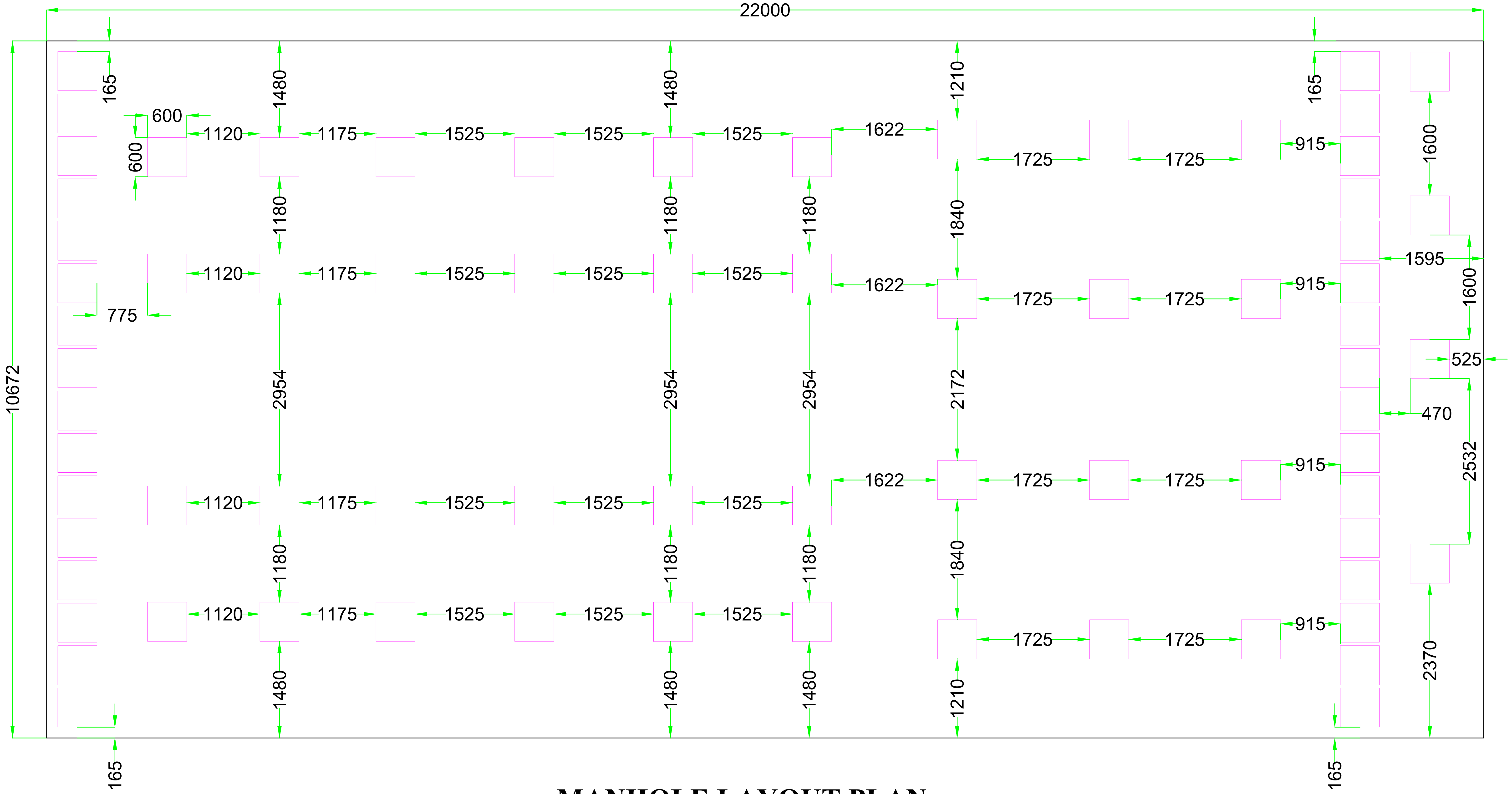
CLIENT:
Navodaya Medical College at Raichur

CONSULTANT:

Global Technologies at Bangalore
HQ.. # 306,
13th Cross,2nd Stage ,Pipeline Road,
Mahalakshmipuram,Bengalore - 560 086

DRAWN BY	CHECKED BY	APPROVED BY
Madhu.V	Shahapuri	Babasaheb
DATE	DATE	DATE
18-09-2019	18-09-2019	18-09-2019

SCALE: NTS
SHEET 03



MANHOLE LAYOUT PLAN

Manhole Covers Details

72 nos. (600mm x 600mm) (75mm thk Precast RCC cover)

DWATS

NOTES

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    'CT' indicates Collection Tank
13. Use UPVC pipes (55mm, 110mm & 150 mm dia (2", 4" & 6")) which can withstand pressure of 6kg/cm².
14. Bench Mark = As per the layout plan provided

REVISIONS

DATE	REMARKS	SIGNATURE

TITLE
Manhole layout plan

DRG. No.
Dw/No:-04

CLIENT:
Navodaya Medical College at Raichur

CONSULTANT:

Global Technologies at Bangalore

HQ.. # 306,
13th Cross,2nd Stage ,Pipeline Road,
Mahalakshmipuram,Bengalore - 560 086

DRAWN BY	CHECKED BY	APPROVED BY
Madhu.V	Shahapuri	Babasaheb
DATE	DATE	DATE
18-09-2019	18-09-2019	18-09-2019

SCALE: NTS | SHEET 04

PROCESS DESIGN

1. Source of water : Sewage waste water
2. System capacity : 225 KLD
3. Operating hour : 24 hours
4. Area required : 1500 - 2000 Sq. feet
5. Technology : Decentralized Wastewater Treatment System (DEWATS) Based, i.e., a combination of settler, Anaerobic baffled Reactor and filtration units.

CHARACTERISTICS OF RAW EFFLUENT

The characteristics of the raw Effluent assumed are given below:

Sl.No	Parameters	Unit	Value
1	Biological Oxygen Demand (BOD)	mg/l	200-250
2	Chemical Oxygen Demand (COD)	mg/l	350-425
3	Total Suspended Solids (TSS)	mg/l	250-375
4	Oil and Grease	mg/l	50-60
5	pH	-	6-9

CHARACTERISTICS OF TREATED EFFLUENT

The required characteristics of treated Effluent water as per PCB are given below:

Sl.No.	Parameters	Unit	Value
1	Biological Oxygen Demand (BOD)	mg/l	< 10
2	Chemical Oxygen Demand (COD)	mg/l	< 50
3	Total Suspended Solids (TSS)	mg/l	< 30
4	Oil and Grease	mg/l	< 10
5	pH	-	6.5-8.0

Note: Treated water quality is subject to inlet raw Effluent parameters. Any change in inlet parameters will change treated Effluent quality accordingly.

DESIGN ASSUMPTIONS

Peak hours:

Sl.No	Peak Timing	No. of Peak Hours
01	06:00 am – 10:00 am	4 hours
02	01:00 pm – 02:00 pm	1 hours
03	04:00 pm – 06:00 pm	2 hours
04	07:00 pm – 10:00 pm	3 hours

Total peak hours : 10 hours

Wastewater quantity : 225 KLD

Peak flow : 15 m3/ hour

Wastewater quality :

Sl.No	Parameters	Unit	Value
01	Typical BOD	mg/l	250
02	Typical COD	mg/l	425
03	Typical TSS	mg/l	375

(As per CPHEEO manual on sewage treatment: Table 5.4)

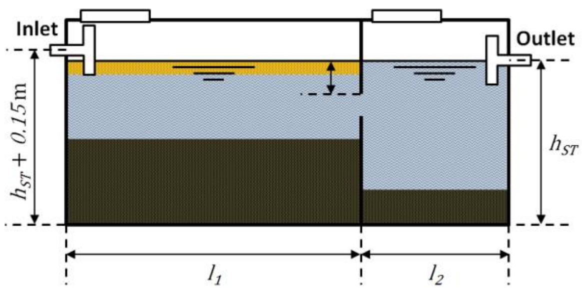
DESIGN CALCULATION OF TREATMENT MODULES

Bar Screen Chamber

A bar screen is a mechanical filter used to remove large objects, such as rags and plastics, from wastewater. It is part of the primary filtration flow and typically is the first, or preliminary, level of filtration, being installed at the influent to a wastewater treatment plant.

Size of Bar Screen : 1.0 m *1.0 m *1.2 m

Settler



Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater (or treated effluent) that is safe enough for release into the environment.

Inlet BOD	: 250 mg/l
Inlet COD	: 425 mg/l
SS/COD Ration	: 0.42
Sludge accumulation duration	: 24 months

Factor “COD Removal to HRT"	: 0.45
COD Removal Rate	: 32 %
Factor "Efficiency ratio of BOD removal to COD removal"	: 1.06
BOD Removal Rate	: 34 %

Estimated outlet BOD	: 165 mg/l
Estimated outlet COD	: 289 mg/l

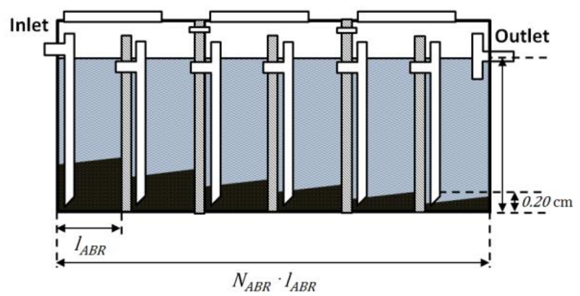
There are 2 Settlers in this DEWATS Model

Dimensions of settler 1 & 2 are as follows

Length of the first chamber in Settler	: 1.8 m
Length of the second chamber in Settler	: 1.1 m
Total Length of Settler	: 1.8+1.1 = 2.9 m
Width	: 4.3 m
Depth	: 3.7 m

No. Of Settler	= 02
Volume of Each Settler	= 2.9 m * 4.3 m * 3.7 m = 46 m^3
Total Volume of Settler	= Volume of ST-1 + Volume of ST-2
Total Volume of Settler	= 46 m^3 + 46 m^3
Total Volume of Settler	= 92 m^3

Anaerobic Baffled Reactor



Anaerobic baffled reactors are suspended type anaerobic digesters which degrade the organics as the wastewater flows in an upward movement passing through a sludge blanket. The contact with the sludge blankets leads to the treatment of the wastewater.

Inlet BOD	: 165 mg/l
Inlet COD	: 289 mg/l
Length	: 1.8 m
Width	: 4.3 m
Depth	: 3.3 m

No. OF ABR = 8 No.

Volume of each ABR = 1.8 m * 4.3 m * 3.3 m = 26 m^3

Total Volume of ABR = 26*8 = 208 m^3

Sludge Volume = 5% of Total Volume of ABR

= 0.05 * 208

= 10.5 m^3

HRT = volume of ABR /(Daily WW flow /24)

= 208 / (225/24)

HRT = 22 hour

SS/COD Ration = 0.42

Organic Load (kg/m^3*day) = (BOD * Max. Peak flow *24)/

(Volume of ABR *1000)

= (165 * 15*24) / (208 *1000)

Organic Load = 0.29 kg/m^3*day

Up-flow velocity in ABR = 0.9 – 1.2 m/hour

BOD Removal Rate by factors = (factor strength * factor temperature * factor No. of chamber * factor HRT* factor organic load)

BOD Removal Rate by factors = (0.80*1.1*0.96*0.95*1)

BOD Removal Rate by factors = 0.8026

Hence, BOD Removal Rate = 80.26 %

COD Removal Rate by factors = BOD Removal rate / factor

= 0.8026/1.07

= 0.73

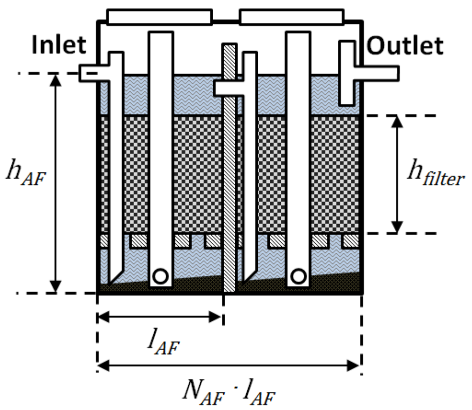
BOD Removal Rate : 80 %

COD Removal Rate : 75 %

Estimated outlet BOD : 32 mg/l

Estimated outlet COD : 74 mg/l

Anaerobic Filter



Anaerobic filters are similar to anaerobic reactors except for the fact that they have inert filter media enabling the growth of microorganisms (which enable anaerobic digestion) in a fixed form.

Inlet BOD	: 32 mg/l
Inlet COD	: 74 mg/l
Length	: 2.0 m
Width	: 4.3 m
Depth	: 3.0 m
No. OF AF	= 6 No.
Volume of each AF	= 2.0 m * 4.3 m * 3.0 m = 26 m^3
Total Volume of AF	= 26*6 = 156 m^3
HRT	= volume of AF / (Daily WW flow /24)
	= 156 / (225/24)
HRT	= 17 hour
SS/COD Ration	= 0.42
Voids on filter mass	= 30 – 45 %
Organic Load (kg/m^3*day)	= (COD * Max. flow */
	(Volume of AF *1000)
	= (87 * 225) / (144 *1000)
Organic Load	= 0.14 kg/m^3*day
Max Up-flow velocity in AF	= 1.5 - 2 m/hour

COD Removal Rate by factors = (factor temperature * factor strength * factor surface area * factor HRT* factor organic load *factor No. of the chamber)

COD Removal Rate by factors = (1.1 * 0.88 * 1.012 * 0.67 * 1* 1.12)

COD Removal Rate by factors = 0.735

Hence, COD Removal Rate = 73.5 %

BOD Removal Rate by factors = COD Removal rate * factor

= 0.735*1.12

= 0.8232

BOD Removal Rate : 82 %

COD Removal Rate : 73.5 %

Estimated outlet BOD : 7 mg/l

Estimated outlet COD : 23 mg/l

Clear Water Tank

It is a storage tank designed to hold the water before passing it through PSF and ACF. If required, Chlorination will be done at this stage.

Pressurized sand and Activated carbon filter

The treated water from the anaerobic filter is further treated using sand and carbon filter. Sand and carbon filters are pressurized vessels containing refined and cleaned sand in one and activated carbon in the other. Pressure Sand filter helps to reduce the suspended solids in the treated water to levels as prescribed by the CPCB, while carbon filter reduces any residual odor and color by the mechanism of adsorption. These filters are to be back flushed at regular intervals to prevent clogging and ensure efficient working of the system as per the manufacturer's guidance.

Design flow rate = 225 m^3/day

Working period = 22 h/day

Average flow rate = 10.23 m^3/hr

Loading rate on filter = 16 m^3/m^2/hr

Filter of 800 mm Dia x 1500mm height as per the Standard Design Practice and Experience. Activated Carbon is used is of 900 IV which gives us the best result.

Expected outlet BOD after PSF & ACF = <05 mg/l

Expected outlet COD after PSF & ACF = < 20 mg/l

Unit Details of DEWATS System

Sl.No	Description	Dimension	Unit	Volume
1	Bar Screen	1.0 m *1.0 m *1.2 m	1	1.2 m^3
2	Settler Chamber	2.9 m * 4.3 m * 3.7 m	2	46*2=92 m^3
3	Anaerobic Baffled Reactor	1.8 m * 4.3 m * 3.3 m	8	26*8= 208 m^3
4	Anaerobic Filter	2.0 m * 4.3 m * 3.0 m	6	26*6=156 m^3
5	Clear Water Tank	1.2 m * 4.3 m * 2.6 m	1	13.5 m^3
6	Pressurized Sand Filter	800 mm Dia x 1500mm height	1	----
7	Activated Carbon Filter	800 mm Dia x 1500mm height	1	----

Ozonisation

Ozonation (also referred to as ozonisation) is a chemical water treatment technique based on the infusion of ozone into water. Ozone is a gas composed of three oxygen atoms (O_3), which is one of the most powerful oxidants.

Ozonation is a type of advanced oxidation process, involving the production of very reactive oxygen species able to attack a wide range of organic compounds and all microorganisms.

Ozone has greater disinfection effectiveness against bacteria and viruses compared to chlorination. In addition, the oxidizing properties can also reduce the concentration of iron, manganese, sulfur and reduce or eliminate taste and odor problems.

The treated water is ozonized further, for reuse application.